

OUTREACH SUSTAINABILITY
CHALLENGES

EDUCATE. INSPIRE. CONNECT.®

EXCELLENCE Dialogue

62nd Lindau Nobel Laureate Meeting

Mission Education

ANNUAL REPORT 2012

CHALLENGES

62nd Lindau Nobel Laureate Meeting

Annual Report 2012

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

Contents

2	A CHALLENGING MISSION: EDUCATE. INSPIRE CONNECT. The Lindau Nobel Laureate Meetings	A MEETING OF MINDS Participants of the 62nd Lindau Nobel Laureate Meeting	PAVING THE WAY Partners & Supporters of the 62nd Lindau Nobel Laureate Meeting	90	Inspiring the Next Generation Mariette DiChristina	3
8	Educate. Inspire. Connect. Countess Bettina Bernadotte & Wolfgang Schürer	24 Why I Set out to Lindau Brian Schmidt	64 Academic Partners Enable Lindau's Mission Education Throughout the World Nikolaus Turner	92	6 Young Scientists, 6 Different Stories Matthias Schöbe	
10	A Global Scientific Dialogue Hosted in Germany Cornelia Quennet-Thielen	32 The Next Generation of Leading Scientists Nicole Alexandra Larsen	68 A Network of Excellence Andrew Holmes	94	Science Communication under Construction Beatrice Lugger	
20	Role Models and Mentors Christian de Duve	38 Much More than Lectures and Lederhosen Ibrahim I. Cisse	70 Connected and Involved Max G. Huber		BEYOND LINDAU Public Outreach Projects	
		PHYSICS MATTERS Programme of the 62nd Lindau Nobel Laureate Meeting	76 The Key to Unlocking Future Growth: Investing in Research Robert-Jan Smits	100	Why Reach Out? Continuity and Change in Lindau's Mission Education Wolfgang Schürer & Wolfgang Huang	
		42 A Scientific Dialogue Rainer Blatt & Burkhard Fricke	78 The Challenge of Balancing Tradition and Innovation Pamela Mars	104	Discovering Treasures Anders Bárány & Wolfgang Huang	
		48 The Higgs Excitement Matthew Chalmers	BROADENING THE DIALOGUE Debates & Impulses at the 62nd Lindau Nobel Laureate Meeting	106	Learning by Viewing—Nobel Labs 360° John C. Mather	
		50 A Triumph for Particle Physics Alexander B. Fry	82 Education for Sustainable Development Robert M. Solow	110	The Challenge of Communication Sir Richard Timothy Hunt	
		54 Cosmology in Lindau Juan García-Bellido	84 The Real Pioneers Gabriela Dür		ENABLING THE MISSION EDUCATION Organisation & Account	
		56 Energy Issues Florian Freistetter	88 How to Advance Innovations Henning Kagermann	120	Organisation & Account	
				124	Supporters	

Challenges

4 For the future, I see the greatest challenges for all the sciences as continued public outreach and inspiration.

John C. Mather (page 106)

It will be a challenge for the Lindau Nobel Laureate Meetings to increase participation of young scientists from countries like Niger which are increasingly becoming central to the highest-level discussions about the future of our planet.

Ibrahim I. Cisse (page 38)

The Lindau Innovation Forum should be continued and perhaps even expanded by integrating different scientific disciplines including the social sciences.

As excellent young researchers play an important part in Lindau, the Innovation Forum should encourage them to reflect on the creative potential of their research. To enable them to do that, they should have an active part in the Innovation Forum in the future.

Henning Kagermann (page 88)

The Bavarian State Government emphasises the goal that the Free State of Bavaria shall contribute to the modernisation of the Lindau Inselhalle venue in an appropriate and effective way.

Horst Seehofer

Many of the characteristics of the Nobel Prize are well reflected in the Lindau Meetings. They are very much in the spirit of Alfred Nobel, in the sense that there is this drive to encourage scientific progress. Nobel was actually not so much interested in rewarding achievements, he wanted to encourage progress, he wanted a better world.

This week will open up great potential. Take advantage of it!

Lars Heikensten in his welcome speech

We need a cosmopolitan science that can provide important contributions to solving pressing issues of the future.

Cornelia Quennet-Thielen (page 10)

I am wondering whether the Lindau Meetings will promote the tremendous potential they have in the science 2.0 era of transparency: how, further on, to transfer the real life meetings in Lindau, with their open dialogues among generations of scientists from all over the world and their interdisciplinarity, into long-lasting, online conversations and networks.

Beatrice Lugger (page 94)

It is our duty to shape the community of Lindau alumni into a sustainable network of responsible scientists, across all national borders.

Max G. Huber (page 70)

Science is not a competition for a prize. Its main challenge is not to win, as in a football or tennis match, but to solve a problem, whether posed by nature or by some practical application.

Christian de Duve (page 20)

5 The challenge is to get the ideas right in the first place. The possibility of energising and mobilising a group of the best young economists from all over the world offers a way to meet both of these challenges, and one hopes that the special circumstances of Lindau can help.

Robert M. Solow (page 82)

A Challenging Mission: Educate. Inspire. Connect.

The Lindau Nobel Laureate Meetings



Educate. Inspire. Connect.

Countess Bettina Bernadotte & Wolfgang Schürer

The holistic approach to educate, inspire and connect scientists of different generations and diverse backgrounds distinguishes the Lindau Meetings from traditional scientific conferences. It remains a challenge to foster and develop the intellectual dimension of this dialogue.

8 Educate. Inspire. Connect. This is not only the leitmotif but the essence of the Lindau Nobel Laureate Meetings. The Lindau scientific dialogue bridges generations, cultures and nationalities. Although some of the world's most renowned scientists, the Nobel Laureates, are taking part, Lindau is much different from a conventional scientific conference. It's about people, not about papers.

In the Lindau context, education means learning from life and learning for life.

Personal interactions between Laureates and the most promising young scientists from around the world take centre stage. Lindau is best characterised as a week of talks, discussions and informal exchanges, marked by a common enthusiasm for science and a collective shared desire to address the challenges facing the world. Young scientists come here to learn, albeit in a very special way. They come here to learn from the Laureates as mentors and role models. In their interactions with the Laureates, the young researchers are free to raise any topic, be it scientific or otherwise. Through learning from the Laureates' experience and through hearing about each other's differing backgrounds and culture, all participants in Lindau learn much of lasting value. There is an

intellectual dimension to education, but it encompasses the person as a whole. The dialogue across and among generations, cultures, nationalities and religions opens new perspectives. It helps develop empathy, understanding and mutual respect. Hence it serves as a compass providing valuable guidance. In the Lindau context, education means learning from life and learning for life.

The willingness to learn is not a matter of age but rather a matter of mind. The process of learning changes over a lifetime, but it never stops. It is invigorating and challenging. The Lindau curriculum provides a wide menu to choose from. Many of the Nobel Laureates are still engaged in cutting-edge research; others may resume their life as a scientist or discuss ethical or even artistic topics. The multiplicity of lectures mirrors the diversity of the respective personalities. The same goes for the young researchers. Coming from diverse backgrounds, each stands at a particular juncture of his or her life. But not only do they look for advice, they also provide inspiration to the Nobel Laureates challenging them with fresh views. The exchange of ideas leaves everyone returning home with more than enough food for thought.

Inspiration is a delicate flower growing off the beaten track, requiring fertile soil to flourish and open space to develop. Tucked away in a mediaeval town on the

shores of Lake Constance, Lindau provides a special atmosphere, laying the ground for an open and thorough dialogue. It presents every participant with ample opportunity to break out of their routine and receive inspiration, which often lasts for a lifetime. Yet, finding the fragile flower of inspiration is a task left to everyone involved. It requires curiosity and passion. Most Nobel Laureates, in particular, never cease to be curious but indeed are eager to learn and become inspired from their younger peers as well.

The Lindau dialogue is indebted to the European tradition of *Universitas*. It is not confined by disciplinary boundaries, nor is it limited to certain topics. The only requirement to join is an open mind. Everyone is taking part on an equal footing. All that counts is sound research and a good argument. For the participants, the experience of the week in Lindau often resonates for the rest of their lives.

The common experience in Lindau fosters connections and even lasting friendships. The scientific dialogue does not end with the closing ceremony of the Lindau Meeting on Mainau Island. It only begins there. The participants return home as ambassadors for the "spirit of Lindau". In recent years, alumnae and alumni have returned, sharing their experience with today's best talents in science. It is our aim to intensify this dialogue in the years to come.

Looking back, we can say, in all modesty, that most of the goals we have set for the development of the meetings in 2000 have been attained. This gives us the opportunity to convey our thanks to the Nobel Laureates and to all stakeholders, partners and benefactors, all of whom have significantly contributed to this progress. Your trust and your engagement is our obligation to continuously serve the Mission Education as trustees. This is our commitment and we are sure that the Lindau dialogue, being both timely and timeless, continues to bear many a valuable fruit for generations to come. But how do we make these fruits available, providing knowledge and inspiration to those who cannot attend the annual meetings? This is the primary challenge we have been facing. We have accepted it and have launched various initiatives reaching out to society.

This report is about challenges—and it is a challenge itself. For years, we have issued our annual report, mainly as a retrospective on our Lindau work. Much has been accomplished, but there is more ahead. This time, we have asked friends and partners of the Lindau dialogue to identify which ones they see as the major challenges the Lindau Meetings have to face. Well, rising to challenges is what scientists usually do. Let us convey our gratitude to all contributors. You have provided us with valuable food for thought.



Countess Bettina Bernadotte (fourth from left), Tony Tan Keng Yam, President of the Republic of Singapore, his wife Mary Chee Bee Kiang, and Wolfgang Schürer at the International Get-Together during the 62nd Lindau Nobel Laureate Meeting.

In an honorary capacity, Countess Bettina Bernadotte af Wisborg has been the president of the council since 2008, following her late mother Countess Sonja. She is the eldest daughter of the late Count Lennart Bernadotte, who was one of the three founders of the Lindau Meetings—and their long-standing spiritus rector. The Lindau Meetings have been part of her life since early childhood. In her regular occupation as managing director of the family business Mainau GmbH, Countess Bettina is dedicated to tourism, environmentally-friendly business management and sustainability, quality management and nature education.

Wolfgang Schürer, permanent visiting professor at the University of St. Gallen, Switzerland, serves pro bono as chairman of the board of the foundation since its establishment in the year 2000. He is Chairman of the MS Management Service AG and serves in various advisory boards. Committed to the value of education, scientific progress and international understanding, Wolfgang Schürer has placed his expertise at the disposal of the Lindau Meetings.

A Global Scientific Dialogue Hosted in Germany

Cornelia Quennet-Thielen

The Lindau Meetings are unique in their concept of an open and cosmopolitan dialogue among outstanding scientists of different generations and backgrounds.

The exchange among experts is invaluable in view of the demanding issues of our time.

10 A country needs beacons if it is to be visible in the world of science. The Lindau Nobel Laureate Meetings on the shores of Lake Constance represent a very special institution which has been shining its light into the world for many decades. The meetings developed on the initiative of a man with great vision, Count Lennart Bernadotte. For over sixty years, these meetings have steadily gained in stature and heightened their scientific profile. “Mission Education” is a very appropriate motto. It is the same every year: The Lindau Nobel Laureate Meeting is the only one of its kind in the world. It is unique because it enables an exchange of opinion and discussions between the generations, between Nobel Laureates on the one hand, and young scientists from many different countries on the other. 27 Nobel Laureates and 592 outstanding young researchers from 69 countries took part in the 2012 meeting.

Science thrives on exchanges. Progress in science and research needs the interest of and exchanges between nations and generations. Encounters inspire. Interest encourages. Curiosity can open up new worlds and give people a different perspective on their own work and on their own culture. The Lindau Meetings are synonymous with exchanges beyond national borders, beyond generations and worlds of experience. This is why they are so dear to us.

Science and politics are united in facing the global issues of our time. Solutions to global problems require scientific expertise and the creativity of elite researchers.

Our future energy supplies, climate change, food and human health are examples of challenges that cannot be solved without the assistance of science. It is precisely the sovereignty of science and its incorruptible intellectuality that make it one of the most valuable interlocutors for policy-makers. This spirit prevails quite especially in Lindau. This too makes the meetings unique and invaluable for education and research policy.

Science thrives on cosmopolitanism. Figures presented at the Euroscience Open Forum in Dublin last summer showed that although Europe only accounts for seven per cent of the world’s population, twenty per cent of all researchers come from Europe. European researchers produce forty per cent of all academic publications. But other countries and regions are quickly catching up. The OECD estimates that forty per cent of all university graduates will come from China and India by 2020. In fact, China already has more university graduates than the USA. In the medium term, this will significantly enhance the innovative capacities of these emerging countries. This development demonstrates impressively the new direction that global knowledge production is taking.

The Lindau Meetings are showing us on a small scale what we want to do on a larger scale: We want to be open to new ideas, remain curious, welcome scientists from all over the world, and learn from one another across cultural borders and generations.

The Lindau Meetings are showing us on a small scale what we want to do on a larger scale: to be open to new ideas, remain curious, welcome scientists from all over the world, and learn from one another across cultural borders and generations.

In this way, a cosmopolitan science can provide important contributions to solving pressing issues of the future.

Science needs dependability. Education, research and innovation are essential sources of our prosperity and of a good life for everyone. There is no better and more rewarding investment than in education and research!

The German government under Chancellor Angela Merkel has given clear priority to considerably stepping up education and research funding—even or indeed especially during the current financial and economic crisis.

The Excellence Initiative, our High Tech Strategy and the Pact for Innovation and Research all invest in the brains of our people and promote excellence and competitiveness. The budget of the Federal Ministry of Education and Research alone has risen by 80 per cent since 2005; in 2013 we are investing over 13 billion euros in education and research. Funding for research and development now totals 2.9 per cent of our GDP—we are coming very close to reaching our target of three per cent.

However, the government’s research policy is about more than just increasing funding. We are linking the growth in funding to clear guiding principles: excellence in research, internationalisation, fostering young scientists and more women in science, as well as building strategic partnerships.

The Lindau Nobel Laureate Meetings are based on these principles. This is why the BMBF has been supporting the Lindau Meetings for many years now. I am already very much looking forward to this year’s meeting, which will be dedicated by turn to the discipline of chemistry.



Cornelia Quennet-Thielen has been state secretary and department head at the Federal Ministry of Education and Research (BMBF) since 2008. The BMBF has funded and supported the Lindau Meetings throughout the years and enabled their continuous development into a truly international scientific forum. In January 2013, Cornelia Quennet-Thielen decorated our long-standing council member Hans Jörnvall with the Officer’s Cross of the Order of Merit of the Federal Republic of Germany, awarded to him by the Federal President for his considerable service to the fruitful development of the Lindau Meetings and his commitment to enhance Germany’s reputation as a hotspot for science and research.

11

The Origins & Institutions



12 In 1951, the first “European Meeting of Nobel Laureates in Medicine” was held in Lindau on the initiative of the two physicians Franz Karl Hein and Gustav Wilhelm Parade, and Count Lennart Bernadotte of nearby Mainau Island—a grandson of Gustaf V, King of Sweden. Due to Count Bernadotte’s efforts and networking in Stockholm, seven Nobel Laureates agreed to participate in this extraordinary meeting, which was conceived as a European initiative of post-war reconciliation among scientists. The initial success gave rise to the idea to establish periodic meetings of Nobel Laureates in Lindau, dedicated alternately to the Nobel Prize disciplines physiology or medicine, physics, and chemistry.

In addition, regular meetings of the Laureates of the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel were enacted in 2004. The basic principle was—and still is—to foster the exchange of knowledge, experience, ideas, and inspiration among scientists—across generations, cultures, and nationalities.

Since these days, the Lindau Nobel Laureate Meetings have evolved into a unique international discussion forum for scientific and societal issues, involving the broad public.

THE COUNCIL

The Council for the Lindau Nobel Laureate Meetings was founded in 1954, three years after the first meeting, to secure their continuance and shape their future development. Count Lennart Bernadotte, the co-founder of the Lindau Meetings, became its first president. The purpose of the council is to organise the annual meetings on the basis of an elaborate scientific programme. This includes the establishment and maintenance of close relations with academic partners worldwide. The council will ensure that eligible and qualified young scientists get the chance to participate in the meetings—regardless of their ethnic or national origin, their religious belief or their gender.

In this regard, the council also contributes to securing the financial conditions for the meetings in close collaboration with the foundation. The council maintains an executive secretariat in Lindau.

Honorary President

Count Lennart Bernadotte †

Board

Countess Bettina Bernadotte, *President*
Wolfgang Schürer, *Vice-President*
Burkhard Fricke, *Vice-President*
Nikolaus Turner, *Treasurer*

Members

Rainer Blatt (as of October 2012)
Werner F. Ebke (until December 2012)
Thomas Ellerbeck, *Spokesman*
Peter Englund
Astrid Gräslund
Martin F. Hellwig
Hans Jörnvall
Klas Kärre (as of March 2012)
Wolfgang Lubitz
Hartmut Michel

Corresponding Members

Lars Bergström
Sten Orrenius
Dagmar Schipanski

Permanent Guests

Gabriela Dür
Gerhard Ecker

The council cordially welcomes its new members Rainer Blatt and Klas Kärre.

Werner F. Ebke had been a corresponding member of the council since 2003 before he became a full member in 2007. He also served on the board of the foundation. He has left the council and the board of the foundation at the end of 2012. Sincere thanks of both council and foundation are due to him for his longstanding support of our common cause.

THE FOUNDATION

The Foundation Lindau Nobelprizewinners Meetings at Lake Constance was established in the year 2000 by fifty Nobel Laureates, the Bernadotte family, and council members. Ever since, Wolfgang Schürer has been the chairman of the board. In general, the foundation’s objective is to promote science, research, and related social activities. In particular, its main purpose is to ensure the continuance and further development of the Lindau Meetings.

This includes the support of projects and initiatives in the realm of the Mission Education. The foundation is registered on Mainau Island; in the interest of a close cooperation with the council, the foundation’s managing director is based at the executive secretariat of the council in Lindau.

Honorary Presidents

Count Lennart Bernadotte †
Roman Herzog

Board

Wolfgang Schürer, *Chairman*
Countess Bettina Bernadotte
Werner F. Ebke (until December 2012)
Thomas Ellerbeck
Nikolaus Turner, *Managing Director*

Honorary Senate

Josef Ackermann
Suleiman Jasir Al-Herbish
José Manuel Barroso
Christof Bosch
Ernesto Bertarelli
Martin Engstroem
William H. Gates III
Ulrich Grete
Roman Herzog
Klaus J. Jacobs †
Henning Kagermann
Malcolm D. Knight
Pamela Mars
Angela Merkel
Joachim Milberg
Ferdinand K. Piëch
Johannes Rau †
Annette Schavan
Shri Kapil Sibal
HRH Princess Maha Chakri Sirindhorn
Edmund Stoiber
Tony Tan
Erwin Teufel
Daniel Vasella
Ernst Ludwig Winnacker
Martin Winterkorn

THE FIRST NOBEL LAUREATES IN LINDAU 1951

Adolf Butenandt
(Germany, Chemistry 1939)

Carl Peter Henrik Dam
(Denmark, Physiology/Medicine 1943)

Gerhard Domagk
(Germany, Physiology/Medicine 1939)

Paul Müller
(Switzerland, Physiology/Medicine 1948)

William Murphy
(USA, Physiology/Medicine 1934)

Hans von Euler-Chelpin
(Sweden, Chemistry 1929)

Otto Warburg
(Germany, Physiology/Medicine 1931)

Founders Assembly of the Foundation

14	260 NOBEL LAUREATES	Georges Charpak Yves Chauvin Steven Chu Aaron Ciechanover Ronald H. Coase Stanley Cohen Claude Cohen-Tannoudji Leon Cooper Elias J. Corey John Warcup Cornforth Mairead Corrigan Maguire James W. Cronin Paul J. Crutzen Robert F. Curl jr. Hans G. Dehmelt Johann Deisenhofer Peter A. Diamond Peter C. Doherty Renato Dulbecco Christian de Duve Gerald Edelman Manfred Eigen Robert Engle Richard R. Ernst Gerhard Ertl Leo Esaki Martin Evans John B. Fenn Albert Fert Edmond Fischer Ernst Otto Fischer Robert W. Fogel Jerome Friedman Milton Friedman Robert F. Furchgott	D. Cleton Gajdusek Andre Geim Murray Gell-Mann Riccardo Giacconi Ivar Giaever Walter Gilbert Alfred G. Gilman Vitaly L. Ginzburg Donald Glaser Sheldon L. Glashow Roy J. Glauber Joseph L. Goldstein Michail Gorbachov Clive Granger Paul Greengard David J. Gross Robert H. Grubbs Peter Grünberg Theodor W. Hänsch John L. Hall Lee Hartwell Herbert A. Hauptman Harald zur Hausen Richard F. Heck Alan C. Heeger Dudley R. Herschbach Avram Hershko Antony Hewish Jules A. Hoffmann Roald Hoffmann Gerardus 't Hooft H. Robert Horvitz David H. Hubel Robert Huber Russel Hulse Timothy Hunt	Leonid Hurwicz Andrew F. Huxley Louis Ignarro Brian Josephson Eric R. Kandel Charles K. Kao Jerome Karle Tawakkol Karman Imre Kertész Wolfgang Ketterle Har Gobind Khorana Lawrence R. Klein Klaus von Klitzing Aaron Klug Makato Kobayashi Walter Kohn Arthur Kornberg Roger D. Kornberg Masatoshi Koshiha Edwin Krebs Herbert Kroemer Harold W. Kroto Finn Kydland Willis E. Lamb Robert Laughlin Paul C. Lauterbur Leon M. Lederman David M. Lee Tsung-Dao Lee Yuan Tseh Lee Jean-Marie Lehn Rita Levi-Montalcini Edward B. Lewis William N. Lipscomb Robert E. Lucas Jr. Alan G. MacDiarmid	Roderick MacKinnon Peter Mansfield Rudolph A. Marcus Harry M. Markowitz Barry Marshall Toshihide Maskawa Eric S. Maskin John C. Mather Daniel L. McFadden Craig C. Mello Bruce Merrifield Robert C. Merton Hartmut Michel James A. Mirreles Rudolf Mößbauer Mario Molina Luc Montagnier Dale T. Mortensen Karl Alexander Müller Kary B. Mullis Robert A. Mundell Ferid Murad Joseph E. Murray Roger B. Myerson Yoichiro Nambu John F. Nash jr. Ei-ichi Negishi Erwin Neher Marshall Nirenberg Douglass C. North Konstantin Novoselov Ryoji Noyori Christiane Nüsslein-Volhard Paul M. Nurse George A. Olah	Douglas Osheroff Arno Allen Penzias Saul Perlmutter Edmund S. Phelps William D. Phillips Christopher A. Pissarides John Polanyi John Pople Lord George Porter Edward C. Prescott Ilja Prigogine José Ramos Horta Norman F. Ramsey Robert Richardson Richard J. Roberts Heinrich Rohrer Joseph Rotblat Alwin Roth F. Sherwood Rowland Carlo Rubbia Bert Sakmann Paul A. Samuelson Bengt Samuelsson Frederick Sanger Thomas J. Sargent Andrew V. Schally Thomas C. Schelling Brian Schmidt Myron S. Scholes Melvin Schwartz John Robert Schrieffer Richard R. Schrock Reinhard Selten Amartya Sen William F. Sharpe K. Barry Sharpless	Lloyd S. Shapley Dan Shechtman Osamu Shimomura Kai M. Siegbahn Christopher A. Sims Ellen Johnson Sirleaf Jens C. Skou Richard Smalley Hamilton O. Smith Michael Smith Oliver Smithies George F. Smoot Robert M. Solow Jack Steinberger Ralph M. Steinmann Thomas A. Steitz Joseph E. Stiglitz John Sulston Akira Suzuki Jack W. Szostak Henry Taube Joseph Taylor Samuel C. C. Ting Susumu Tonegawa Charles H. Townes Tomas Tranströmer Roger Y. Tsien Daniel C. Tsui Simon van der Meer Harold E. Varmus Martinus Veltman John E. Walker Robin Warren James D. Watson Thomas H. Weller Eric F. Wieschaus	Torsten N. Wiesel Frank Wilczek Maurice H.F. Wilkens Jody Williams Robert Wilson Kurt Wüthrich Rosalyn Yalow Chen Ning Yang Ada Yonath Muhammad Yunus Ahmed Zewail Rolf Zinkernagel	BERNADOTTE AF WISBORG FAMILY Countess Bettina Bernadotte Count Björn Bernadotte Countess Catherina Bernadotte Count Christian Bernadotte Countess Diana Bernadotte Countess Sonja Bernadotte	COUNCIL MEMBERS Anders Bárány Werner F. Ebke Thomas Ellerbeck Ludwig E. Feinendegen Astrid Gräslund Hans Jörnvall Franz Knöpfle Hubert Markl Sten Orrenius Wolfgang Schürer Helmut Sies Nikolaus Turner Jürgen Uhlenbusch	15
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New Members of the Honorary Senate

16 The Honorary Senate is the most prestigious body of the Lindau Foundation. Its members share the values and goals of the Mission Education and feel dedicated to further advance it. They are valued advisers to the board of the foundation and distinguished ambassadors for the cause of the Lindau Nobel Laureate Meetings.

As a token of appreciation for their ongoing support and in recognition of their charitable commitment and lifetime achievements, Tony Tan, President of the Republic of Singapore, and Ferdinand K. Piëch, Chairman of the Supervisory Board of Volkswagen AG, were inducted into the Honorary Senate at the 62nd Lindau Nobel Laureate Meeting.

EXCERPTS FROM THE LAUDATIONS

Ferdinand K. Piëch

“Innovation and excellence are the hallmarks of Professor Ferdinand K. Piëch’s lifetime achievements. His devotion to advancements in engineering has even exceeded the tradition of his family and has created a legacy of his own. His approach focuses not just on research and development but especially on their application. New materials and fuel-efficient motors are only two prime examples among many. His achievements give testimony of his drive for both excellence in research and for sustainability. Combining the continuous quest for high-level technology and product quality is the *conditio sine qua non* of Professor Piëch’s track-record. He therefore serves as an inspiration for generations of engineers.”

Tony Tan

“Dr. Tony Tan has been dedicated to fostering education and research for most of his life. As a pre-eminent servant of his country, he has been a quiet but tireless force in the rise of the Republic of Singapore as a global hub of science and education in Asia. He has been the *spiritus rector* of the four national universities of Singapore and spearheaded many strategic initiatives for research and education. His intellectual charisma and deep understanding of the global research landscape distinguish him as a highly respected ambassador vis-à-vis Europe and the world. Dr. Tony Tan serves as a role model far beyond Singapore. His particular devotion to science and education and his dedication to social and charitable initiatives have borne many a valuable fruit. He has embraced the Lindau Mission Education by encouraging and enabling young scientists from Singapore to engage in the Lindau dialogue.”

“This assembly of brilliant scientific minds allows the scientific elite of today to educate, connect with and inspire the up-and-coming young talents of tomorrow.”

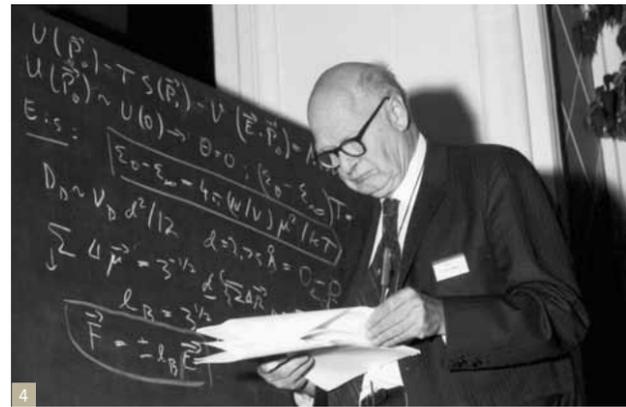
Tony Tan

“The intense exchange between scientists from very different fields and very many nations is probably more important today than ever before. This is exactly what makes these meetings here in Lindau so very valuable.”

Ferdinand K. Piëch



Over 60 Years of Lindau Meetings



- [1] The founders: Franz Karl Hein, Count Lennart Bernadotte, and Gustav Wilhelm Parade initiated the first "European Meeting of Nobel Laureates in Lindau" in 1951.
- [2] Werner Heisenberg (in the centre)
- [3] Otto Hahn participated in a total of 16 Lindau Meetings. "I first came as a chemist, then disguised as a physicist and now again to the meeting of Medicine Laureates, because my work also has something to do with medicine [...] and should you ever invite those from literature, then you should know that in my youth I applied myself fervently to the art of poetry." (Hahn, 1954)
- [4] J. Hans D. Jensen
- [5] German Federal Chancellor Willy Brandt attended the 1972 Lindau Meeting, one year after he was awarded the Nobel Peace Prize.



- [1] John F. Nash Jr. has been among the participants ever since regular meetings dedicated to economic sciences were established in 2004.
- [2] Count Lennart Bernadotte, here with his wife Countess Sonja Bernadotte who succeeded him as president of the council in 1987, passed away in 2004 after having been the spiritus rector of the Lindau Meetings for more than 50 years.
- [3, 4] A record number of 59 Nobel Laureates and more than 670 young researchers from 68 countries participated in the 60th Lindau Meeting in 2010.
- [5] Countess Bettina Bernadotte and Wolfgang Schürer welcomed Bill Gates at the 2011 Lindau Meeting on physiology/medicine, which centred on the topic of Global Health.



Role Models and Mentors

Christian de Duve

Christian de Duve advises aspiring young researchers to choose their mentors well and strive for excellence. However, their goal should not be the Nobel Prize, but rather to find the answers to questions and the solutions to problems.

20 I often say, half-jokingly, that the most important thing in life is to “choose our parents well”. Indeed, we get our genes from our parents, and genes are of crucial importance. But we have no control over their choice; we have to live with our genes. Not so with what neurobiologists call “epigenetic”—what is added to our genes and wired into our brains after birth. This, at first, is also beyond our control and dependent on inputs from parents, family, teachers, companions, social milieu and other outside factors that are largely determined by the accidents of birth and early education. Some individuals are more fortunate than others in this respect. But, unlike the genetic determinants, such influences are not irreversibly imprinted into our brains. As time goes on, we become increasingly able to steer our course and make our own responsible decisions. All of you who, coming from a variety of backgrounds, and having earned the privilege of being selected to attend a Lindau Meeting, have attained this level. You have reached a stage where you have become the captains of your ships. Your future is to a large extent in your hands.

Here is where my second advice, more within your reach than the first one, comes into play: choose your mentors well. This is particularly true in science. The art of scientific research is not learned in books, but at the bench, under the guidance of a master, like the crafts in the Middle Ages.

I myself have been particularly fortunate in this respect. My first mentor, the Belgian physiologist Joseph P. Bouckaert, was a first-class scientist, trained by the Englishman Archibald Vivian Hill, co-recipient of the 1922 Nobel Prize in Medicine. Later, I enjoyed the privilege of working under no fewer than four Laureates in Medicine—Hugo Theorell (1955) in Sweden, and Carl and Gerty Cori (1947) and Earl Sutherland (1971) in the United States—before joining them on the Stockholm roster in 1974.

Make excellence your top priority in whatever pursuit you set for yourself.

In this respect, the Lindau Meetings provide an invaluable experience for rising young scientists like you. They give you a unique opportunity to get to know many top scientists personally, to interact closely with them and, perhaps, to establish a long-term relationship. All this you can enjoy within magnificent surroundings as guests of Countess Bettina Bernadotte and of the wonderful council over which she presides. Make the best of it, but do not do so uncritically. Do it with the objectivity of scientists.

At the risk of betraying the “Lindau spirit”, I must, as a Laureate myself, issue a warning: the Nobel Prize is not, by itself, a certificate of excellence, wisdom or, even, honesty.

All it does is highlight a significant discovery or invention. The decision as to what deserves this distinction and to whom the credit for it should be attributed is not made by God, but by very human committees of Swedish scientists. They accomplish this task with exceptional conscientiousness and dedication but, like the rest of us, may occasionally be ill-informed or mistaken. Furthermore, Laureates may sometimes abuse their prestige later to defend unworthy causes. Such cases are rare but have been known to happen. Particularly important, there are many more deserving candidates than lucky Laureates. A large number of examples are known. Earning a Nobel Prize is to some extent like winning at a lottery, except that the tickets are very expensive.

In conclusion, the important thing is to choose your mentors and role models well, be they Nobel Laureates or not. To this recommendation let me add one more piece of advice: do not make it your goal in life to gain a Nobel Prize, like an athlete works to earn an Olympic medal. Science is not a competition for a prize. Its main challenge is not to win, as in a football or tennis match, but to solve a problem, whether posed by nature or by some practical application. However, it does have a competitive aspect—often a strong one—to the extent that one wants to be the first to find the solution. Getting to know the

answer to a tantalising question does not provide the same gratification if it is found by someone else rather than by oneself. Such ambition is understandable and may include the prospect of a prize.

Perhaps, you will one day come to Lindau as a Laureate yourself. I hope this happens because, for the Laureates who attend a Lindau Meeting, encountering so many motivated youngsters is a uniquely rewarding experience. But do not make this your primary goal. Make excellence your top priority in whatever pursuit you set for yourself, within the limits set by intellectual rigor and honesty—the scientific equivalent of fairness in sport.



Ninety-five-year-old Christian René de Duve was awarded the Nobel Prize in Physiology or Medicine in 1974 jointly with Albert Claude and George E. Palade “for their discoveries concerning the structural and functional organisation of the cell”. He has participated six times in the Lindau Meetings, at first in 1978 and lastly in 2011 at the 61st meeting—the 20th meeting dedicated to his discipline—where he gave a much acclaimed and very moving lecture on “The Future of Life”.



“My generation, our generation has made a mess of things. It is up to you to do better. The future is in your hands. Good Luck!”

Christian de Duve, The Future of Life, Lindau Mediatheque

A Meeting of Minds

Participants of the 62nd Lindau Nobel Laureate Meeting



Why I Set out to Lindau

Brian Schmidt

Scientific progress is mainly accelerated by young scientists. We must foster their enthusiasm, give them guidance and connect them, because science is an international endeavour the world embarks on together.

24 When I received my phone call from Sweden at 8.39 pm on 4 October 2011, my life was turned upside down, but one of the first things I thought about was Lindau. I had met the Australian student contingent on its way to the meeting a couple of years before, and the Lindau Nobel Laureate Meeting was something I wanted to be part of. I was trying to figure out how I might get there when a letter suddenly appeared from the council, and my trip to Germany was secured.

One of the key successes of Lindau is bridging cultures and distance and initiating thousands of relationships amongst the world's brightest young scientists

In 1990, during my first year of graduate school, I came to the Alps for a meeting that brought together young scientists and the wisened professors from within my discipline. It remains the single most important event in my scientific career. There, in the space of a few short weeks I got a sense of what science was all about. Here were the beginnings of a friendship and collaboration that led to much of my PhD thesis, as well as the project that led to the discovery of the accelerating universe. For my senior colleagues over the years, the meeting was also special

for them as a place to get to know and understand the younger generation of scientists, and renew relationships with each other. I saw Lindau as a chance to recreate this pivotal 1990 experience.

I arrived and first impressions were good. I immediately joined the Innovation Forum and then was off to dinner with Nobel Laureates all around. The next morning I led off the scientific proceedings, and I was staggered by the scale of the meeting—it is hard to conceive of exactly what 600 students means, until you are up in front of them.

As the meeting was attended primarily by physics PhD students and post-docs, I decided to give a comprehensive physics-based overview of cosmology, and I particularly enjoyed the smaller sessions on the subject afterwards where a subset of students joined. Questions freely flowed and we discussed the major issues, as well as the bigger concerns surrounding research careers. It is also the place where I got to begin forming some relationships with the students.

For the rest of the week I listened to a wide range of presentations from my fellow Laureates. The announcement of the discovery of what almost certainly is the Higgs boson added extra spice to the meeting, and being able to share that moment with my particle physics colleagues and all of the students was particularly memorable.

The week was a time to have relaxed conversations over meals with fellow Laureates and their partners, along with a variety of activities with the students. At the end of the week we sailed Lake Constance, a great social event with the band singing “Smoke on the Water” on the lake that inspired the song.

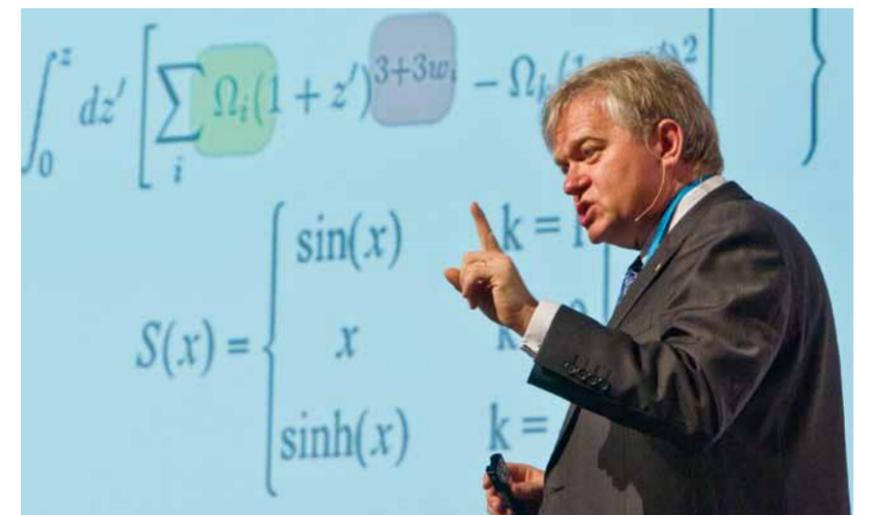
I see most scientific progress to be made by young scientists: people with unbridled enthusiasm, unjaded curiosity, unconstrained notions about how the world works, and untold amounts of time to learn new things. Mentoring by senior scientists is also important to help young scientists avoid making the same mistakes they made, to encourage especially promising avenues of exploration, and to help steer people through the challenges of a research career. At Lindau, probably the most important activity that I undertook was reminding the scholars that I was just like them (just 20 years older), and explaining my approach to the challenges that I have faced throughout my career. But being at Lindau is also to be part of something far bigger than just me.

Science is an international endeavour that the world embarks on together, and to work effectively, science requires relationships be put in place. One of the key successes of Lindau is bridging cultures and distance and initiating thousands of relationships amongst the world's

brightest young scientists—a unique chance to do this on the scale achieved. Once these relationships are in place, because the world is so connected, it is trivial to build these friendships into ideas, projects, and eventually discoveries.

One of the revelations for me at Lindau was just how old a group of men we, the Nobel Laureates in Physics, are. I think one of the challenges for the programme in the future is to ensure that more of the younger cohorts of Nobel Laureates attend the meeting, as well as some of the few women who make up our ranks. Another challenge for Lindau is to build on its relationships with industry. There is great potential here, but coming up with a programme that is both interesting for industry and Laureates, and relevant for students will take both thought, and some trial and error.

It is my intent to attend Lindau Meetings into the foreseeable future—it was great to be part of a unique event that empowers and links young scientists, but at the same time a fun and enriching experience for me.



“For the discovery of the accelerating expansion of the Universe through observations of distant supernovae”, Brian Paul Schmidt was awarded one half of the 2011 Nobel Prize in Physics jointly with Adam G. Riess, while the other half was awarded to Saul Perlmutter. In the moment of joy over the award, Schmidt almost instantly realised with excitement that it also meant he would be able to participate in the upcoming Lindau Meeting, he recounted.

27 Nobel Laureates in Lindau 2012

26 The interdisciplinarity in contemporary science and research is mirrored by the diverse scientific backgrounds of the participants of the Lindau Meetings—Nobel Laureates and young researchers alike. Despite the programmatic focus on physics, eight of the 27 Nobel Laureates gathered in Lindau last summer for the 62nd meeting are in fact Laureates in the discipline of chemistry, and two are Laureates in physiology or medicine. This is partly due to the appealing concept of an absorptive scientific programme that characterises the Lindau Meetings. But beyond that, it is primarily due to the keynote of these meetings, the idea of bringing together scientists of different generations for the exchange of knowledge, ideas, experience, and opinions.

Many Nobel Laureates have reported to consider it both their pleasure and their heartfelt responsibility to engage in the Lindau dialogue, and consequently participate regularly in the meetings.

Just to name some, Brian Josephson has participated twelve times, Hartmut Michel fifteen times, and Ivar Giaever even sixteen times.

James Cronin, USA
Physics, 1980

Paul Crutzen, Netherlands
Chemistry, 1995

Albert Fert, France
Physics, 2007

Ivar Giaever, Norway
Physics, 1973

Roy Glauber, USA
Physics, 2005

David Gross, USA
Physics, 2004

Peter Grünberg, Germany
Physics, 2007

John Hall, USA
Physics, 2005

Theodor W. Hänsch, Germany
Physics, 2005

Harald zur Hausen, Germany
Physiology/Medicine, 2008

Dudley Herschbach, USA
Chemistry, 1986

Brian Josephson, United Kingdom
Physics, 1973

Walter Kohn, Austria/USA
Chemistry, 1998

Sir Harold W. Kroto, United Kingdom
Chemistry, 1996

Robert B. Laughlin, USA
Physics, 1998

John C. Mather, USA
Physics, 2006

Hartmut Michel, Germany
Chemistry, 1988

Mario Molina, Mexico
Chemistry, 1995

Erwin Neher, Germany
Physiology/Medicine, 1991

Douglas Osheroff, USA
Physics, 1996

William D. Phillips, USA
Physics, 1997

Carlo Rubbia, Italy
Physics, 1984

Brian Schmidt, USA/Australia
Physics, 2011

Dan Shechtman, Israel
Chemistry, 2011

George F. Smoot, USA
Physics, 2006

Martinus J. G. Veltman, Netherlands
Physics, 1999

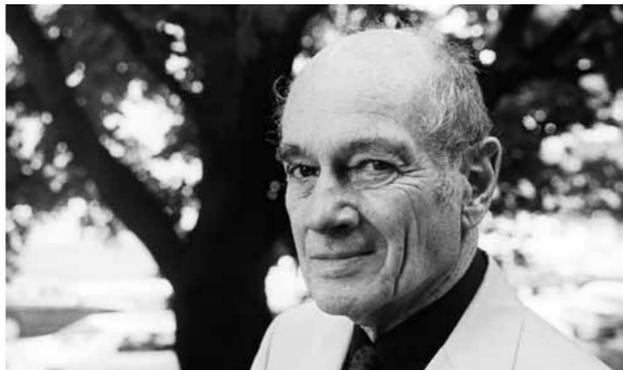
Kurt Wüthrich, Switzerland
Chemistry, 2002



Please find profiles with biographical information on all 27 Nobel Laureates in the Lindau Mediatheque.

NOBELS—Nobel Laureates Photographed by Peter Badge

28



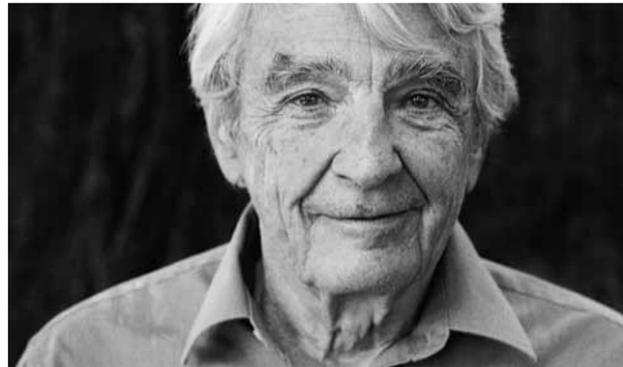
James Cronin (Physics, 1980)



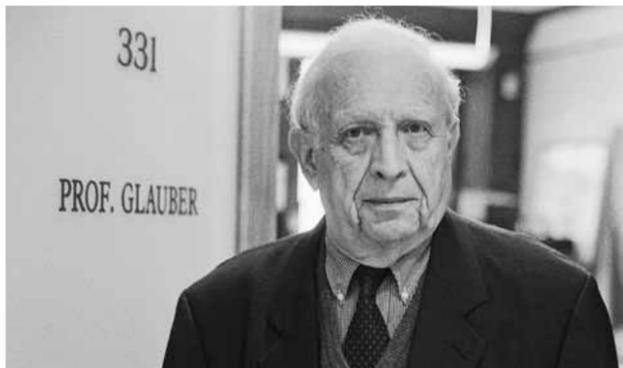
Paul Crutzen (Chemistry, 1995)



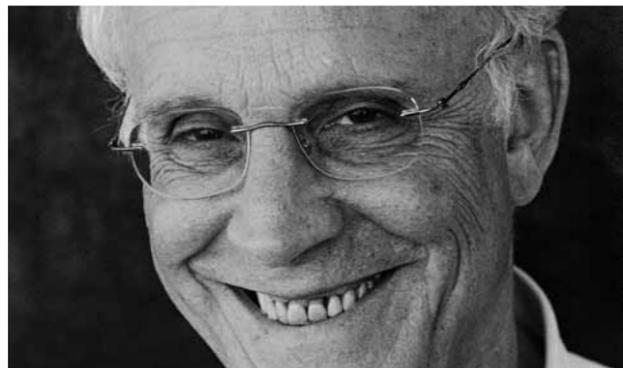
Albert Fert (Physics, 2007)



Ivar Giaever (Physics, 1973)



Roy Glauber (Physics, 2005)



David Gross (Physics, 2004)

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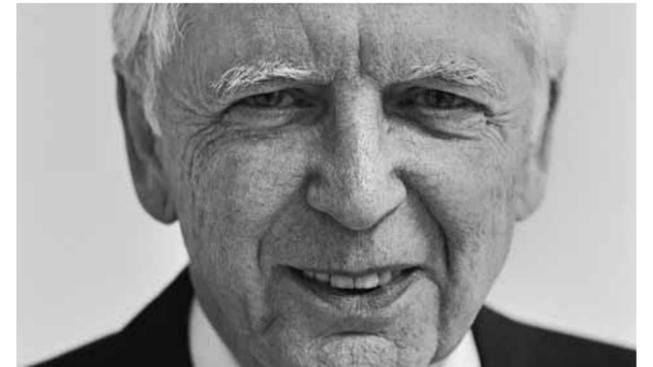
Peter Grünberg (Physics, 2007)



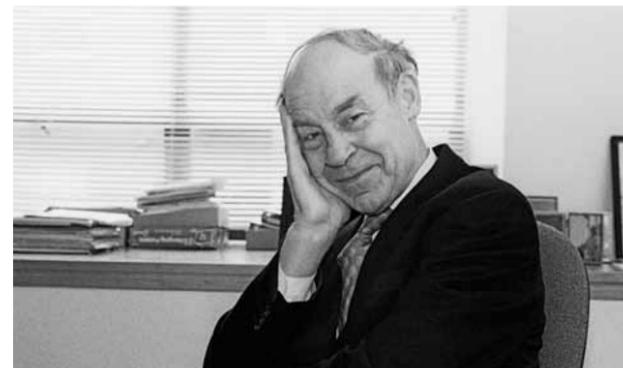
John Hall (Physics, 2005)



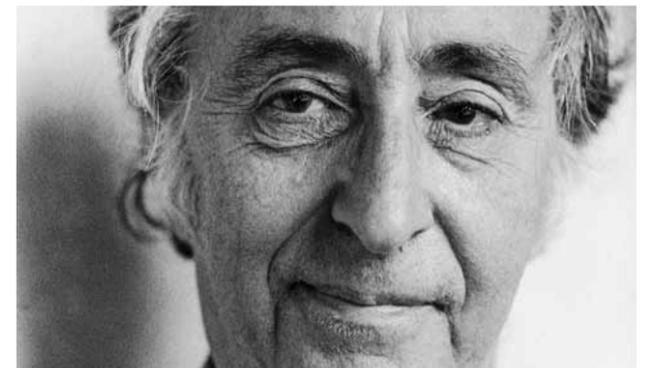
Theodor Hänsch (Physics, 2005)



Harald zur Hausen (Physiology/Medicine, 2008)



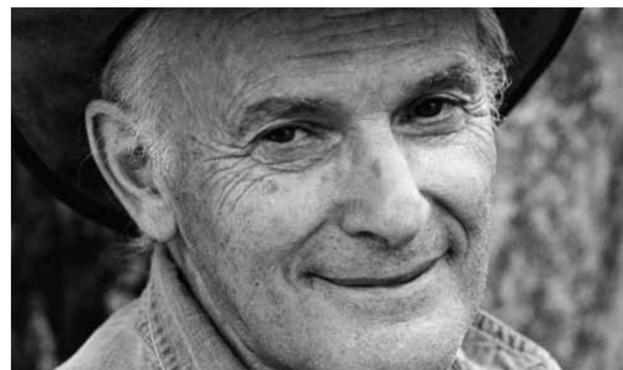
Dudley Herschbach (Chemistry, 1986)



Brian Josephson (Physics, 1973)



Walter Kohn (Chemistry, 1998)



Sir Harold Kroto (Chemistry, 1996)



William Phillips (Physics, 1997)



Carlo Rubbia (Physics, 1984)



Robert Laughlin (Physics, 1998)



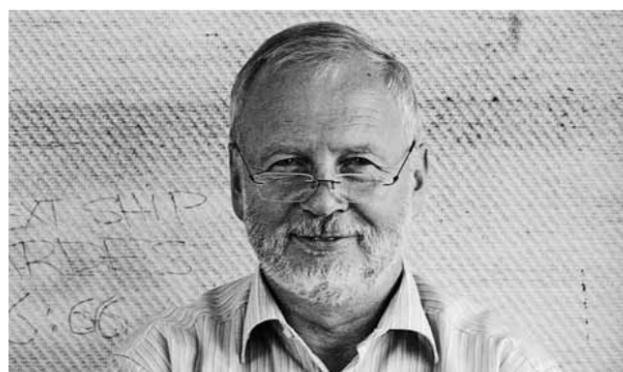
John Mather (Physics, 2006)



Brian Schmidt (Physics, 2011)



Dan Shechtman (Chemistry, 2011)



Hartmut Michel (Chemistry, 1988)



Mario Molina (Chemistry, 1995)



George Smoot (Physics, 2006)



Martinus Veltman (Physics, 1999)



Erwin Neher (Physiology/Medicine, 1991)



Douglas Osheroff (Physics, 1996)



Kurt Wüthrich (Chemistry, 2002)



The Next Generation of Leading Scientists

Nicole Alexandra Larsen

“A week I will never forget”—Nicole Larsen recalls her inspiring and motivating Lindau experiences. Feeling closely connected with other young researchers worldwide, she also addresses the doubts and problems challenging her generation.

32 In July 2012, I had the opportunity to meet with Brian Schmidt and 26 other Nobel Laureates at the 62nd Lindau Nobel Laureate Meeting. During my time at Lindau, I went to talks by some of the greatest minds in all of physics. I met students from all over the world, with interests ranging over all areas of science.

I ate lunch with Brian Josephson, who was awarded the Nobel Prize for his work with tunneling phenomena in superconductors; I had dinner with Doug Osheroff, who discovered superfluidity in helium-3; and I drank beers with one of my greatest heroes, Brian Schmidt, who regaled us with hilarious stories of trying to get his Nobel Prize medal through airport security. In short, it was a week I will never forget.

There were two days in particular at the meeting that will always stand out in my memory. On the morning of 4 July an announcement came from the CMS and ATLAS collaborations at CERN about the 5-sigma discovery of a new elementary particle: the Higgs boson, first postulated over four decades ago and the last particle in the standard model to be observed.

The Nobel Laureates had a panel discussion with the leaders of CERN about the implications of this discovery. Although I was not personally involved with the work leading to this discovery, I experienced a fierce sense of pride in my colleagues. This final verification of the standard model represents an enormous victory for particle

physics, and indeed, for all of science. How lucky I was to be present when this historic event took place!

For this one week in July, I felt a part of the global scientific community in a way that I never had before.

The following day I was one of a handful of young researchers chosen to participate in a series of debates produced by Nature and Scientific American called “Confronting the Universe”. I was partnered with fellow students Sean Bartz and Peter Zinn and Laureates George Smoot and Martinus Veltman to ruminate on the future of the standard model.

Eager to hear the Laureates’ thoughts on my research, I took the first opportunity to ask if they had any theories about dark matter. “I think it doesn’t exist,” said Dr. Veltman flatly, further asserting that there is no evidence for any sort of physics beyond the standard model. The rest of us were shocked at his dismissal. I do believe there is significant evidence for a new kind of particle, comprising what we think of as dark matter. Nevertheless, by compelling us to hold our ideas to a higher level of scrutiny, skeptics like Dr. Veltman are some of the most important people in science. The Nature discussion forced me to defend the very foundations

on which my research is based and to draw upon a reserve of confidence that I did not know I had.

While I was at Lindau I was educated and inspired by the giants who have gone before me. I was encouraged when Nobel Laureates such as George Smoot and Brian Schmidt were eager to hear about LUX and PIXeY, reinforcing that my research is both exciting and valuable. I crossed swords with Martinus Veltman and held my own. And to top it all off, I was present at the announcement of one of the greatest discoveries in the history of physics. The Lindau Meeting gave me an invaluable sense of how my work fits into the big picture and what I can do to make a difference.

Furthermore, I got to meet and connect with my peers from around the world. We compared our experiences and our struggles and we talked about the questions that intrigue us the most. I especially enjoyed speaking with the astronomers and the particle physicists, whose work touches on and motivates my own but lies outside the domain of what I think about on a day-to-day basis. For this one week in July I felt a part of the global scientific community in a way that I never had before.

What I gained less from the meeting was a clear sense of the future. Certainly the

panel on climate change addressed one of the biggest concerns we face today. And certainly the announcement from CERN spawned some very exciting discussions of the current status of particle physics. Most of the meeting, however, focused on historical perspectives. The Lindau Meeting, by bringing together some of the greatest minds in the world, is a perfect venue for actively examining today’s big problems: from sustainability to public health, from oil dependence to the future of the space industry. I would like to suggest that future Lindau Meetings increase the focus on future prospects and on open questions in the field.

Moreover, I would have liked to see the experts at Lindau weigh in on practical concerns such as policy, funding, and the current climate of scientific research. With the current state of the global economy, today’s physics graduates face an uncertain job market. Funding agencies increasingly eschew basic research in favour of more immediate technological applications. As a young researcher, I wonder about the future. Will I be able to get a job? Will I be able to obtain funding? Will there be a place for me and my work in the years to come? My challenge to the Lindau Meetings is thus to look forward, as well as into the past, and by doing so, contribute in an even greater way to the careers of young scientists and to the future of science.



The 26-year-old physicist Nicole Alexandra Larsen is a doctoral candidate at Yale University in New Haven, USA. After receiving her Bachelor degrees in Applied Mathematics and Physics, Nicole Larsen was granted a US National Science Foundation Graduate Research Fellowship. Her graduate studies and research experiments centre on dark matter. “The 1999 discovery of dark energy first inspired me to pursue a career in particle astrophysics”, she wrote in her application to participate in last year’s physics meeting in Lindau. Nicole Larsen was nominated by the Oak Ridge Associated Universities to be considered as a participant in the 62nd Lindau Meeting. The ORAU has been an academic partner of the Lindau Meetings since 2001.



Is Dark Matter Real?, film produced by Nature at the 62nd Lindau Meeting, featuring Nicole Larsen

592 Young Researchers from 69 Countries

34 Those who pass the multi-step selection process and get the chance to participate at a Lindau Nobel Laureate Meeting undoubtedly represent the budding scientific elite of tomorrow: enthusiastic men and women aged less than 35 and engaged in undergraduate, graduate or postgraduate studies or research at esteemed universities and top-ranking research institutions around the globe.



The 592 young researchers who participated in the 62nd Lindau Nobel Laureate Meeting were initially nominated as eligible candidates by academic partners from all over the world. The evaluation of all applications by the review panel of the Lindau Council is based on marks or appraisals, scientific publications, tutorial experience, and recommendations by mentors. The select participants stand out due to their strong motivation to join and engage in the Lindau dialogue and a credible interest in the scientific topics scheduled.



In 2012, the gender balance has reached a ratio of 27% female to 73% male, which is remarkably positive for the discipline of physics.



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Albania 1 • Argentina 2 • Australia 8 • Austria 8 • Bangladesh 5 • Belgium 4 • Brazil 8 • Bulgaria 1 • Cameroon 1 • Canada 9 • Chile 3 • China 33 • Colombia 4 • Cuba 3 • Czech Republic 8 • Denmark 2 • East Timor 3 • Egypt 3 • Estonia 2 • Ethiopia 2 • Finland 2 • France 8 • Germany 167 • Greece 5 • Hong Kong 1 • India 31 • Indonesia 2 • Iran 1 • Israel 6 • Italy 21 • Japan 16 • Jordan 2 • Kenya 2 • Latvia 2 • Liechtenstein 1 • Luxembourg 2 • Malaysia 6 • Malta 1 • Mexico 5 • Mongolia 1 • Nepal 1 • Netherlands 10 • Niger 1 • Nigeria 1 • Norway 1 • Pakistan 9 • Palestinian Territories 2 • Poland 8 • Portugal 1 • Réunion 1 • Romania 1 • Russian Federation 8 • Serbia 3 • Singapore 5 • Slovenia 3 • Somalia 1 • Spain 16 • South Africa 1 • South Korea 5 • Sudan 1 • Sweden 5 • Switzerland 4 • Taiwan 3 • Thailand 6 • Turkey 6 • Ukraine 3 • Uruguay 2 • United Kingdom 3 • United States of America 90 •

Intergenerational Dialogue



The unconstrained atmosphere at the Lindau Meetings provides an ideal setting for face-to-face encounters between young researchers and Nobel Laureates.

- [1] Erwin Neher
- [2] Carlo Rubbia
- [3] John Hall
- [4] Ivar Giaever
- [5] Robert Laughlin



- [1] Theodor Hänsch
- [2] William Phillips
- [3] Albert Fert
- [4] Dan Shechtman
- [5] Dudley Herschbach



Much More than Lectures and Lederhosen

Ibrahim I. Cisse

There is more to a Lindau Meeting than scientific sessions. The spirit of togetherness and fellowship among the participants emerges at the varied cultural and social events and activities. Individual experiences make it memorable.

38 It was a hot summer's day, and I was most excited to be attending the 62nd Lindau Nobel Laureate Meeting. On the plane my mind drifted between how great it would be to meet and discuss with the Nobel Laureates in my field, and the unique opportunity to experience the rich culture of Bavaria.

As young scientists our role is not only to push our own field of research; we also have a responsibility to help address pertinent questions in the world.

After arriving in Munich I took the local train to Lindau. I often peeked at windows of other carriages of the train to see whether I might recognise a Laureate or meet another young scientist, but I did not. I was traveling a day earlier than most other participants, as I was invited by the German Federal Minister of Education and Research on a boat trip. Indeed many satellite activities were organised, and attendees were selected such that everyone got to participate in at least one. For me the boat trip was a big highlight, but not the first great experience I had in Lindau.

As the train pulled into Lindau there was a host family awaiting me at the station. Besides the classic stay in hotels, participants were given the option of staying with one of many local families who open their homes to welcome young scientists from all over the world. I opted for a host family, and this was the best decision. My host father is originally from South Africa, is an active member of a Lindau sailing club, and has lived in the area for more than 20 years. Simply stated, he tells me "I visited here and fell in love and I never left." His wife is from a town that borders the neighbouring state, Baden-Wurttemberg. At the train station I was also welcomed by their 11-year-old son. Their eldest daughter was on her way back from school. When she got home, soon after the introductions, her passion for swimming was apparent as she suggested we all head out to the lake for a quick swim. After a hot train ride, nothing seemed more refreshing than swimming in Lake Constance! Throughout the week I would experience such great memories with my host family. One of my most memorable times with them was an impromptu sailing trip on their sailboat. On that trip we travelled the coasts not only of Germany, but also of Switzerland and Austria, all within two hours. After that multi-national sailing adventure, I would rush home, only to return to the lake, this time for the minister's dinner and boat trip.

This boat trip was the first time I would meet other young researchers as well as some of the Nobel Laureates who were attending the meeting. As the German Federal Minister of Education and Research, Annette Schavan put it, "There has perhaps never been a time when we've had so many top politicians and top scientists on the same boat, both figuratively and literally!" But this was my experience with the Lindau Meeting in general.

In retrospect, a surprising outcome of the meeting for me has been to get us to understand that we have a role as young scientists not only to push our own field of research, but also a responsibility to help address pertinent questions in the world. For example, on our trip to Mainau Island one public debate changed the perspective I had about what role my country of origin, Niger in West Africa, can play in addressing the world energy supply crisis. As the discussion centred on whether uranium-based nuclear energy should be pursued or reduced in countries like Germany, Japan or the US, it was clear that alternatives like solar energy can never be produced sufficiently in Europe due to the lack of adequate sunlight. Whether it be nuclear energy or solar energy, it occurred to us that the solution to this world crisis may come from young scientists in poor countries like Niger, which happens to be the world's fourth producer of uranium but is also centrally located in the Sahara

desert, and rich in both solar exposure and nuclear minerals. Therefore, the way I see it, it will be a challenge in the future for the Lindau Nobel Laureate Meetings to increase participation of young scientists from countries like Niger which are not necessarily English-speaking, but are increasingly becoming central to the highest-level discussions about the future of our planet.

On a personal note, I must say that some of the young scientists I met at the meeting have since become very close collaborators, as we are interacting with exciting ideas from fields of research that previously did not merge. And I have since made direct contacts in key decision-making centres in the world, including the White House Office of Science in the US, or her Majesty's global Science and Innovation Network in the UK. In conclusion, I can say that I went to the Lindau Nobel Laureate Meeting thinking how great it would be to meet Nobel Laureates, which it was, but beyond my expectation, it was everyone else I met that left me more excited about the world we can build for future generations.



30-year-old Ibrahim Cisse, depicted here together with Countess Bettina Bernadotte and his hosts in Lindau, Birgit and Kenneth Strachan, is a post-doc fellow at the esteemed Ecole Normale Supérieure in Paris. As a physicist in life sciences he takes interdisciplinary approaches to explain how biophysics can help shape physical theories. His research focus is on single-molecule detection and characterisation of weak and transient bio-molecular interactions.



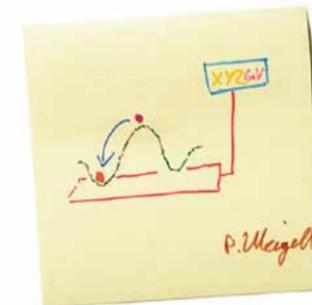
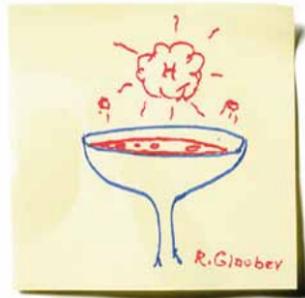
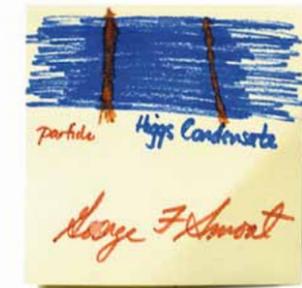
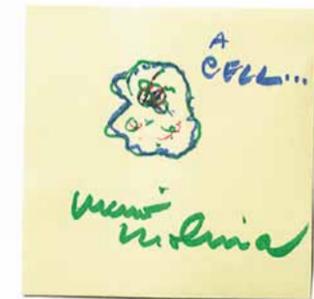
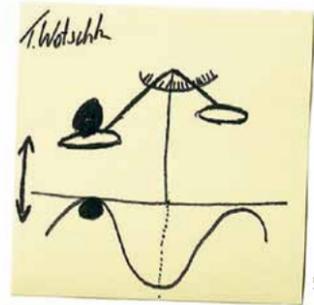
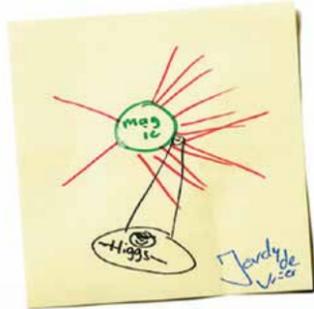
Beyond the Classroom, film produced by Nature at the 62nd Lindau Meeting, featuring Ibrahim Cisse

Physics Matters

Programme of the 62nd Lindau Nobel Laureate Meeting

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[1] Jordy De Vries (Netherlands) [2] Elena M. Donegani (Italy) [3] Ana Ros Camacho (Spain) [4] Robert B. Laughlin [5] Thomas Watschke (Germany) [6] Roy J. Glauber [7] Michael Grau (Germany) [8] Theodor W. Hänsch [9] Harald zur Hausen [10] Julie Hogan (USA) [11] Aarti Nagarajan (India) [12] Brian P. Schmidt [13] Jonathan Litz (USA) [14] Sir Harold W. Kroto [15] Hartmut Michel [16] Jakub Mielczarek (Poland) [17] Mario Molina [18] Erwin Neher [19] Birgit Ritter (Germany) [20] Nahid T. Sarvari (Iran) [21] George F. Smoot [22] Martinus J. G. Veltman [23] Philipp Weigell (Germany) [24] Ipek Güler (Turkey) [25] Brian D. Josephson

"How do you picture the Higgs?" Editors of the Frankfurter Allgemeine Zeitung asked Nobel Laureates and young researchers to draw their image of the long-sought particle.

A Scientific Dialogue

Rainer Blatt & Burkhard Fricke

The sessions that form the scientific programme of a Lindau Meeting are designed to activate the exchange of knowledge, ideas, thoughts, and experience. But they would not have the same lasting effect without the Nobel Laureates involved.

42 What are the prerequisites for scientific progress and ground-breaking research achievements? Any attempt to answer this question will come down to an extensive list of complex philosophical, ideological, structural and technical preconditions. But it is certainly neither our claim nor our intention to provide a satisfactory answer here. Instead, we have challenged ourselves to define the modest contribution of the Lindau Nobel Laureate Meetings to the advancement of science and research. Our aim is to support aspiring young researchers at a crucial and decisive stage of their career; and our approach is to facilitate the exchange of knowledge, to provide inspiration as a source of motivation, and to foster collaboration—in short: “Educate. Inspire. Connect.”

The scientific programme of the Lindau Meetings is based on the principle of dialogue.

The scientific programme of the Lindau Meetings is based on the principle of dialogue. The different session formats are designed to activate the exchange of knowledge, ideas, thoughts, and experience. But the distinctive feature in contrast to common scientific conferences is the unconstrained participation of Nobel Laureates.

“Learning from the best” would definitely be a suitable paraphrase for the experience of hearing scientific lectures by Nobel Laureates. By deliberately choosing their lecture topics, the Laureates actively play a part in the formation of the scientific programme and contribute to the diversity of themes covered. And as many of them decide to talk on their award-winning research findings, which have had such an enormous impact on scientific progress, the lectures at the Lindau Meetings are not only educative, but highly inspirational and memorable. Thinking of last year’s meeting, Dan Shechtman’s lecture on “The Discovery of Quasi-Periodic Materials” comes to mind. Despite being a chemist at a meeting on physics, Shechtman captivated everyone with his vivid account of the long and hard struggle of getting his discovery acknowledged and his reputation restored. His advice to the young researchers was to develop perseverance and tenacity in order to succeed—a highly motivating lecture!

Each Nobel Laureate also chairs a discussion session related to the topic of their lecture—accessible exclusively to the meeting participants. The purpose of this format is to encourage uninhibited discussions between the young researchers and the Laureates. Specialist scientific questions are raised and answered and new ideas are put forward and debated. There is even room for very personal matters and concerns. The intimacy, informality and

frankness that characterises the atmosphere of these discussions is in fact the core of the Lindau dialogue.

Mentoring and mutual learning are represented best in the science master classes we have been offering since 2011—upon an initiative of the Nobel Laureates Roger Y. Tsien and Aaron Ciechanover. The format allows for an intensified scientific exchange. A select group of one to four young scientists is given the unique opportunity to present their current research work to the Laureate who has offered to chair the class, and to a narrow audience, composed exclusively of competent fellow researchers. In advance, the speakers and the Laureate come together to familiarise themselves with each other’s research topics in preparatory workshop-like meetings. For these scientists, giving a presentation in one of the master classes is certainly an excellent opportunity to refine their presentation skills and receive invaluable feedback—from no less than a Nobel Laureate. Thanks to the commitment of the Laureates Albert Fert, David Gross, William Phillips, and George Smoot, at the 62nd Lindau Meeting we were able to offer four coveted master classes, marked by a high level of professionalism and specialisation.

The same is true for the panel discussions at the Lindau Meetings. In the conception of these high-profile panels, we are fortun-

nate to have a multitude of Nobel-Prize-bestowed experts at hand, each of them generously willing to share their expertise and engage in profound and controversial discussions. At the 62nd meeting, our panel discussion on the experiments conducted at CERN coincided with the announcement of the discovery of a new sub-atomic particle, commonly assumed to be the long-sought Higgs boson. The most interesting and exciting discussion among the particle physics experts David Gross, Carlo Rubbia, and Martinus Veltman, joined by George Smoot, literally echoed the enthusiasm that prevailed among the meeting participants.

“We young researchers have spent the last week in paradise.” Words like these, uttered by last year’s meeting participant Azure Hansen from the US, fill us with pride and give us the feeling that the Lindau Nobel Laureate Meetings meet the demands of aspiring young scientists. Our leitmotif Educate. Inspire. Connect. impels and challenges us not to stand still, but to keep on moving and further enhance the programme of our meetings, for the benefit of future participants, and eventually for the benefit of global scientific progress.



Rainer Blatt ([1], right, with William Phillips) heads the Institute for Experimental Physics at the University of Innsbruck in Austria and became a member of the Lindau Council in 2012. Rainer Blatt will co-chair the future Lindau Meetings on physics with regard to their scientific programme, taking on that responsibility from the council’s vice-president Burkhard Fricke ([2], right). He is an emeritus professor of physics at the University of Kassel where he heads the research group for theoretical atomic and molecular physics. He was the scientific co-chairman of a total of four meetings and conceived the programme of the 62nd meeting jointly with the council’s corresponding member Lars Bergström ([2], left), professor of theoretical physics at Stockholm University and secretary of the Nobel Committee for Physics.

The Scientific Programme

44 LECTURES & DISCUSSIONS

James Cronin

Spontaneous Ionisation to Subatomic Physics:
Some Vignettes from Cosmic Ray History

Paul Crutzen

Atmospheric Chemistry and Climate in the Anthropocene

Albert Fert

The Present and Future Impact of Spin Electronics on
the Information and Communication Technologies

Ivar Giaever

The Strange Case of “Global Warming”

Roy Glauber

The Quantum Mechanics of Light:
Interference, Entanglement—and Ghosts

David Gross

A Century of Quantum Mechanics

Peter Grünberg

An Introduction to the Harmonies of
Alpine Folklore Music with Live Examples

John Hall

Five Decades of Lasers, Six Decades of Progress, and a
Proposed Space Experiment to Test Einstein’s Assumptions

Theodor Hänsch

Laser Spectroscopy of Hydrogen

Dudley Herschbach

Glimpses of Chemical Wizardry

Brian Josephson

The Real M-Theory

Walter Kohn

Blindness and Physics. A Progress Report.

Sir Harold Kroto

Science—Lost in Translation?

Robert Laughlin

Powering the Future

John Mather

Seeing Farther with New Telescopes

Hartmut Michel

Photosynthesis, Biomass, Biofuels:
Conversion Efficiencies and Consequences

Mario Molina

The Science and Policy of Climate Change

Erwin Neher

Biophysics of Neurotransmitter Release

Douglas Osheroff

How Advances in Science are Made

William Phillips

Creating Artificial Magnetic Fields to
Act on Neutral Atoms

Carlo Rubbia

Neutrinos: a Golden Field for Astroparticle Physics

Brian Schmidt

Observations, and the Standard Model of Cosmology

Dan Shechtman

Quasi-Periodic Material Discovery—The Role of TEM

George Smoot

Mapping the Universe in Space and Time

Martinus Veltman

The LHC at CERN and the Higgs

Kurt Wüthrich

Structural Genomics—Exploring the Protein Universe

MASTER CLASSES

Information Storage and Processing with Spin Electronics

chaired by Albert Fert

Lecturers:

Andrew DiLullo, Ohio University

Karin Everschor, University of Cologne

Cold Atomic Gases

chaired by William D. Phillips

Lecturers:

Emanuel Alves de Lima Henn, Stuttgart Universität

Azure Hansen, University of Rochester

Kater Murch, University of California, Berkeley

Claire Thomas, University of California, Berkeley

André Xuereb, University of Malta

Fundamental Physics in the Era of the LHC

chaired by David J. Gross

Lecturers:

Heather Gray, CERN

Simon Viel, University of British Columbia

Yonit Hochberg, Weizmann Institute of Science

Alexander Mott, Massachusetts Institute of Technology

Juan Pedro Ochoa-Ricoux, Berkeley Lab

Jordy de Vries, Kernfysisch Versneller Instituut

Cosmology and Astrophysics: Gamma Ray Bursts and Galaxies

chaired by George F. Smoot

Lecturers:

Josh Dillon, Massachusetts Institute of Technology

Marianne Heida, SRON Netherlands

Institute for Space Research

Yingjie Peng, ETH Zurich

Stefania Salvadori, Kapteyn Astronomical Institute

PANEL DISCUSSIONS

CERN

moderated by Felicitas Pauss, Head of

International Relations, CERN

Panelists:

David J. Gross, Carlo Rubbia, George F. Smoot, Martinus Veltman

The Future of Energy Supply & Storage

Moderated by Geoffrey Carr, Science Editor, The Economist

Panelists:

Martin Keilhacker (German Physical Society), Robert B. Laughlin,

Carlo Rubbia, Georg Schütte (State Secretary, German Federal

Ministry of Education and Research)

SCIENCE BREAKFAST DISCUSSIONS

On the Brink of an Era of Quantum Technologies

upon invitation of the Republic of Singapore

Panelists:

Artur Ekert, Director of the Centre for Quantum Technologies,
National University of Singapore

William D. Phillips, Fellow with the United States’ National Insti-
tute of Standards and Technology and the Joint Quantum Institute

Colin Teo, PhD Student, Centre for Quantum Technologies,
National University of Singapore

Moderator:

Jenny Hogan, Outreach and Media Relations Manager, Centre for
Quantum Technologies, National University of Singapore

Extending the Possible Through Novel Ideas & Collaborative Partnerships

upon invitation of Mars, Incorporated

Panelists:

Dudley R. Herschbach, Harvard University

Chris Nagel, Founding Scientist, Continuum Energy Technologies

Amanda Peter Randles, Harvard University

Moderator:

Adam Smith, Editorial Director of Nobel Media

Medical Physics—a Major Challenge for Cancer Research

upon invitation of the German Cancer Research Center (DKFZ)

Panelists:

Jürgen Debus, Head of Radiotherapy, DKFZ and
University Hospital Heidelberg

Lena Maier-Hein, PostDoc, Div. of Medical Informatics, DKFZ

Otmar Wiestler, Chairman and Scientific Member of
the Management Board, DKFZ

Moderator:

Stefanie Seltmann, Head of Public Relations, DKFZ

How Will Our Society Produce, Use, and Manage

Electric Energy in the Future?

upon invitation of SAP AG

Panelists:

Stephan Fischer, Global Head of Applied Research, SAP AG

Robert B. Laughlin, Stanford University

Zoltán Nocht, Director Future Energy Research, SAP AG

INFORMATION SESSION

European Funding for Excellence in Research.

10.000 Researchers per Year—Can You Be One?

Luis Farina Busto & Mike Rogers, European Commission

The Scientific Programme



[1] Walter Kohn
 [2] Peter Grünberg
 [4] Martinus J. G. Veltman
 [5] Dan Shechtman



[2] Kurt Wüthrich
 [3] Panel on the experimental findings at CERN
 [4] Sir Harold W. Kroto at the Valentin-Heider-Gymnasium
 [5] John L. Hall and his wife Marylin in a discussion with young researchers



The Higgs Excitement

Matthew Chalmers

The participants of the 62nd Lindau Meeting had the rare chance to share in the excitement of the discovery of the Higgs boson with three of the Nobel Laureates who helped make it happen.

48 The standard model of particle physics is anything but standard, and much more than just a model. It is a complete theory of the fundamental building blocks of matter that has survived 40 years of assault from experiment. Some 15 Nobel Prizes have been awarded to the creators of its equations and to the discoverers of its particles—the quarks, leptons and bosons that make up everything.

Yet, until last summer there was still a possibility that this remarkable theory was built on sand because it demanded the existence of a particle that had never been seen: the Higgs boson, without which the standard model particles would have no mass. When on 4 July 2012 physicists at CERN's Large Hadron Collider (LHC) in Geneva announced to the world that they had bagged a new particle that fits the Higgs description, the last remaining gap in the standard model was filled.

The discovery was not a big surprise for co-architect of the theory David Gross.

“We’d been expecting something like this to turn up for the past 30 years,” Gross told the audience in Lindau. “It is a wonderful triumph of theory.”

That theory—quantum field theory—grew from marrying the two great revolutions in physics from a century ago: quantum mechanics, which describes the very small, and special relativity, which describes the very fast. It explains nature’s basic forces in terms of the exchange of “vector bosons” between point-like quarks and leptons. The electromagnetic force between two electrons, for instance, is transmitted by the photon as described with extraordinary precision in the 1940s by quantum electrodynamics.

Gross helped devise the quantum theory of the strong nuclear force, quantum chromodynamics, which explains how quarks are bound by gluons inside protons and neutrons. The Higgs, though, emerges from the quantum description of the weak force, which the standard model describes by the unified electroweak theory.

This theory predicted the existence of the massive W and Z bosons to sit alongside the massless photon, and motivated physicists to build giant particle colliders to search for the new particles.

The man who helped put the electroweak theory on solid mathematical foundations, Martinus Veltman, was close to giving up on the Higgs given the decades of no-shows at previous colliders. “You can formulate electroweak symmetry breaking without a Higgs but you pay a high price in the theory,” he said. Veltman, a veteran of the field for 60 years, also warned that the Higgs could

spell danger for particle physics. “If it just turns out to be the simplest standard model variety, it would close the last door on the theory and leave us in the dark,” he said.

That would leave a lot of unanswered questions. For despite its successes, the standard model falls short on several fronts. It ignores gravity, which is not a problem for elementary particles that weigh just billionths of a billionth of a microgram but is a major obstacle to the goal of constructing a single theory of nature’s forces. The standard model offers no explanation for why its six quarks and six leptons are arranged in three families, or why some particles weigh thousands of times more than others, and it is mute on the nature of the dark matter and energy thought to comprise 95 per cent of the universe.

There are plenty of ideas for new theories, and Gross is confident that the standard model is not the final word in the centuries old search for nature’s fundamental laws. But it is experiments that will shine the way forward, says Carlo Rubbia, who was awarded the Nobel Prize for leading the team that discovered the W and Z in 1983. Rubbia, who was also instrumental in getting the LHC off the ground during the 1980s, called for a new collider to be built as soon as possible to scour the Higgs sector for cracks that offer a glimpse to the new physics.

“Elementary particle physics, not only because of the Higgs, is in a very interesting situation,” said Rubbia, highlighting the potential of astro-particle physics and neutrino experiments to drive the field forward. “We don’t know where the next discovery is coming from but we are convinced that physics will not stop here,” he said. “The question is whether we have the ability to respond to these questions, which of course are becoming progressively more difficult.”

Meanwhile, the LHC is only at the beginning of its 20-year-long programme and still has much more to explore at the high-energy frontier. “You are living in very exciting times,” Gross told Lindau’s young researchers. “Even though there has been amazing progress in the last 100 years there remain so many amazing questions and amazing phenomena to discover. And so many Nobel Prizes to win.”



Matthew Chalmers (leftmost, together with George Smoot, David Gross, John Mather, Carlo Rubbia, Martinus Veltman, and Gerardus 't Hooft) is a freelance writer and editor in the UK. He has a PhD in experimental particle physics. Chalmers has attended the Lindau Meetings of 2008, 2010 (picture) and 2012 at which he moderated panel discussions and press conferences dedicated to the research conducted at CERN.



Please find a video of the 2012 panel discussion on CERN in the Lindau Mediatheque.

A Triumph for Particle Physics

Alexander B. Fry

The discovery of the fundamental particle that is believed to be the key to the standard model of physics was the dominant topic discussed by all particle physicists participating in the 62nd Lindau Meeting. Euphoric assessments prevailed.

50 “This is a great day for physics and for all humanity”, Nobel Laureate David Gross welcomed the news from a press conference in Geneva that was transmitted live to an excited audience in Lindau on 4 July: A new fundamental particle had been discovered at the CERN—most probably the long-sought Higgs boson.

Rumors about this announcement had been swirling around before, and it was a fortunate coincidence that the organisers of the Lindau Meeting had planned a panel discussion with Nobel Laureates and experts from CERN (European Organisation for Nuclear Research) months in advance of any inkling that there would be such grand news that same day.

“The Higgs discovery has extended the energy range of our research to way beyond what we had before”, Martinus Veltman said.

The LHC (Large Hadron Collider) at CERN is a 27-kilometre circumference ring, which circulates beams of protons at speeds exceedingly close to the speed of light. It is the largest and most complex machine humans have ever built. Inside evacuated tubes there are two counter-rotating beams of protons, which are made to occasionally collide in the heart of detectors creating cascades of fundamental particles.

LHC’s biggest particle detectors are CMS and ATLAS. During the press conference, they presented their data independently. CMS reported the observation of Higgs-like signatures in several decay channels for a combined result of a 125.3 GeV mass particle. ATLAS reported a similar combined result of a 126.5 GeV mass particle. The new particle is about 130 times the mass of an ordinary proton.

Following the CERN press conference the Lindau panel discussion with Nobel Laureates Martinus Veltman, David Gross, Carlo Rubbia, and George Smoot commenced. The moderator was Felicitas Paus, Head of International Relations for CERN. Live on the panel over at CERN was renowned theoretical physicist John Ellis, ATLAS expert Andreas Hoecker, CMS expert Chiara Mariotti, and LHC deputy spokesperson Burkhard Schmidt.

Martinus Veltman opened the discussion with a remark that was fitting with his realist personality. “It is beyond a shadow of a doubt very important,” he said and added with hesitancy: “The Higgs discovery has extended the energy range of our research to way beyond what we had before, though it is not clear we will ever have machines that will reach these highest level energies.”

David Gross offered a more congratulatory view: “I haven’t been able to stop smiling all

day. This is a triumph for CERN, a triumph for the people who built this marvelous instrument, a triumph for the people who paid to build to this instrument, a triumph of our experimental colleagues who built these incredible detectors and have been working so hard, and last but not least, it is a triumph of theory.”

The theory Gross referred to is the standard model of physics. It predicts the forces, interactions, and properties of fundamental particles and phenomena in physics. However, mathematically the standard model allows only massless particles. Back in the sixties, the physicist Peter Higgs and others therefore postulated an interaction that gives the particles their mass, a force field through which they glide as if through syrup in order to become heavy. If this field didn’t exist, all particles would only be able to move with the speed of light without ever forming stable matter. The proposed exchange particle of this force field was dubbed Higgs boson.

Theoretically, the success of the standard model relies crucially on the existence of the Higgs boson. Experimentally, it is extremely difficult to discover, as this missing piece of the puzzle would only be formed at very high energies and decay again extremely rapidly. Only the LHC particle accelerator at CERN can generate these energies when protons collide—and now probably discovered the Higgs.

The subtleties of particle physics, however, do not yet allow us to unequivocally know the nature of the particle that has been discovered at CERN. This is why physicists with the current data are careful to state that a new fundamental scalar boson has been found, which is not necessarily the Higgs boson.

Carlo Rubbia expressed little doubt over the validity of what was reported. George Smoot saw both sides of the situation, “It would be poetry in a certain sense. This whole structure fits together quite beautifully, though theorists to my mind stuck too tightly to the most simple beautiful version.” One young researcher asked Smoot what the larger, particularly cosmological, implications of this result are. George Smoot emphasised that dark matter, the early-universe baryon asymmetry, and the acceleration of the universe are all phenomena which are not included in the standard model. He noted how the fields of particle physics and cosmology are merging.

Pushing the edge of knowledge is, as always, a daunting task. All of the Nobel Laureates on the panel indicated deference and congratulations to the researchers who had done such excellent work. CERN employs over 6,000 physicists in various capacities to meet the challenges of engineering, theorising, and analysing results. It does not come as a surprise



that many of the young researchers at Lindau were associated with CERN in some capacity.

Ultimately the fundamental boson discovered at CERN is a further proof that the standard model of physics is a highly successful and predictive theory. However, the standard model of physics does not explain all of the strange observations we have seen in the Universe, which all indicate physics beyond the standard model. So this new discovery does not necessarily shine a light as to where we should head next. The general consensus of the Laureates seemed to be that we should celebrate this discovery and keep taking and analysing data in order to generate more knowledge—a challenge that many of the attending young scientists will gladly accept in their future work.

Alexander Bastidas Fry (right, with Countess Bettina Bernadotte) is a PhD astronomy graduate student at the University of Washington and a freelance science writer. His ambition as a blogger and twitterer is to contribute to a better public understanding of science. Alexander Fry was part of the team of the official Lindau Meeting blog.

The Scientific Programme

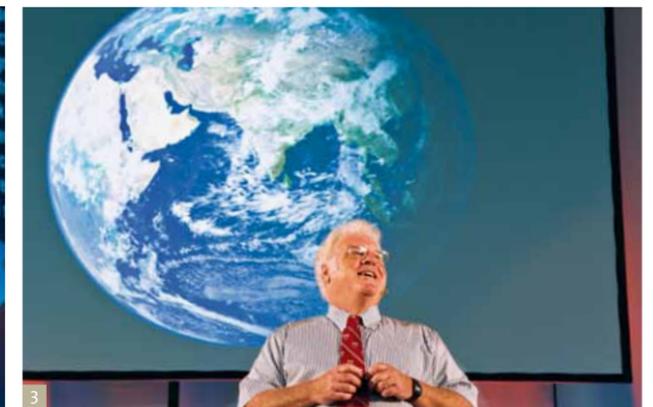
52



Cosmology issues like the expansion of the universe or observations and measurements in space were given closer attention in several lectures.

- [1] Brian Schmidt
- [2] George Smoot
- [4] John Mather
- [5] Stefania Salvadori—presenter at the science master class chaired by George Smoot

53



Energy and climate change issues were also among the central topics discussed at the 62nd Lindau Meeting.

- [1] Mario Molina
- [2] Martin Keilhacker, Carlo Rubbia, Georg Schütte, and Robert Laughlin on the panel “The Future of Energy Supply and Storage” moderated by Geoffrey Carr.
- [3] Robert B. Laughlin presented his newest book on energy issues—upon invitation of the foundation, Bodensee Standort Marketing, and Schwäbische Zeitung.
- [4] Hartmut Michel
- [5] Paul Crutzen



Cosmology in Lindau

Juan García-Bellido

Despite tremendous recent progress in cosmological measurements and observations, the nature of almost 95 per cent of all energy and matter in the universe remains unknown. Brian Schmidt, John Mather and George Smoot gave an account of the current state of research.

54 The three lectures on cosmology, by Brian Schmidt, John Mather and George Smoot, were brilliant and at the same time entertaining and informative. The first lecture, by Schmidt, was a stimulating account of the present standard model of cosmology. He began with Vesto Slipher's measurements of redshifts to the nearby nebulae, on to Hubble's realisation that these were just galaxies like the Milky Way, and then to the law of linear expansion with distance—known today as Hubble's Law—which presents modern cosmology in the context of a proper theory of gravitation, Einstein's general theory of relativity.

The cosmology talks at Lindau gave a very wide and profound view of the cosmos, a world in its own, with laws and dynamics that only now are beginning to be explored and that could lead to surprises in fundamental physics.

The talk soon masterfully described difficult concepts such as event horizons and conformal diagrams of the expansion of the universe, showing detailed expressions for the luminosity distance as a function of redshift and other cosmological parameters. Although the young scientists who

filled the room are probably among the most brilliant in the world, a high degree of specialisation in that field would have been necessary to follow the talk at a deeper level. I expected and indeed was glad to see many hands raised for questions in the discussion session on that talk held in the afternoon.

Schmidt was followed by John Mather and George Smoot, co-PI's of the COBE satellite, Nobel Laureates in Physics 2006. Mather began with his memories from childhood about how he felt the need to "build equipment for measuring things," and how during his PhD thesis he tested several instruments to measure the CMB spectrum from earth without much success, until he finally had the opportunity to send a satellite into space. His tenacity is a good example of "know how" in science and a huge incentive for the young people at Lindau. Today, he is the Project Scientist of the John Webb Space Telescope of NASA, the future replacement for the Hubble Space Telescope.

He then described a wide spectrum of future projects in astronomy—some under construction, others recently approved—which showed the need for international coordination among the various space agencies, American, European, Japanese, Russian and Canadian. His talk was a lesson in humility and inspiration for future generations of astronomers.

Then came Smoot to brilliantly close the cycle, describing the technological advances that are allowing humanity to make far deeper and more detailed maps of the large-scale structure of the universe, which has led us to understand better its evolution from the first fraction of a second at the Big Bang until today, 13.7 billion years later. He showed several movies of our place in the universe, from the solar system to the very confines of the observable universe as seen in the microwave background. He also showed the distribution and clusters of galaxies in the cosmic web which arise from minute quantum fluctuations—stretched during inflation—that grow to become microwave background anisotropies, and density fluctuations from which galaxies are formed by gravitational collapse. I met George in 2000, when I invited him to the CAPP meeting in Verbier, Switzerland. Already then he was recognised as a clear candidate for the Nobel Prize. He likes the hustle and bustle that was clearly encouraged at Lindau, where Nobel Laureates are treated as demigods by young students who want to emulate that, as well as learn from them.

The cosmology talks at Lindau gave a very wide and profound view of the cosmos, a world in its own, with laws and dynamics that only now are beginning to be explored and that could lead

to surprises in fundamental physics. In the next few years we will expand our knowledge about the universe beyond our neighbourhood.

Perhaps then we may be able to answer the basic questions now posed about the true nature of dark matter and dark energy. Recent progress in this field is truly spectacular, from a science which was fundamentally speculative in the middle of the last century to a very different one, dominated by experimental data. We have now reached sufficient precision to determine a dozen or so cosmological parameters within a few percentage points of accuracy; and in the near future, with the Planck satellite and the Dark Energy Survey, we will reach below one percent.

Despite the improvement in cosmological measurements, all three cosmology Laureates asserted that we remain ignorant of the nature of almost 95% of all energy and matter in the universe, the dark matter and dark energy; and that the stuff we are made of (atoms) is mostly irrelevant for the present expansion of the universe, a humbling thought for humankind.



Juan García-Bellido, here depicted together with Nobel Laureate David Gross, is a theoretical physicist and cosmologist. He obtained his PhD from the Universidad Autonoma de Madrid (UAM) and had postdoctoral positions at Stanford University, TH-Division CERN, and Imperial College London. Since 1999 he is a professor at the Department of Theoretical Physics of the UAM. He attended the 62nd Lindau Meeting to report in Spanish in the official meeting blog.



In the Lindau Mediatheque all contents related to cosmology have been cross-linked in atopic cluster to allow users to detect their requested information with just a few clicks.

Energy Issues

Florian Freistetter

The current use of energy, its consequences for our climate, and strategies to meet the growing demand of clean energy in the future were among the topics raised by Paul Crutzen, Mario Molina, Hartmut Michel, Robert Laughlin and Carlo Rubbia.

56 Man has changed the Earth. That was the message the 1995 Nobel Laureate in Chemistry Paul Crutzen conveyed in his talk on “Atmospheric Chemistry and Climate in the Anthropocene”. In his presentation he demonstrated how the actions of man during the last centuries have influenced the earth. The number of people, the number of cattle, the use of energy, the urban population, the industrial output: everything has increased vastly in the recent past and does so still. We use nine times as much water as we did during the past century, not only for drinking and washing; industry has a large demand for water. To make one pound of cheese, 50,000 litres of water are needed, altogether.

We humans are not only using up the natural resources of earth with ever-increasing speed, but also literally changing the face of the planet.

We humans are not only using up the natural resources of earth with ever-increasing speed, but also literally changing the face of the planet. According to Crutzen, humans act as powerful geological agents and today the erosion rate is fifty times as high as the natural rate. Since the beginning of the 19th century, mankind has opened a new geological timescale: the Anthropocene. From every generation

to the next, the effect of human activities is accumulating and accelerating.

The impact of these activities was the topic of Mario Molina’s talk. Molina received the Nobel Prize for Chemistry with Paul Crutzen in 1995, for his work on the chemistry of the atmosphere. In Lindau, he talked about “The Science and Policy of Climate Change”. Molina reminded the audience that the energy balance of earth is based on well-known and established scientific laws. It is governed by the Planck distribution law, the photoelectric effect and the Stefan-Boltzmann law. All measurements show that today we have a greenhouse effect. Since the industrial revolution the global mean surface temperature has risen about 0.8 degrees and the IPCC estimates a more than 90 per cent probability that this is due to human activities. Molina is most worried about weather extremes, likes floods or droughts. Models and measurements show, for example, that extreme heat waves have increased 40 times during the last 50 years. To avoid any further risky temperature increase, we should use different sorts of energy and use them more efficiently.

One way to do this was addressed by Nobel Laureate Hartmut Michel, who received the Nobel Prize for Chemistry in 1988. His talk on “Photosynthesis, Biomass, Biofuels: Conversion Efficiencies and Consequences” investigated the current problems of con-

verting biomass into energy, and ways to solve them. He explained that photosynthesis is in fact not very efficient. Plants use only a small part of the whole electromagnetic spectrum emitted by the sun. They use red and blue wavelengths and reflect the rest (that is the reason why they are green). Theoretically, only 4.5 per cent of solar energy can be converted via photosynthesis, in reality it is even less. Germany would not be able to meet its requirements only with biofuel; there would not be enough space to plant enough biomass. Genetic engineering could be a solution: genetically enhanced plants could be 50 to 100 per cent more efficient in converting energy. But, according to Michel, today biofuel is no technology for the future. We need other techniques.

Robert Laughlin, Nobel Laureate in Physics in 1988, took the audience on a trip to such a future, roughly 200 years from now. In his talk “Powering the Future” he asked everyone to visualize a time when there are no fossil fuels left. Without oil and coal, we would be missing the basis of our current technology. What would a world look like without them? Would people still drive cars, fly in planes and have electrical lights in their homes? The answer to all three questions is “Yes”, according to the audience and Laughlin. Even in the year 2200, people will want to drive around and society will find a way to do so. Laughlin predicted that people will never vote for a

form of energy that is more expensive than nuclear energy. Even if the costs of renewable energies do not decrease in the future, nuclear energy will still be there.

“The Future of Energy Supply and Storage” was the topic of the panel discussion on the last day of the conference. Nobel Laureate Carlo Rubbia advocated transition to a methanol economy, where methanol would replace fossil fuels and supply the energy for our cars, planes, industry and power plants. Robert Laughlin reminded the audience of the problem of costs. Today alternative energies still have a fossil backup, but in the future things will be different. Besides costs, there is the problem of transport and storage. In Rubbia’s opinion, solar energy from the deserts will be stored and transported by hot liquids. He noted that long pipelines are easier to build than long electrical power lines. But whatever we do, we have to do it soon. “We are running out of time”, Rubbia said. Global cooperation seems necessary.



Free-lance science writer and journalist Florian Freistetter is considered to be among the most influential science bloggers in the German-speaking countries. Last year, he actively supported the team of the official Lindau Meeting blog and closely followed the sessions on energy issues. He holds a doctor’s degree in astronomy.



“The Future of Energy & Storage”, panel discussion at the 62nd Lindau Meeting

The Social Programme

58



[1, 4] Cultural performances, music and dance set a grand framework for the evening Get-Together on the International Day, presented by the Republic of Singapore. Though the contrast could have hardly been greater, the Bavarian Evening with its traditional folk dance and music performances [2, 3] was equally festive. [5] Nobel Laureate Dan Shechtman (right, together with Countess Bettina Bernadotte and Wolfgang Heubisch, Bavarian State Minister of Sciences, Research and the Arts) even dressed up in traditional Bavarian "Lederhosen".

59



The barbecue "Grill&Chill" [1, 3] was a pleasant opportunity for becoming acquainted with locals from Lindau and mingling with other meeting participants. The scenic boat trip on Lake Constance to Mainau Island [2, 4, 5], presented by the State of Baden-Württemberg, was not only ideal for a little sightseeing, but also the occasion to celebrate the closing of a successful meeting. Almost everyone, including Nobel Laureates ([5] Ivar Giaever and wife Inger dancing with young researchers), hit the dance floor.



The Social Programme

60 OPENING CEREMONY

Welcome Addresses

Countess Bettina Bernadotte

Lars Heikensten
Executive Director of the Nobel Foundation

Annette Schavan
Federal Minister of Education and Research (Germany)

Induction of New Members to the
Honorary Senate of the Foundation

CONCERT

Concert by an ensemble of the Vienna
Philharmonic Orchestra at the city theatre
of Lindau

upon invitation of the Republic of Austria,
represented by Karlheinz Töchterle, Federal
Minister for Science and Research

FOUNDATION DINNER

Dinner at Hotel Bad Schachen

upon invitation of the Foundation
Lindau Nobelprizewinners Meetings at
Lake Constance

INTERNATIONAL GET-TOGETHER

upon invitation of the Republic of
Singapore, represented by President
Tony Tan

Welcome Addresses

Countess Bettina Bernadotte
Tony Tan
President of the Republic of Singapore

Presentation

Alexander Ling
*Centre for Quantum Technologies,
National University of Singapore*

Dinner

Cultural Performance & Dance

ACADEMIC DINNERS

upon invitation of:

Alexander von Humboldt Foundation

German Research Foundation (DFG)

Elite Network of Bavaria

German Academic Exchange Service
(DAAD)

Helmholtz Association

Max Planck Society

Nobel Foundation

Rheinmetall AG

United States Department of Energy

Wilhelm und Else Heraeus-Stiftung

GRILL&CHILL: CONNECTING CULTURES

Barbecue upon invitation of the council,
the foundation, and the city of Lindau

BAVARIAN EVENING

upon invitation of the Elite Network of
Bavaria & the Free State of Bavaria,
represented by Minister Wolfgang Heubisch

Welcome Addresses

Wolfgang Heubisch
*State Minister of Science, Research and
the Arts*

Theodor W. Hänsch
Nobel Physics Laureate 2005

Presentations

Marcus Otten
Ludwig-Maximilians-Universität, Munich

Pascal Neibecker
*Technical University Munich & University
of Augsburg*

Elite Network Design Award

Dinner

Bavarian Music & Dance

BADEN-WÜRTTEMBERG BOAT TRIP

Boat trip on Lake Constance to
Mainau Island

upon invitation of the State of
Baden-Württemberg, represented by
Theresia Bauer, Minister of Science,
Research and the Arts



[1] Lars Heikensten, Executive Director of the Nobel Foundation, gives his welcome address during the opening ceremony. [2] (from left) Martin Winterkorn, CEO, Volkswagen AG and member of the foundation's honorary senate, Siegfried Dais, Deputy Chairman of the Board of Management, Robert Bosch GmbH, and Ferdinand K. Piëch, chairman of the supervisory board of Volkswagen AG and 2012 honorary senate inductee.

Paving the Way

Partners & Supporters of the 62nd Lindau Nobel Laureate Meeting



Academic Partners Enable Lindau's Mission Education Throughout the World

Nikolaus Turner

The cooperation between the Lindau Meetings and their academic partners in 50 countries is a cornerstone of the on-going internationalisation process of the meetings. Both sides benefit mutually from the commitment to connect and promote scientists worldwide.

64 The Lindau Nobel Laureates Meetings are global in nature, as is their subject, science. Our academic partners embrace and share these concepts and their efforts and contributions have helped us launch our Mission Education on a worldwide scale. The Nobel Laureates who participate in the meetings, as well as the young researchers who attend them, acknowledge with gratitude the special achievements of our academic partners, representing some of the most renowned science and research institutions.

The DNA of the Lindau Meetings contains two key ingredients: the trans-generational aspect, and the exchange of knowledge and ideas regardless of nationality, culture, religion or gender.

Against the backdrop of German history in the first half of the 20th century, the Lindau Nobel Laureate Meetings were founded in the spirit of truth and reconciliation. The founders had realised that from the traumatic European experience of the immediate past, a cosmopolitan endeavour was needed to prepare the next generation.

Internationalism injects a kind of cross-fertilisation potential, in that people from various countries and backgrounds are engaging with one another. Science depends on curious minds and scientific discourse, and also on deep respect for the opinions of others.

A global scientific exchange heightens the perspective for universal sciences, and Lindau tries its best to provide this very dialogue.

Through the goodwill and commitment of our academic partners, we are making the goal of our mission come true. During the last 62 years more than 25,000 young scientists have had the opportunity to meet, to learn and to interact with Nobel Laureates, and with each other, establishing relationships that last. Nearly 600 young scholars from close to 70 countries qualified to participate in the last Lindau Meeting. Looking back at their Lindau experiences after some years, young scientists have often called the meetings “an once-in-a-lifetime experience.” As important as that is, in fact the Lindau Nobel Laureates Meetings are just a starting point for a lifelong journey.

In order to get close to attracting some of the world's most talented researchers, we depend on our academic partners, for only they have the means to spread the information and message in their respective countries. They are the trustees of the process and over time they are also beneficiaries of the process, since the outcome is the advancement of scientific discussion inside their homelands. Our partners raise awareness and entice the

talents of their nations to compete and qualify for attendance at a Lindau Meeting. They become associates with those talented students and often remain at their disposal in the process of lifelong learning. The academic partners often continue to assist the young scientists by coaching their careers and staying available for mentoring and financial assistance far beyond Lindau.

The Lindau Nobel Laureate Meetings continue to build on the cooperation, support and assistance of about 200 academic partners worldwide, representing 50 countries so far. Transnational institutions add to the geographic coverage: the European Commission's Marie Curie Fellowship Programme, the European Research Foundation, the OPEC Fund for International Development, and TWAS and COMSTECH are examples.

The potential of the programme of the Lindau Meetings and the activities of the Mission Education is unbounded, and that is why we appreciate the commitment of our existing partners, and encourage others to join. Together we generate a genuine global interest, and the quality of the meetings is gaining. In this way we can enhance a stable, global network for the scientific world of the future. Our endeavour is to offer young researchers, academic institutions and professors a two-way street: by coming from their

countries to Lindau to take part in the scientific exploration, and then in the other direction to have the treasure trove of the mediatheque containing Lindau lectures made freely available around the world. The contributions of the Nobel Laureates in the framework of the Lindau Meetings are creating a value beyond the annual meetings where their lectures are delivered. Through the alumni network one can partake of the lectures covering an entire century of natural science history.

This report is an opportunity to express appreciation and gratitude to our academic partners worldwide. Lindau's mission—Educate. Inspire. Connect.—is something in which our academic partners, Nobel Laureates and young researchers, all have a joint stake. Needless to say, cross-cultural dialogue should contribute to a more peaceful world, but what we try to do is provide a better understanding. Thanks to our partners we have a chance to get closer to our goal. The rest is on the shoulders of the participants and their exchanges.



Director-General Suleiman Al-Herbish (right) and Nikolaus Turner sign the cooperation of OFID and the Lindau Meetings.

Nikolaus Turner has been a member of the boards of both the council and the foundation for many years. Besides being the treasurer of the council and the managing director of the foundation, he is also instrumental in the on-going development of our strategic worldwide network of academic partners and in fostering the relations with our supporters.

Academic Partners

**66 THE PARTICIPANTS OF THE
62ND LINDAU NOBEL LAUREATE MEETING
WERE INITIALLY NOMINATED BY THE FOLLOWING
109 INSTITUTIONS FROM 33 COUNTRIES—
AND BY 18 NOBEL LAUREATES.**

Academy of Finland
Academy of Sciences Malaysia
Academy of Sciences of the Czech Republic
acatech-German National Academy of Science and Engineering
Alexander S. Onassis Public Benefit Foundation
Alexander von Humboldt-Foundation
Australian Academy of Sciences
Austrian Federal Ministry of Science and Humanities
AutoUni Volkswagen AG
Bangladesh Academy of Sciences
Bavarian Academy of Sciences and Research
Bielefeld University
Brandenburg University of Technology Cottbus
Brazilian Academy of Sciences
Chilean Academy of Science
COMSTECH
Consejo de Estado Cuba
Croucher Foundation
Danish Agency for Science, Technology and Innovation
Ministry of Science and Technology, India
Deutsche Bundesstiftung Umwelt
Deutsche Telekom Foundation
Elite Network Bavaria
Estonian Academy of Sciences
European Commission
European Molecular Biology Laboratory
European Molecular Biology Organization
European Organization for Nuclear Research
Fondazione Cariplo
Foundation for Polish Science

Fraunhofer-Gesellschaft
French Atomic Energy and Alternative Energies Commission
Friedrich Schiller University Jena
Gerhard C. Starck Stiftung
German Academic Exchange Service
German Academy of Sciences Leopoldina
German Aerospace Center
German Research Foundation
Goethe University Frankfurt
Heidelberg University
Heinrich Heine University Düsseldorf
Helmholtz Association of German Research Centres
Hertie Foundation
Humboldt University of Berlin
International University of Lake Constance
Japan Society for the Promotion of Sciences
Jordan University of Science and Technology
Justus Liebig University Giessen
Klaus Tschira Foundation
Körber Foundation
Korean Academy of Science and Technology (KAST)
Leibniz Association
Ludwig Maximilian University München
Mars Incorporated
Martin Luther University of Halle-Wittenberg
Max Planck Institute for Biophysics Frankfurt
Max Planck Institute for Nuclear Physics Heidelberg
Max Planck Institute for Physics Munich
Max Planck Society
Mexican Academy of Sciences
Microsoft Corporation
Mongolian Academy of Sciences
National Center for Scientific Research
National Fund for Scientific Research
National Research Fund Luxembourg
National Science and Technology Development Agency

National Science Council
Natural Sciences & Engineering Research Council of Canada
Nobel Foundation
Oak Ridge Associated Universities
Otto von Guericke University Magdeburg
Philipp University Marburg
Preston Institute of Nano Science and Technology (PINSAT)
Robert Bosch Foundation
Royal Netherlands Academy of Arts and Sciences
Ruhr University Bochum
RWE AG
RWTH Aachen University
Siemens AG
Singapore National Research Foundation
Sino-German Center for Research Promotion
Slovenian Academy of Sciences and Arts
Südwestmetall
Swiss Re
Technische Universität Berlin
Technische Universität Braunschweig
Technische Universität Darmstadt
Technische Universität Dortmund
Technische Universität Dresden
The Academy of Sciences for the Developing World
The Association of German Engineers
The Scientific and Technological Research Council of Turkey
The Spanish National Research Council
The Weizmann Institute of Science
University of Augsburg
University of Bayreuth
University of Bonn
University of Göttingen
University of Hamburg
University of Hannover
University of Kassel
University of Konstanz

University of Latvia
University of Leipzig
University of Liechtenstein
University of Malta
University of Regensburg
University of the Republic Uruguay
Volkswagen Foundation

NOBEL LAUREATES

Peter Agre
James W. Cronin
Peter A. Grünberg
John L. Hall
Theodor W. Hänsch
Dudley Herschbach
Walter Kohn
Sir Harold W. Kroto
John Mather
Hartmut Michel
K. Alex Müller
Erwin Neher
Martin Perl
William D. Phillips
Brian Schmidt
George Smoot
Martinus J. G. Veltman
Harald zur Hausen

A Network of Excellence

Andrew Holmes

The Lindau Meetings have established a worldwide network of academic partners. Together they provide the opportunity for young researchers to connect and collaborate—for their own benefit and the sake of global scientific progress.

68 Imagine being part of a scientific community where it takes many hours of flying time to reach another country with a strongly-developed science base. We are the world's largest island and almost the driest continent. Our nation is growing fast. We speak English as a first language, and are hugely multicultural. Our schools and tertiary institutions provide an excellent education, and we publish more than 3 per cent of the world's scientific papers, although we represent only 0.3 per cent (23 million) of the world's population. Our challenge is to stay connected with the world and we can do this in part by joining networks of excellence.

Our challenge is to stay connected with the world and we can do this in part by joining networks of excellence.

The annual Lindau Nobel Laureate Meetings provide access to one such network. About eight years ago the Australian Academy of Science was invited to nominate up to seven candidates to participate in the Lindau Meeting. The consequences of this on-going link have been quite profound.

The meetings and the associated vision of the Mission Education provide a perfect vehicle for inspiring young scientists to discover science, meet their peers and to develop the ambition to carry out

scientific research that might one day earn a Nobel Prize or equivalent award. Scientists with a strong link to Australia have been moderately well represented as recent recipients of the Nobel Prize. Our most recent successes have been in the areas of physiology/medicine where awards have gone to Peter Doherty (1996), Barry Marshall and Robin Warren (2005) and Elizabeth Blackburn (2009). In 2011 astronomer Brian Schmidt from the Australian National University was a co-recipient of the Nobel Prize in Physics. Since 2005 Australian early-career researchers have had the exhilarating experience of hearing the best scientists in the world talk about their research and their wider interests through their participation in the Lindau Nobel Laureate Meetings. They have met peers who will be the scientists of tomorrow in both developed and not-so-developed countries, and they have met like-minded researchers who are passionate about the Mission Education.

At Lindau we have been given vast opportunities to think about our science and to communicate with others. We have been stimulated to be outspoken, yet appreciative of other points of view and we have communicated these ideas with the rest of the world. It has been a privilege to be participants in the recorded interviews with the Laureates as well as to communicate through the outstanding Science Show broadcasts presented

by David Fisher from the Australian Broadcasting Corporation.

What distinguishes Lindau from other scientific meetings? At the simplest level you can attend more than once only if you are awarded the Nobel Prize! More seriously, the opportunity has been provided for young scientists to establish lifelong friendships across the globe that will guarantee connectivity for years to come. In Australia we have learned through experience that our scientific survival depends on being "connected" with the rest of the world. Modern science is essentially a collaborative affair. The most exciting advances are at the interfaces of disciplines, and it is obvious that the best people to work on a particular problem are likely to be drawn from more than one country. And the best ideas are likely to be exchanged in such a forum as the Lindau Meetings. There is good evidence to show that work published collaboratively is likely to be more widely read, as collaborative papers, especially those involving authors from more than one country, are more highly cited. Even more significantly scientists can communicate in environments where political and cultural restraints may hinder similar communications between diplomats and politicians. This notion of "soft diplomacy" is being recognised around the world as an opportunity, and Lindau leads in providing a natural seed for its growth.

The Australian young researchers who will attend Lindau in the next eight years will be supported by Australia's Science and Industry Endowment Fund (SIEF), that was the beneficiary of the revenue arising from important patents in wireless LAN (WiFi) technology. The technology emerged from CSIRO's pioneering work in radio astronomy, and it is fitting that some of the revenue has been re-invested in the Mission Education of young Australians who attend Lindau Nobel Laureate Meetings. It is hoped that in a future year Australia may have the opportunity to celebrate its scientific heritage at a Lindau International Day.

What are the future challenges to be met by the global scientific community at forthcoming Lindau Nobel Laureate Meetings in celebrating the early vision of Count Bernadotte and his colleagues? We in Australia are considering the implications of a government white paper, "Australia in the Asian Century", and through our participation in the Lindau Nobel Laureate Meetings eligible scholars from partner countries in the Asia-Pacific region who are based in Australia will have the opportunity of enjoying the profound experience of participation in a Lindau Meeting. On a broader front should the Lindau Council consider inviting, for example, recipients of the Fields Medal?

In summary, the past participants of Lindau Meetings form the basis of a world-



wide network of excellence that should provide the foundation for increasing scientific and diplomatic collaboration among nations. It would be a fitting recognition of the existence of this group to provide a vehicle for global scientific alliances to allow continuing collaboration across national boundaries. Could host governments outside the EU support applications of their Lindau alumni to participate in EU research programmes and networks on a competitive basis? This would certainly expand and enhance the already very successful research projects funded (largely) in Europe. Whatever emerges we can recognise the fundamental importance of the networking opportunities offered by Lindau Nobel Laureate Meetings to the future careers of participants.

Andrew Holmes is a University of Melbourne Laureate Professor of Chemistry at the Bio21 Institute, a fellow of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and a Distinguished Research Fellow at Imperial College London. He is internationally recognised and acclaimed for his contributions to materials chemistry and its application to energy efficient and sustainable products. In his position as Foreign Secretary of the Australian Academy of Science (AAS), Andrew Holmes has spurred the partnership with the Lindau Nobel Laureate Meetings since 2005 to enable the regular participation of promising young scientists from Australia.

69

Connected and Involved

Max G. Huber

Creating networks of personal and professional contacts is decisive for scientists, especially at the beginning of their careers. The privilege of participating in the Lindau Meetings and joining the community of alumni has a lasting value.

70

It was a bright Sunday morning when I first met the group of about 20 young doctoral and post-doctoral students. Following a personal invitation by the council and by the DAAD, they had come from all over the world to participate in this year's Lindau Nobel Laureate Meeting. Needless to say they all were excited and anxious to personally meet some of the outstanding scientists many of them they had read about in the literature but never met. I had been asked to assist our young colleagues during the meeting. They were bright and eager to attend the official lectures of the Laureates during the morning sessions, to meet the Laureates personally in the afternoon, and to enjoy the social evening events with their truly international atmosphere.

Several decades ago, I had been invited to participate in one of the Lindau Meetings—as a young physics student. “My” Lindau Meeting would become a decisive event in my professional career: for the first time I met Werner Heisenberg, Paul Dirac, Max Born and others—distinct pillars of physics during the first half of the 20th century. They left a deep impact on my life.

This year the first highlight we experienced as a group was a “private dinner” on Tuesday evening in a typical Bavarian Biergarten. It turned out to be a great evening with about a dozen Laureates who came to spend the evening with us.

Both the scholars and the students seemed to enjoy the lively discussion. It was my impression that we talked about all of the relevant problems of science and, obviously, of mankind. In any case we definitely got a somewhat deeper view of our scientific and professional lives.

On the last day, we were all invited on a boat trip to Mainau Island, the private property of the late Count Bernadotte: it was he who inaugurated these meetings right after World War II. Since then the meetings have been organised every summer.

I doubt the participants will ever forget the warm and friendly reception by his daughter Countess Bettina, who takes pride to continue the meetings as her family's legacy. The special atmosphere of this particular excursion, and of the whole week, makes this conference so special. In a perfect way it combines the personal and professional exchange of ideas and experiences between the young and the elder generation of scientists—across all borders. The participants became aware of their opportunities, and at the same time of their individual responsibilities as members of a privileged group, to promote science and preserve our globe for the benefit of generations to come. Clearly, for all our new friends their Lindau experience will have a deep and valuable impact on their future development.

The next day, the participants left Lindau. Most of them started a tour of Germany to meet some of their German friends and to visit universities and institutions they had always heard about. Finally, I too left Lindau, by boat, to leisurely contemplate the past week.

In my pensive mood I tried to imagine how much the world of scholars would miss if the Lindau Meeting had not been invented. It is an ideal occasion for generations of students from all over the world to experience their common responsibilities for the future progress of science—equally important—for peace and for a sustainable development of our world.

During the past 60 years Lindau has become a strong trademark, well-known, and uniquely appreciated by the various scientific communities all over the world. Next year another generation of privileged students will be given the opportunity to personally meet with Nobel Laureates in Lindau. After that week they, too, I am convinced, will leave the charming little town in one of the most beautiful regions of central Europe with new perspectives for their future work. And most importantly with an increased awareness of the chances available to them.

No doubt “Lindau” has become a truly international and intercultural melting pot of both young scientists and successful

scholars. The unique atmosphere of the meeting place favours the informal exchange of ideas and experiences among the participants, and in addition helps to establish distinct personal and professional relations across the traditional boundaries of disciplines, cultures and nationalities. Thus, in a kind of a self-organising procedure a supra-national community of gifted scientists is created each year. The Lindau alumni are united in their common perception of the chances of science and of the challenges of our modern world. It seems to me that such a global network of the Lindau alumni could actively and efficiently promote science, and at the same time help to counter-balance the manmade impact on our natural resources.

The Lindau alumni are united in their common perception of the chances of science and of the challenges of our modern world.

The successful series of more than 60 Lindau Meetings appears as a sound basis for such a global network urgently needed for our fragile world. It is our duty to shape the community of Lindau alumni into a sustainable network of responsible scientists, across all national borders.



Max G. Huber was Vice-President of the German Academic Exchange Service (DAAD) for 16 years until 2012. In his academic career in theoretical physics, he held professorships at the universities of Durham (“Duke”), Heidelberg, Erlangen-Nuremberg, and Bonn where he was rector before joining the DAAD. Back in the 1960s, as a young student of mathematics and physics, Max Huber was selected to participate a Lindau Nobel Laureate Meeting. Today, he is still closely connected with the Lindau Meetings and forms part of a vital network of alumni.

The DAAD is the largest and financially strongest organisation for international co-operation in higher education and academic exchange worldwide—and a long-standing academic partner of the Lindau Meetings. The participants nominated and supported by the DAAD are among the best-qualified young researchers of their home countries.

71

Supporting the Mission Education



From a global perspective, 2012 has been yet another year of financial crisis and uncertainty. This situation directly affects governments, companies, and, due to interest rates, especially foundations and their returns.

Despite this harsh financial environment, the Lindau Meetings fortunately not only managed to maintain the level of funding support, and thus the scientific and organizational quality. Important new outreach projects could also be initiated during the course of the year.

Neither the 62nd Lindau Nobel Laureate Meeting nor the outreach projects in the realm of our Mission Education could have been accomplished without the substantial and extensive support of public authorities, private enterprises and science-promoting institutions and foundations. Generous contributions to the endowment of the Lindau Foundation as well as project-related funding, grants and donations-in-kind have enabled and secured sustainable enhancements in all areas.

FOUNDATION ENDOWMENT

Since 2000, significant contributions to the foundation's endowment have enabled a wide range of activities within Lindau's Mission Education. The foundation would like to thank all endowment members for their trust and engagement.

In 2012 the endowment capital has again been significantly enhanced:

MARS, Inc., one of the Principal Maecenates increased their substantial donation, giving testimony of their commitment to Lindau's Mission Education.

The Maecenates Dr. Ing. h. c. Porsche AG and Bayer AG continued their support with additional contributions to the foundation's endowment.

The OPEC Fund for International Development (OFID) has joined as Principal Patron with a donation to the endowment. Volkswagen AG and Swiss Re have increased their contribution.

McKinsey & Company has finally decided to join as Patron of the Lindau Nobel Laureate Meetings with a first donation to our endowment.

Among the Principal Donors, Merck KGaA and Jacobs Foundation again contributed to the endowment.

We are grateful to welcome Fondazione Fidinam, Alexander S. Onassis Foundation, Peter D. Dornier, Dr. Robert Stolze as well as Dr. AnneMarie Lynen & Dr. Jörn Wilkening as new Donors of our foundation.

We would also like to thank our Donors Boehringer Ingelheim GmbH and Alice & W. Simon Newman for their increased donations as well as their continuous support in 2012.

The board and the Founders Assembly of the foundation look forward to a stimulating cooperation with all our partners around the world to enhance Lindau's Mission Education: Educate. Inspire. Connect.

BENEFACTORS

The 62nd Lindau Meeting has received financial support from a multitude of funders, among them long-term supporters such as the German Ministry of Education and Research, the European Commission, the Free State of Bavaria, and the International Lake Constance Conference. Furthermore, many foundations like the AKB Stiftung, the Gemeinnützige Hertie Stiftung, the Robert Bosch Stiftung, the Jacobs Foundation, the Klaus Tschira Stiftung, and the Deutsche Telekom Stiftung continued their support, as well as companies such as BASF. A fellowship programme for physics students studying in Germany was realised with aid from the Wilhelm und Else Heraeus-Stiftung.

DONATIONS-IN-KIND

Donations-in-kind are equally indispensable as funding means to ensure a high standard scientific meeting. Thus, we are grateful for the invaluable services provided for example by Volkswagen Group, EnBW, JonesDay, Stadtwerke Lindau, Sennheiser, Jura, and others.

CO-HOSTS OF MEETING EVENTS

Involving partners is another successful strategy to organise an eventful and varied meeting week every year. In 2012, the Republic of Singapore hosted the International Day at the 62nd Lindau Meeting by financing and co-organising a science breakfast, a lunch, and a memorable evening get-together with presentations, performances, dinner and dance. As in many past years, the Free State of Bavaria generously hosted the equally well-accustomed Bavarian Evening with presentations, folk dance and music performances, a traditional buffet dinner and local beer. Three additional science breakfasts during the meeting week were hosted, financed and co-organised by the German Cancer Research Center DKFZ, Mars, Incorporated, and SAP AG.

ACADEMIC PARTNERS

Lindau's academic partners have enabled the participation of many young researchers by supporting the application and selection process and covering travel and lodging expenses.

JOINT FORCES IN OUTREACH PROJECTS

Two major projects were at the core of 2012 outreach and will be continued throughout the following years. Our comprehensive multimedia mediatheque is funded by the German Ministry of Education and Research and the Carl Zeiss Stiftung. The exhibition "Sketches of Science", curated jointly with the Stockholm Nobel Museum, will be touring the world, and is funded by the Klaus Tschira Stiftung.

Supporting the Mission Education



The 62nd Lindau Meeting is an edifying and enjoyable event, due in part to the commitment of our supporters. Among them are the Federal Ministry of Education and Research, represented in 2012 by Annette Schavan [1, centre], the Free State of Bavaria, represented at the opening and at the Bavarian Evening by the State Minister of Sciences, Research and the Arts, Wolfgang Heubisch [2, left], as well as the State of Baden-Württemberg, represented on the closing day boat trip to Mainau Island by the Minister of Science, Research and the Arts, Theresia Bauer [3, 1st row left]. The Republic of Singapore, represented by President Tony Tan [4, 2nd from left], hosted the International Day at the meeting. The Federal Republic of Austria, represented by the Federal Minister for Science and Research Karlheinz Töchterle, invited all participants to a concert of the Vienna Philharmonic Chamber Orchestra in Lindau's city theatre on the opening day [5].



Ursula Piëch, Member of the Supervisory Board, and Ferdinand K. Piëch, Chairman of the Supervisory Board, Volkswagen AG, at their arrival upon the meeting's opening (right) [1]. The Volkswagen Group provided a VIP car shuttle service [2], the coffee facilities were presented by the Swiss company Jura [4], and bottled water was made available by EnBW [5]. Telekommunikation Lindau provided fully equipped computer working places and facilitated the wireless internet access throughout the meeting week [3].

The Key to Unlocking Future Growth: Investing in Research

Robert-Jan Smits

Global challenges like energy security, climate change and ageing populations call for joint action. Bringing together the best scientists and researchers to tackle these issues is a crucial step towards sustainable solutions.

76 Europe has a long-standing tradition in the field of research and innovation, which is demonstrated by a broad and strong technological and research base with a skilled workforce, world-leading universities and first-class research intensive companies. Indeed, Europe is the second biggest spender in research, is the world's largest employer of researchers, and produces nearly double the number of doctorates as the US. We are the world's leading producer of scientific publications and have a third of the world's patent applications. Europe also has a globally competitive industrial backbone particularly in chemicals, pharmaceuticals, transport equipment, electrical and optical equipment and machinery, and a high share of knowledge-intensive exports. Investment in research and innovation has brought prosperity and well-being to Europe; and this should be a lesson for the future.

Investment in research and innovation has brought prosperity and well-being to Europe; and this should be a lesson for the future.

However, it is true that Europe's economy is going through a tough time. We also have other challenges: energy security, climate change and ageing populations, to name but three. We need our best brains to tackle these issues, come up with innovative solutions and invent new products and services that will bring us future growth and jobs. In other words, we need to turn the European Union into an Innovation Union. This requires designing policies that create truly top-class incentives and framework conditions for entrepreneurs: potential game-changers for growth and job creation.

To name just a few action points: an EU-wide unitary patent will reduce costs to protect inventions by as much as 80 per cent. Swifter access to standard setting will bring new ideas faster to the market. Public procurement will be used more intelligently to support innovative solutions. Soon Europe will have an EU-wide venture capital passport, and we are on the right track for the completion of the single market. In addition to these initiatives, Europe also needs to step up its investments in research, both at national and European levels.

The EU member states have set themselves the common goal of raising combined public and private investment in R&D to 3 per cent of GDP. In 2010, the EU average was 2 per cent. So more needs to be done,

and the Commission is putting its money where its mouth is. Horizon 2020, with a proposed 80 billion Euro budget over seven years, will bring together all existing EU research and innovation funding. It will provide support in a seamless way from idea to market, with streamlined funding and less red tape. Horizon 2020 embodies many of the specific commitments made under our Innovation Union flagship initiative. It is structured around three distinct but mutually reinforcing pillars.

The first pillar is aimed at boosting excellence in basic research. A proposed investment of over 24 billion Euros will enable the most talented scientists to carry out cutting edge research of the highest quality. This includes more than 13 billion Euros for the very successful European Research Council, securing the best fundamental research that leads to the greatest innovations.

The second pillar on 'Industrial Leadership' strives to make Europe a more attractive location to invest in research and innovation, by funding actions where businesses set the agenda. A dedicated budget of nearly 18 billion Euros over the next seven years will include major investment in key technologies, greater access to capital for innovative companies and specific support for SMEs.

The third pillar on 'Societal Challenges' has a proposed budget of nearly 32 billion Euros to help address major concerns shared by all Europeans, and indeed world-wide. These include climate change, making renewable energy more affordable, ensuring food safety and security, better healthcare and coping with the challenge of an ageing population.

Europe is rightly focusing huge efforts on fiscal consolidation, but we must ensure that this is smart fiscal consolidation, with measures that will produce jobs, growth and competitiveness today and tomorrow. Cutting spending in areas such as education, research and innovation would be exactly the wrong thing to do. Horizon 2020 is the Commission's response at the European level, and should be seen as an economic policy measure as much as a research policy instrument. We need the support of policymakers and stakeholders across Europe for Horizon 2020, and for our other initiatives under Innovation Union.

The Lindau Nobel Laureate Meetings, which the Commission is proud to support, are an excellent initiative to bring stakeholders together. The meetings allow established and aspiring researchers to meet and exchange experience, knowledge and views, ensuring that the best ideas can be used in a way that makes a real difference across our continent, and beyond.



In his position as Director-General for Research & Innovation at the European Commission, Robert-Jan Smits (left, with Annette Schavan and Bill Gates in Lindau 2011) is responsible for developing and implementing the European research and innovation policy. The European Commission is a key partner and major supporter of the Lindau Meetings. President José Manuel Barroso has been a member of the Honorary Senate of the foundation since 2009.

The Challenge of Balancing Tradition with Innovation

Pamela Mars

Ever since the Lindau dialogue was established more than 60 years ago, it has involved and captivated generations of scientists. The Mission Education, to sustain and enhance the vital exchange of knowledge, deserves long-term support.

78 For more than 60 years, Lindau has been at the forefront of nurturing the transfer of knowledge among generations of scientists. Through growth and evolution, the founders' vision of advancing science through collaborations between Nobel Laureates and young researchers remains as relevant and vital today as it was at the inaugural Lindau Nobel Laureate Meeting in 1951. Lindau's commitment to education, inspiration and connection continues to help it address these key challenges of how to bring together generations of scientists, marry tradition with innovation, and ensure societal relevance.

These are challenges shared by Mars. As a private, family-owned company, we also think in terms of generations. Our original objective as a business, laid out by my grandfather in 1947, was to create a mutuality of benefits for all of our stakeholders through our success. This legacy has evolved over time to include our Five Principles—Quality, Responsibility, Mutuality, Efficiency and Freedom.

By delivering on these principles, we have been able to build a sustainable business that can make a difference to the challenges we share with society. But we realise that to remain a leading food business we must also address significant future challenges: in particular the need for more quality, nutritious food that is sourced and manufactured in a way that protects and restores our environment. These are big,

complex issues that require sophisticated responses of equal scale. Without transformative and uncommon collaborations across generations of scientists, we will not have the innovation necessary to tackle them. This is why we are so supportive of Lindau.

Lindau's continued commitment to the Mission Education has enabled it to successfully address the challenge of how to connect generations and therefore maintain its relevance in today's environment. Through the dedicated and thoughtful stewardship of the Council for the Lindau Nobel Laureate Meetings, the Lindau Foundation and Countess Bettina Bernadotte, the Mission Education continues to evolve and be translated into new ideas. The launch of the mediatheque—an online archive of multimedia content from over 60 years of Lindau Meetings—exemplifies how the meetings are bridging the gap between their history and future.

Since the first meeting on the shores of Lake Constance, Lindau has acted as a catalyst for interdisciplinary dialogue and interaction.

Of course, there is no greater evidence of Lindau's relevance today and its contribution to the future of science than its meetings. Since the first meeting on the shores

of Lake Constance, Lindau has acted as a catalyst for interdisciplinary dialogue and interaction. I was fortunate enough to experience this first-hand at the 60th anniversary of the meetings in 2010 when I had the pleasure of engaging with 59 Laureates and more than 675 young scientists from all scientific disciplines. The scale, diversity and quality of the 2010 interdisciplinary meeting had a great impact on me personally, and increased my appreciation for the kinds of partnerships that are possible with like-minded, principles-driven organisations and individuals.

We are proud to be a key supporter of Lindau and participate in this truly unique forum. Looking back at its development over the last half century, I am confident that the Lindau Meetings will continue to address the challenge of how to evolve, and be a catalyst that advances the scientific collaborations that benefit society—realising the vision of the meetings' spiritus rector, Count Lennart Bernadotte.

In the course of Mars, Incorporated's long-standing commitment to Lindau and as a major supporter, board member Pamela Mars (right, during the donation of cocoa trees at the "Discoveries: Water" exhibition in 2009) has gained an in-depth insight into the nature of the Lindau Nobel Laureate Meetings. As a respected and trusted adviser and mentor, Pamela Mars was inducted into the Honorary Senate of the foundation in 2008.



Since 2010, Mars has hosted science breakfasts at the Lindau Meetings. Last year, the Mars science breakfast featured a panel discussion between the Nobel Laureate Dudley Herschbach (2nd from left), the researcher Amanda Peters Randles of Harvard University (2nd from right), and scientist Chris Nagel of Continuum Energy Technologies (right), moderated by Adam Smith, the editorial director of Nobel Media (leftmost).



Broadening the Dialogue

Debates & Impulses at the
62nd Lindau Nobel Laureate Meeting

80

81



Nobel Laureate Peter A. Grünberg at the
"Little Scientists' House" in Lindau in 2008

Education for Sustainable Development

Robert M. Solow

Sustainability—a concept indispensable to the viability of societies—is constantly on the agenda of the broader Lindau dialogue. It is the subject of one of the greater debates recurring at the meetings on the natural and the economic sciences.

82

J.M. Keynes famously remarked that economists are not the guardians of civilization, but they are the guardians of the possibility of civilization. He did not have the question of sustainability in mind, but the very same thought would apply equally there too. The actual achievement of a sustainable way of life depends on the decisions and actions of many individuals, organisations, and public and private institutions. But there is no natural or obvious indicator of sustainability that can be directly observed. It is not easy to know whether the current state of affairs is or is not sustainable. Economists can first contribute to an analysis of what it means to conduct production, consumption, depletion and accumulation in a sustainable way, then define how a society can try to measure whether it is behaving sustainably, and then explain what feasible actions would contribute more or contribute less to the achievement of a sustainable development path. Much thought has already been devoted to these questions by Partha Dasgupta and others, and more thought and research are needed. The questions are complex, and useful answers may differ significantly from one region of the world to another.

These remarks already imply one connection between education and sustainable development, and even suggest a possible role for the Lindau Meetings. The gatherings of excellent young economists are

a natural locus for discussion of the main issues in the evaluation of alternative paths of economic development and their implications for sustainability, along with the need for adaptation of any framework for measurement and evaluation to diverse local conditions.

The Lindau Meetings of excellent young economists are a natural locus for discussion of the main issues in the evaluation of alternative paths of economic development and their implications for sustainability.

It is sometimes taken for granted without further thought that sustainability is an important issue only for advanced and already emerging economies. They are, after all, the current main source of depletion of non-renewable natural resources, the main polluters of air and water, the main contributors to climate change. But some economists have argued convincingly that very poor communities are often driven by ignorance, perverse incentives, and the standard “tragedy of the commons” to behave in ways that may be rational for them in the short run but destructive of their meager natural-resource base in the long run.

A standard example is that deforestation in pursuit of firewood leads to the washing away of topsoil on hilly ground, and eventually to the destruction of needed agricultural capacity. Here we see another set of connections between education and sustainable development. One branch leads to the testing of simple incentive schemes and their effects on behaviour, in the manner of Abhijit Banerjee and Esther Duflo; another branch leads to the preparation of textbooks and course materials oriented toward the problems of sustainability in poor economies, and suitable for training local academics and professionals. Lastly, let me mention an altogether different way in which education can affect the prospects for sustainable development. Excessive increase of population is often a major threat to sustainability in poor economies. Experience suggests that the education of women (and perhaps of men) leads not only to greater economic opportunity for women and their families, but also to reduced fertility. Economic development is thus promoted, and lower fertility adds a direct bias in favour of sustainability.

There are two common challenges faced by any attempt to allow ideas to make a practical difference in social life. One is to overcome inertia and the resistance of vested interests. The other is to get the ideas right in the first place. The possibility of energising and mobilising a group of

the best young economists from all over the world offers a way to meet both of these challenges, and one hopes that the special circumstances of Lindau can help.

IMPULSES

Laureate Professor Robert Solow has been committed to the Lindau Nobel Laureate Meetings and their outreach for many years. In 2004, the first Meeting of the Winners of the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel was held. Paul Samuelson provided the impulse to add economics as a forth discipline to the Lindau canon. Robert Solow, Samuelson’s colleague at MIT, supported this endeavour from the start. The 5th Lindau Meeting on Economic Sciences will take place in 2014.

A current project aims at attracting pupils aged 16 to 18 to economic sciences during a formative phase of their lives. It is supposed to introduce them to economics and its importance to understanding the mechanisms which influence our daily lives. 17 Laureates in Economic



Sciences have joined, contributing original articles to the book titled “Economics for the Curious”, edited by Robert Solow, which is due for publication in early summer 2013. With sustainability being among his prime research interests, Robert Solow has also laid the foundations for a new initiative, “Education & Sustainability”, which the Lindau Meetings will focus on in the coming years.

The 1987 Laureate of the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel, the so-called Nobel Prize in Economics, Robert Merton Solow is particularly known for his model to determine the causes of economic growth. In his long scientific career, Professor Solow has also made important contributions to the development of natural resource economics and in the field of macroeconomics.

83

The Real Pioneers

Gabriela Dür

It is largely up to teachers to wake a fascination for science and research among young people. The Lindau programme Teaching Spirit makes an important contribution to inspire and motivate especially committed teachers.

84 In a knowledge-based society, great importance attaches to education, science and research. These are a prerequisite for the continuing successful and positive development of society, for safeguarding technological progress, economic growth and thereby prosperity and quality of life. Education has frequently been described as the most important resource of the 21st century. Therefore, our society must pay particular attention to educating children and young people, who must be prepared to meet the considerable challenges of the future. They not only require an ever-increasing fund of specialist knowledge, but also certain key qualifications to enable them to be successful in an ever more complex world and lead an independent life.

Given the social, economic and ecological challenges with which our society is confronted now at the beginning of the 21st century, it is incumbent upon us to communicate to our children and young people the educational content with which to actively and creatively overcome these challenges and problems. To do so, we need good schools and above all good teaching staff. As the results of the PISA assessment impressively demonstrate, the rankings are dominated by those countries in which teachers enjoy high esteem in society and thus also among their students.

This in turn requires that the teachers of tomorrow receive the best possible preparation for their difficult task, and that in general only the best candidates are admitted to training. But what distinguishes the best candidates? If we consider that students, in the course of their school days, are steadily losing the curiosity and motivation required, in particular to tackle subjects like mathematics and the natural sciences—something which scientific studies prove—it becomes clear that besides an in-depth subject knowledge and pronounced social skills, teachers also need one gift more than any other: they must be able to fill their students with enthusiasm for their subject.

It is nowadays a necessity to make every effort to spark young people's enthusiasm for science and technology.

For many countries, it is nowadays a necessity to make every effort to spark young people's enthusiasm for science and technology in order to improve their career opportunities. Sadly, in many cases, both the business and political communities are also lacking in interest in the MINT subjects (mathematics, informatics, natural sciences and technology). These are the very mathematical and scientific subjects that offer students the best opportunities in the most promising careers of the future.

Teachers of these MINT subjects have a key role to play. It is their task to imbue students with a fascination for subjects that are apparently dull and perceived as difficult, and arouse their curiosity to explore natural scientific phenomena.

Of course teachers need wide-ranging support: on one hand, through continuous training, but also in the form of appropriate aids which will help them to make lessons attractive, student-friendly and interesting, as well as to communicate the content graphically. In this context, initiatives such as the Teaching Spirit programme launched by the Council for the Lindau Nobel Laureate Meetings with the support of the Vodafone Foundation, as well as the mini lectures, in which Nobel Laureates summarise complex subjects in a manner understandable to school and university students and interested laymen, are deserving of particular recognition. They are unique of their kind, and they provide a great enrichment for both teachers and their lessons.

The Teaching Spirit programme offers committed teachers the opportunity to make personal contact with Nobel Laureates and share in the spirit of the Lindau Meetings, which annually attract around 600 young scientists from across the world, and communicate this enthusiasm for the natural sciences to the schools and classrooms in the region around Lake Constance.

The initial, highly positive reports from teachers who have taken part in the Teaching Spirit programme give cause to hope that this valuable initiative can be expanded and made available to many other teachers.

The International Conference at Lake Constance has set itself the goal of making the region around Lake Constance an “attractive and competitive centre of education, science and research of international high-standing”. The outreach initiatives undertaken by the Lindau Nobel Laureate Meetings have an important contribution to make. Successful initiatives must meet the highest quality standards; they need a constant supply of new ideas, strong networks and a high level of commitment on the part of supporters and sponsors. The meetings of Nobel Laureates will, without doubt, successfully master these challenges, now and in the future.



From left: Jürg Zumtobel, Chairman of the Supervisory Board of Zumtobel AG, Jakob Brunnschweiler, Chairperson of the International Lake Constance Conference (IBK), and Gabriela Dür at the dinner hosted by the foundation at the 62nd Lindau Meeting.

In her position as chairperson of the Commission for Education, Science and Research of the IBK, Gabriela Dür is a permanent guest at the meetings of the Lindau Council. Having worked as a teacher for German and English in earlier years, Gabriela Dür now heads the Department of Science and Further Education of the State Government of Vorarlberg in Austria. The IBK has been an important supporter of the Lindau Nobel Laureate Meetings for many years and is constantly being involved as a strong partner in educational initiatives like the impulse programme Teaching Spirit.

Impulses for Education

86 TEACHING SPIRIT

Young people cannot become science and research enthusiasts in one single day. This requires the continuous dedication and work of teachers at schools—every day. Those who teach and inspire our youth lay the foundations of our knowledge society. Teaching Spirit is an impulse programme conceived to value the role and work of excellent teachers of natural sciences.

The programme was launched as an initiative in 2011 and continued successfully last year. In recognition of their outstanding efforts and achievements in teaching natural sciences in class and in extra-curricular projects, 14 teachers from Germany, four from Switzerland, and one each from Austria and Liechtenstein were invited to attend a full day of the 62nd Lindau Nobel Laureate Meeting. Joined by Nobel Laureate Harald zur Hausen, the participants took the opportunity to discuss innovative educational strategies and exchange their didactic experiences. Teaching Spirit will henceforth be an integral part in the programme of the Lindau Meetings.

SUPPORTERS & PARTNERS OF TEACHING SPIRIT

Vodafone Foundation Germany

German Philologist Association (DPHv)

Karlheinz Beckurts Foundation

Deutsche Telekom Foundation

Little Scientists's House (Stiftung Haus der kleinen Forscher)

Jugend forscht

International Lake Constance Conference (IBK)



DIDACTIC TOPIC: RESEARCH-BASED LEARNING

In the course of the programme, Klaus Peter Haupt of the Albert Schweitzer School in Kassel gave a presentation on research-based learning in regular school lessons. He referred to the Student Research Centre North-Hesse of the University of Kassel to exemplify the importance of extra-curricular commitment of teachers and to show how students can be inspired for science. Haupt advocates a didactic approach that promotes the autonomy of learners. Students should be trained to acquire skills and knowledge by themselves.

PARTICIPANTS OF TEACHING SPIRIT 2012

Margrit Eismann, Regelschule "Johannes Dixel", Seebach

Stefanie Eller, Freie Universität, Berlin

Fritz Epple, Liechtensteinisches Gymnasium, Vaduz

Mario Hartmann, Sekundarschule Gelbhausgarten, Schaffhausen

Joachim Hoffmüller, Luitpold Gymnasium, München

Martin Hölzel, Gymnasium Olching

Stefan Joost, Oken-Gymnasium, Offenburg

Jürgen Kaletta, Otto-von-Taube-Gymnasium, Gauting

Birgit Kraut, Wilhelm-von-Humboldt-Schule, Berlin

Andreas Lichtenberger, Kantonsschule Glattal, Dübendorf

Ursula Meisinger-Schmidt, Wolfgang-Kubelka-Realschule, Schondorf

Viola Mandler, Innerstädtisches Gymnasium, Rostock

Klaus Muthsam, Welfen-Gymnasium, Schongau

Monika Neumayer, Bildungsanstalt für Kinderpädagogik, Feldkirch

Dmitrij Nikolenkov, Kantonsschule Trogen

Wolfgang Pils, Kantonsschule Im Lee, Winterthur

Christina Roeckerath, Couven Gymnasium, Aachen

Martin Stübig, Hegau-Gymnasium, Singen

Stefan Wentzel, Matthias-Claudius-Schule, Bochum

Kerstin Zobel, Georg-Cantor-Gymnasium, Halle



Nobel Laureate Harald zur Hausen (3rd from left) and Thomas Ellerbeck (right), spokesman of the council and board member of the foundation, took the opportunity to honour Stefan Wentzel, Stefan Joost, Margrit Eismann and Martin Hölzel (from left) who had previously been awarded the "Deutscher Lehrpreis", a prize for outstanding German teachers, founded by the Vodafone Foundation Germany.

How to Advance Innovations

Henning Kagermann

One of the challenges for the development of the Lindau Meetings is to broaden the range of issues and dialogue partners. The Innovation Forum has the potential to establish a strategic discourse on the enhancement of innovations.

88 Since 2010, Nobel Laureates have met with business executives in Lindau to discuss how to advance innovations at the interface of science, industry and society. I very much appreciate this activity and have had the honour to be the co-chair of the Innovation Forum in 2012. To intensify the exchange between science and business is of vital importance and there are very good reasons why this exchange has become an integral part of the Lindau Meetings over the last few years.

The Innovation Forum raises the awareness of the significance of an intersectoral dialogue among global leaders from science, business and society.

The Innovation Forum raises the awareness of the significance of an intersectoral dialogue among global leaders from science, business and society. It becomes evident that—although completely unforeseen in most cases—the results of research often offer the basis for innovations that are not only successful on the market but provide solutions for societal needs. In the modern “knowledge society” innovations have become the critical driver for economic growth as well as social welfare.

The Global Risks Survey 2012 of the World Economic Forum finds the following global risks to be among the most important over the next ten years: extreme volatility of energy and agricultural prices, rising green-house gas emissions and failure of climate change adaptation, water supply and food shortage crises, mineral resource supply vulnerability. Global primary energy consumption is expected to increase by 26 per cent by 2030, while renewables will be the fastest-growing resources. Some important scarce resources like indium and gallium that are used in LEDs, LCDs and OLEDs, for example, may already be fully depleted by 2030.

Furthermore, the increasing demand for energy and scarce resources mean increasing environmental concerns and concerns about consumer acceptance. It is quite clear that “more of the same” solutions will not help. In fact, incremental and especially breakthrough innovations are needed to increase supply and substitute materials or sources of power, as well as to increase efficiency and reduce demand.

The challenges are to manage the increasing economic, technological and environmental risks and to ensure the resilience of values—but also to capture new business opportunities like cleantech, which has a huge global market potential. To handle the risks and opportunities, combined with the global challenges, we will depend on new insights that can be transferred

into applications. Breakthrough innovations based on science and technology will play a crucial, though unpredictable part.

Consequently, it is not surprising that numerous countries have utilised the shock of the economic crisis to enhance their innovative capability. The crisis of the past years underlines the importance of innovations as the basis for successful and sustainable economies. The former dominant positions of traditionally strong R&D countries decline down rapidly, particularly in those areas that are relevant for the future in general, and especially with regard to the newly-industrialised countries and developing nations. At the same time, it becomes apparent that national innovation policies must take into greater account the changes that are caused by new forms of application-oriented innovation processes, the development of global values and converging technologies. Additionally, non-technological, user-driven innovations, particularly in the service sector, become increasingly relevant.

The great importance of innovations for the global challenges as well as for the successful economic development of states or regions makes it necessary to establish national and international platforms to enhance innovations across the different sectors. In Germany, for example, this is the task and aim of the National Academy of Science and Engineering (acatech),

the presidency of which I am co-chairing together with Reinhard Hüttl. Acatech serves as a platform for relevant stakeholders from science, business and politics to share knowledge and to coordinate actions. As an independent and trusted advisor for society and politics the academy helps to advance innovations for sustainable growth. In my view, it is getting more and more important to have international platforms for a strategic discourse on the enhancement of innovation. Well-established institutions like the World Economic Forum in Davos are important. It is crucial, however, that additional platforms around the world focus on innovation, like the Science and Technology in Society Forum recently held in Kyoto or the Innovation Forum in Lindau.

It is the right message that an Innovation Forum is part of the Lindau Nobel Laureate Meetings to foster the exchange among science, business and society. The reputation and the charisma of Nobel Laureates is extremely helpful in order to raise awareness. It should be continued and perhaps even expanded by integrating different scientific disciplines including the social sciences. As excellent young researchers play an important part in Lindau, the Innovation Forum should encourage them to reflect on the creative potential of their research. To enable them to do that, they should have an active part in the Innovation Forum in the future.



Henning Kagermann [1], professor for theoretical physics, is one of the two presidents of acatech, the German National Academy of Science and Engineering, which represents the interests of the German scientific and technological communities and is determined to support the knowledge transfer between science and industry. Professor Kagermann was inducted into the Honorary Senate of the Lindau Foundation in 2006. He chaired the Innovation Forum at the 2012 Lindau Nobel Laureate Meeting jointly with Nobel Laureate David Gross.

Inspiring the Next Generation

Mariette DiChristina

A Scientific American feature about 30 participants of the 2012 Lindau Meeting, has contributed to sanitise the public image of scientists. Intriguingly skilled and motivated young researchers are the role models of modern science.

90 As John F. Kennedy, a former president of the United States, once said, “Children are the world’s most valuable resource and the best hope for the future.” I’d like to add: the best hope for those children to create a better world in the coming years is science.

The food we eat. The clothes we wear. The building materials that shelter us. The tools we use. All of these—and many other things—were invented and improved through the rational process we call science. In fact, as Gerard Piel, a past publisher of Scientific American, put it, “The most remarkable discovery made by scientists is science itself.” Simply put, science is humankind’s best invention yet for pursuing the truth and an understanding of how the world works. It lets us test our assumptions, gather observations and confirm the results.

Science is also the engine of modern prosperity, powering economic growth in an increasingly globalised world. In addition, when you look at the world’s most pressing problems, from feeding the hungry, to creating enough energy for a growing population sustainably, to curing the desperately ill, science is the way forward.

But there’s a problem. Not everybody understands or appreciates the value of basic research, and how it can lead to advances in fundamental knowledge and our general societal well-being.

In many countries few people have even met a scientist. That leads to some mistaken assumptions—which turn kids away from science. As studies show, if you ask US students, for instance, to draw a picture of a scientist, they will create an image of a stereotypical wizened old white man with wild hair—and they do not see themselves ever becoming that person, that researcher. Without role models, youngsters don’t know that scientists can look like anyone, even young people like them, and that the jobs of researchers are very intellectually stimulating and exciting. Many times, they don’t get drawn in to science.

Without role models, youngsters don’t know that scientists can look like anyone, even young people like them, and that the jobs of researchers are very intellectually stimulating and exciting.

This inspiration gap is a challenge for the Mission Education, and a reason that Scientific American, as part of the Nature Publishing Group, has collaborated with the Lindau Nobel Laureate Meetings for several years to create several public-outreach programmes.

This year, as part of our Lindau efforts, Scientific American added a new programme that we’re especially proud of,

called “30 under 30.” Our idea was simple. We knew that many young scientists from around the world have enjoyed the rare privilege of communing with the Laureates during the Lindau Meetings each year. We also knew that many more later have enjoyed the wonderful video lectures added to the Lindau Mediatheque.

But those young researchers are already interested in their respective disciplines. They already know the power of science to improve the world. What about the younger people? How can they see that they, too, might like to be a researcher someday—or to work in a field related to science?

With the cooperation of Lindau, we selected a set of young scientists to profile in 2012, which was a year focused on physics. We ran the first annual “30 under 30” stories leading up to the meeting. We learned about how awed the participants felt by the fields they study: “One of the grandeurs of physics, I find, is its rigour and the close bond between theory and experiment,” said Arnold Mathijssen of the Netherlands in one comment. We learned about their heroes. We learned about them as people, too. They told our audience their hobbies, from opera singing to sailboat regatta sailing, from rock climbing to piano playing, and from piloting planes to cooking.

We found the warm response to “30 under 30” gratifying and plan to continue it next year. In addition, Scientific American continues its other Lindau-related activities. These include a special section in the printed edition, following the theme of the annual meeting. The report provides a collection of fascinating excerpts of past articles written by Nobel-Prizewinning Scientific American authors, along with a summary of the current key questions in the field. Last, we bring a lot of social media attention to the meeting, with our 470,000-plus Twitter followers and thousands of Facebook and Google+ followers as well.

We are also grateful to the Lindau Nobel Laureate Meetings team for supporting Scientific American’s educational initiatives by, for instance, letting attendees know about our 1,000 Scientists in 1,000 Days program, which matches volunteer scientists with teachers in the US who would like a visit to the classroom to inspire the children about science.

As the old African proverb goes, it takes a village to raise a child. As every parent who’s ever watched an infant explore his or her world knows, youngsters are born curious experimenters: scientists! Now it will take everyone in the global “science village” to help support and foster their explorations, so that the world will continue to benefit from the energetic, creative minds of young scientists in the years to come.



Mariette DiChristina has been a science journalist for more than 20 years. In her position as editor-in-chief, she oversees Scientific American, ScientificAmerican.com, Scientific American Mind and all newsstand special editions. The first time she came to Lindau was in 2010 to attend the 60th meeting that saw the record number of 59 participating Nobel Laureates—hence the photo with Arno Penzias (left) and George Smoot (right).



“30 under 30”, ScientificAmerican.com

6 Young Scientists, 6 Different Stories

Matthias Schöbe

As the editor of their video diaries, Matthias Schöbe accompanied six participants throughout the meeting. The project attests to the diversity of the young researchers and their different interests and backgrounds.

92 Heather Gray from South Africa is part of the ATLAS experiment research team at CERN. She certainly knew well in advance what was going to be announced by Rolf-Dieter Heuer, Director General of CERN, on 4 July 2012—which became an especially memorable day for everyone gathered at the 62nd Lindau Nobel Laureate Meeting.

The palpable excitement that prevailed all over Lindau those days led Heather to devote her video diary to the dynamics that developed as the news of the presumed discovery of the Higgs boson was finally released. Using a simple camcorder, Heather captured impressions from the audience that watched the live-stream of the CERN press conference. She interviewed a number of participants and commented on the news herself. Heather's approach is an excellent example of what the video diary project which I coordinated is all about: very diverse participants are asked to tell the story of their individual Lindau experience and share it with fellow young researchers from all over the world, to give them the opportunity to get an impression of what it is like to participate in one of the science world's most prestigious meetings.

Since the project was initiated three years ago, 48 self-made videos by 20 young researchers from 13 countries have been produced at the past three Lindau Meetings on natural sciences. As of today, these

videos have generated 19,400 hits on the YouTube channel of the Lindau Meetings—an outstanding success for a project that proved to be quite challenging on several levels. But despite all the challenges—geographic, physical and technical—excitement about taking part in the Lindau Meeting was up from the moment the participants started filming. And this is by far the most important guarantor of success of the video diary project: the participants' never-ending enthusiasm and their endeavour to connect and interact with others and share their Lindau experience.

Our core aim is to enhance the participants' opportunities to share their experiences with the global research community.

Even though all of the video diarists were physicists, they were more diverse than one might expect. Six quite different people were chosen out of 41 outstanding applicants. Ghada Bassioni of the Ain Shams University in Cairo conveyed what it is like to be a woman in the male-dominated world of physics. Ghada lived and studied in Germany for many years, but her perspective on the matter was not unambiguously affected by her socialisation in a predominantly Islamic country. She was notably anxious to disprove the widely spread prejudice that women have to

struggle harder to manage a successful career. Heather Gray proved to be a keen observer when covering the Higgs boson excitement—probably due to her professional acquaintance with this scientific news. Albert O. Juma from Kenya, engaged in research at the Helmholtz Centre for Materials and Energy in Berlin, managed very well to contrast the research environment and resources of his developing home country versus the situation in developed Germany, to demonstrate the different working conditions for young scientists and researchers. Pascal Neibecker, a fellow of the Elite Network of Bavaria, was eager to explain how his participation in Lindau would affect his career as a researcher. He talked with several Nobel Laureates about balancing work and life and dealing with setbacks. P. Harshavardhan Reddy of the University of Hyderabad discussed with fellow young researchers from China and the US whether science and research can actually contribute to the growth of developing countries. For him it was very surprising to find out that the situation is not all black-and-white, and that the similarities in every-day laboratory life in developing and developed countries are quite strong. Last but not least, Casey Schwarz from the University of Central Florida thought about the responsibility of scientists for society. She interviewed several young researchers and Nobel Laureates and discussed the repercussions of science in society.

The video diary project has been immensely exciting for the Executive Producer and Media Consultant Eric May and me. Since we have been entrusted by the organisers of the Lindau Meetings to work together so closely with some of the most promising young researchers from all over the world, we have truly become part of Lindau's Mission Education. Our aim is to enhance the participants' opportunities to share their experiences with the global research community. At the same time, we are convinced that video diaries of participants serve as the most authentic testimonials to the dedication, qualification, and diversity of the meetings' participants. Thus, we would be glad to take on the challenge to further advance the project. With around 550 young researchers from up to 70 countries participating each year, there are so many different stories to tell. Select participants could be accompanied by professional film teams while producing their individual video diaries before, during and even after the meeting. The project has the potential to attract much interest of TV and online media. The video diaries are produced by science enthusiasts in order to connect with others, and to inspire others.



1st row: Heather Gray, Albert O. Juma; 2nd row: Nora Johnson [not a video diarist], Casey Schwartz, Matthias Schöbe, Ghada Bassioni, P. Harshavardhan Reddy Media technician and consultant Matthias Schöbe is specialised on video production. He has attended the past three Lindau Meetings on natural sciences to coach and accompany small groups of select participants on their mission to produce their own individual video diaries during the meeting week. The resulting videos are as diverse as the young scientists who volunteered for the project.



Please find the videos diaries along with other videos and films in the YouTube channel of the Lindau Meetings.

Science Communication under Construction

Beatrice Lugger

In the digital science 2.0 era it is a challenge for scientists to be heard and understood. The new media provide a wide range of opportunities for sharing information within the scientific community and with the public.

94 Brian Schmidt, Nobel Laureate in Physics, is one of them: he is @cosmicpinot, a twitterer. His tweets are read by more than 5,000 followers—and certainly he tweeted during the Lindau Nobel Laureate Meeting in 2012. “I like the ability to tell the world what I see as interesting and relevant—all in a form which I can do with very little overhead on my time”, the cosmologist and astronomer says. Nobel Laureates who tweet—who might have guessed this five years ago?

We need highly-qualified journalists who investigate, criticize and classify, and scientists who are willing and able to explain what their findings are.

Apart from the offline world with science cafes, public dialogues and open days, the online world today provides a wide range of opportunities for scientists to communicate. The Lindau Meetings, which are outstanding in supporting the exchange of ideas and knowledge between young researchers and Nobel Laureates, have a tradition in the use of new media. The meetings' website gives lots of background information and the great archive in the mediatheque invites everyone to click through history. In 2008 the meetings launched their first official blog, which

today is the centrepiece of the interactive home of the meeting, the community site lindau.nature.com. And one might expect further uses of new media in the future as scientists, diverse technologies and internet-based tools offer new means of scientific methodology, publication, assessment and, not least, communication.

First one must mention the fundamental change in the way scientific research is published. “Open Access” is the key word. This way of publishing is not only promoted by huge scientific academies and foundations, they even launch their own. An example is eLife, an open-access journal for research in life science and biomedicine started in December 2012. eLife is supported by the US Howard Hughes Medical Institute, the Max-Planck-Society based in Germany and the British Wellcome Trust. Almost certainly open-access journals, with their technological benefits such as the opportunity to make available all experimental data, how-to videos or 3-dimensional structures, will succeed. Even Philip Campbell, the editor-in-chief of Nature, one of the world's premier and traditional scientific journals, said in June 2012 that open access to scientific research articles will “happen in the long run.”

Many new and helpful platforms make it much easier for scientists to share ideas, papers, data or figures and even negative findings. Science social networks like

Academia.edu attract more than two million academics. Another two million scientists and more than 200,000 research groups use the library Mendeley.com for better collaborations. The classic social media is also of interest. One in 40 scholars was active on Twitter with an average of five tweets per week in the year 2012. Scientists tweet and write blog entries not only privately; they also write about their own research, and comment and link to recent publications.

The combination of publications, social media activities, data sharing, data repositories, pre- and post-publication discussions, videos, patents and including the numbers of downloads, interactions, likes, re-tweets and more, lead to a never-before known transparency of the sciences, and scientists themselves. Content, previously restricted only to specialists, is now available to a wider audience. Altmetrics—alternative metrics that include all these activities—will give a detailed picture of how certain findings have influenced society.

Especially in this new era of transparency there is a growing need for scientists to communicate with lay people, and take part in public debates about scientific findings and movements. In a survey by the European Commission 63 per cent of the interviewees named scientists working at universities or governmental labora-

tories as best qualified to explain the impact of scientific and technological developments in society.

Researchers today are not aware of this. Too many of them still believe that only journalists should take care of the communication about science to the public and “translate” what scientists do: a clear misunderstanding. What we need are highly-qualified journalists who investigate, criticise and classify. And we need scientists who are willing and able to explain what their findings are. Especially, when everyone can click through experimental data and interpretations, we certainly need clear role models for all involved in science communication.

For Brian Schmidt, who obviously possesses natural communication talents, his twitter activities are a reaction of give and take: “Since I rely on twitter to find out what is happening, I figure I owe it to the collective twitter-world to do my own part.” As the Lindau Meetings are at the cutting edge so far, I am wondering whether they will promote the tremendous potential the meetings have in the science 2.0 era of transparency: how, further on, to transfer the real life meetings in Lindau, with their open dialogues among generations of scientists from all over the world and their interdisciplinarity, into long-lasting, online conversations and networks.



Beatrice Lugger has been a consultant for the social media activities of the Lindau Nobel Laureate Meetings since 2008. In her position as the Deputy Scientific Director of the German National Institute for Science Communication, NaWik, she aims to address the situation for scientists by offering science communication courses for them—writing, presenting, social media and more.



The Lindau Nobel Community—
the interactive home of the Lindau Meetings

Communications

Given the diversity and subject matter of the programme and the reputation of the participants, the 62nd Lindau Nobel Laureate Meeting was a hotspot for science journalists from all over the world. More than 150 journalists from around 30 countries attended the various sessions, thereby confirming the trend of the previous years that public attention for topics and people in science and research is growing perceptively.

PRESS COVERAGE WORLDWIDE

The 2012 Lindau Meeting was covered by newspapers and magazines throughout the world—among them:

- American Physical Society, US
- Berner Zeitung, Switzerland
- Corriere della Sera, Italy
- Der Standard, Austria
- El Economista, Mexico
- El Tiempo, Colombia
- Eureka, Russia
- La Crónica de Hoy, Mexico
- Neue Züricher Zeitung, Switzerland
- Physics World, UK
- Pravda, Russia
- Scientific American, USA & China
- The Economist, UK
- The Hindu, India
- The Star, Kenia
- Times of India, India
- Xinhua, China
- Bild Zeitung, Germany
- Die Welt, Germany
- DPA, Germany
- Frankfurter Allgemeine Zeitung, Germany
- Handelsblatt, Germany
- Lindauer Zeitung, Germany
- Stuttgarter Zeitung, Germany
- Süddeutsche Zeitung, Germany

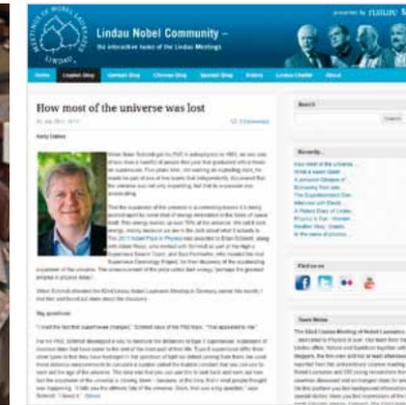
INTERNATIONAL TV & RADIO COVERAGE

Several television broadcasting services from different countries were accredited at the 2012 Lindau Meeting. In addition, film footage of the meeting was provided to broadcasters around the globe to enable international TV coverage.

- Astro Aswani, Malaysia
- Channel News Asia, Singapore
- Euronews, France
- Indagando TV, Spain
- ORF, Austria
- Tecnopolis TV, Argentina
- Bayerischer Rundfunk (BR), Germany
- Deutsche Welle TV, Germany
- Deutschlandfunk, Germany
- Südwestrundfunk (SWR), Germany
- 3sat, Germany

TIES WITH SCIENCE JOURNALISTS ASSOCIATIONS

The Lindau Nobel Laureate Meetings cooperate closely with science journalists associations like the European Union of Science Journalists Associations (EUSJA), the Arab Science Journalists Association (ASJA) or the US National Association of Science Writers (NASW). Our efforts to establish and maintain these ties have again yielded international journalistic coverage of our meeting in 2012.



ONLINE FOCUS: LINDAU NOBEL COMMUNITY

In the course of our long-standing partnership with Nature Publishing Group, we have put a special focus on online communication and social media to establish the Lindau Nobel Community at lindau.nature.com—our online platform for everyone interested in science and research. As in the years before, the site featured the official blog of the 2012 Lindau Meeting with articles in English, German, Spanish, and Mandarin (Chinese), videos, photos and links to a multitude of online contents including our posts and tweets on Facebook and Twitter.

lindau.nature.com

FACEBOOK ACTIVITY

Our Facebook site has just recently reached a new milestone by having more than 4,000 followers. Participants of past Lindau Meetings and those looking forward to participate in up-coming meetings visit our site to reminisce about their experiences, to share various contents, or to keep in contact with each other. We actively use this channel to provide useful information on the Lindau Meetings and spread educative or entertaining contents.

www.facebook.com/LindauNobelLaureatesMeeting

SPECIAL SUPPLEMENT IN FAZ

The distinguished Frankfurter Allgemeine Zeitung covered the entire Lindau Meeting in a special 8-page editorial supplement headed “Zukunftslabor Lindau” (lab of the future) that received notable attention throughout Germany. Centred on the presumed discovery of the Higgs boson, the supplement further covered vital aspects of the other two major topics of the meeting, cosmology and energy issues.

NATURE OUTLOOK DEDICATED TO MEETING

The worldwide acclaimed science magazine Nature dedicated an edition of its supplement Outlook to the 62nd Lindau Meeting. Entitled “Physics Masterclass”, the supplement “celebrated the spirit of the Lindau Meeting” and looked in more detail at meeting issues like the expansion of the universe and dark energy. Mirroring the culture of dialogue prevailing at the Lindau Meetings, this Nature Outlook featured a conversation in letters between two keen astronomers, the Nobel Laureate John Mather and the Australian postdoctoral researcher Minnie Mao, about observations in space. Furthermore, the supplement contained five Q&A articles—five sets of questions posed by young participants and answered by Nobel Laureates. Along with a multitude of other contents, these Q&As can also be read online on the official website of the Lindau Nobel Community.

NATURE VIDEO SERIES CONTINUED

Like the years since 2008, Nature Publishing Group has again sent a film team led by Martin Freeth and Charlotte Stoddart to the Lindau Meeting in 2012 to produce five educational films, each one starring select participants, Nobel Laureates and aspiring young researchers. Nature filmed their debates on five of the most demanding questions in physics today: Is dark matter real? How can we solve the looming energy crisis? How is physics perceived by the public? How can we test our ideas about the Universe? And is this the golden age of astronomy? All films of the 2012 series “Confronting the Universe” as well as all film series of the previous years can be viewed online.

www.nature.com/lindau

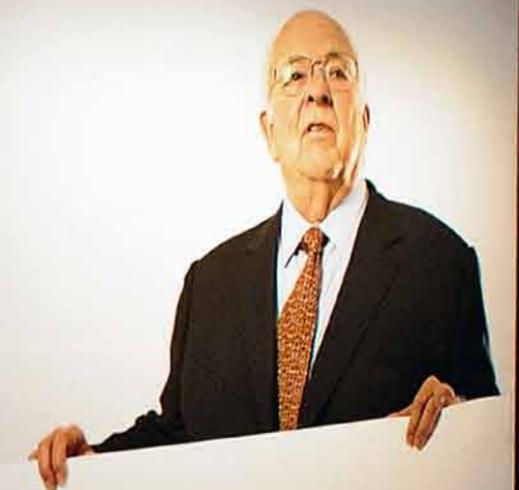
SCIENTIFIC AMERICAN FEATURES 30 PARTICIPANTS

No less than the globally-recognised magazine Scientific American decided to prominently feature a group of 30 promising young scientists who participated in the 2012 Lindau Nobel Laureate Meeting. They were each introduced with an individual profile that provides first-hand information on their research interests, their expectations, their role models and their view of physics, now and in the future.

Beyond Lindau

Public Outreach Projects

98



99



Why Reach Out? Continuity and Change in Lindau’s Mission Education

Wolfgang Schürer & Wolfgang Huang

The Lindau dialogue serves as a catalyst of the exchange between science and society. As the paradigms of society change and the systems within are in flux, our continuous endeavour is to adapt the Mission Education to the overall context.

100 The founding fathers of the Lindau Nobel Laureate Meetings had clear ideas as to what the defining elements of the Lindau dialogue should be. In the year 1951, two Lindau physicians and city councillors, Dr. Franz Karl Hein and Dr. Gustav Wilhelm Parade, still deeply affected by the harrowing experiences of World War II, were determined to make their own contribution to the reintegration of Germany into the European scientific landscape through a European Meeting of Nobel Laureates to be held in their city.

This was the moment at which the Lindau Meetings were born. Just two years later, Count Lennart Bernadotte, the grandson of King Gustaf V of Sweden, who was approached by the two city councillors, changed the scope of the meetings with the addition of a second significant component: on his initiative, for the first time—and from then on— young scientists were invited to engage in an exchange of ideas with the Laureates.

This programme—at once European and international, imbued with direct social relevance, committed to mutual understanding between nations and characterised by the cross-fertilisation of knowledge, inspiration and exchange— has been the hallmark of the Lindau Nobel Laureate Meetings for more than six successful decades. The Green Charter gave testimony to Count Lennart’s

dedication of what is today known as the principle of sustainability.

Since the year 2000, the newly-established Foundation Lindau Nobelprizewinners Meetings at Lake Constance has served as both a financial anchor and a catalyst for ideas. It has become the essential impetus in bringing the legacy of the founding fathers up to date and adding new emphases: a gender balance, internationalism and an exchange of ideas among and across generations, nationalities and cultures, an emphasis on excellence and interdisciplinarity, and a focus on issues of social relevance, particularly sustainability.

The task of the boards of the Lindau Meetings is to give contemporary form to the substance of the Lindau dialogue, ensuring its relevance for the future.

This principle is timeless: the task of the boards of the Lindau Meetings is to give contemporary form to the substance of the Lindau dialogue, ensuring its relevance for the future. Over the past 60 years a fundamental and continuing shift has been taking place within every aspect of society, and nowhere more than in the field of science. Evidence of this change

can be found and retraced in the Lindau Mediatheque (mediatheque.lindau-nobel.org), which features science lectures by Nobel Laureates from a century of research, allowing a fascinating, deep insight into science history.

It is worth mentioning—in brief and abridged—some of the changes that have taken place in the scientific landscape over the past 60 years. The image of the scientist working alone in his or her laboratory may never have been more than an ideal, but it remains a stereotypical view of science to this day. Yet when it comes to cutting edge research, we are now more likely to encounter large research groups which may number over 1000 participants. Consider for example the team headed by John Mather (see page 106) at the Goddard Space Flight Center, or the research team at CERN who made such an important breakthrough in particle physics in 2012. The work at CERN is an impressive example of the international character of modern research. Even though scientific discourse has long transcended national borders, integrating an international group in a joint research project presents a great challenge. Still the collaboration within national traditions of scientific excellence holds a potential that far outweighs the sum of the parts.

There are also conflicting trends to be observed as specialisation in a chosen field rubs shoulders with increasing inter-disciplinarity. Far from being a paradox, this correlates to the necessity of remaining open to other branches of science, even as research becomes more and more specific. Only in this way can research results bear fruit in other fields. Interdisciplinarity in the form of continuous critical scrutiny of one’s own methods is an important element in addressing one of the principal concerns of modern science: the reduction of complexity. In an environment awash with data and information, two of the most important tasks of science in its attempt to make sense of the world are to acquire knowledge and understanding, and then to reflect on them. To these tasks one may also add the exposition of scientific results, which in an open society constitutes a valuable source of legitimacy of science.

In some ways, the world today may be flat—but this serves only as an indication of the diverse cultural and cognitive maps. It is essential to bear this in mind as the scientific dialogue with an initial European focus goes global. The Lindau Meetings seek to treat these differences seriously: the dialogue between generations has been extended, bridging various cultures. However, this is not the only aspect where the Lindau Meetings are adapting to change.

In implementing their strategy of continuing development, the council and the foundation are constantly working to keep the meetings a forum for scientific debate firmly anchored in a social context. This is achieved through various means, such as the science master classes, choosing topics of current relevance, and streaming the scientific programme on the Web. The global impact of the Lindau dialogue is strengthened through a network of academic partners, international guest nations and media activities that extend to every continent in the world.

The outreach programme aims to communicate the spirit of Lindau to society at large, above and beyond the space and time restrictions of a one-week conference.

Interdisciplinary meetings at intervals of five years are a firmly established part of the Lindau canon. Nevertheless, the annual mono-disciplinary meetings are increasingly providing a forum for interdisciplinary issues, not to mention reflections on the achievements, and limits, of science. Interchange extends beyond the natural sciences to embrace the social sciences and humanities as well. Topics relating to science and society are on the agenda, with issues of sustainability

providing a central theme, in continuation of the tradition begun by Count Lennart.

There is also the outreach programme which aims to communicate the spirit of Lindau to society at large, above and beyond the space and time restrictions of a one-week conference. Society at large stands for all of us, across the world. This outreach is unique, bringing credibility to the meetings to facilitate and nurture a committed discussion. One of the essential motivating factors behind this programme is the desire to generate interest in the importance of the natural sciences—in education, research and technology—in order to prepare our societies for the future. The economist Albert O. Hirschman once described the pleasure scientists take in research as “the happiness of pursuit”. Our desire is to let others share this pleasure.

The principal components of the outreach programme currently include:

- the mediatheque, which encompasses a century of scientific history in modern media form, presented in highest scientific standards and available online to all, free of charge;
- numerous exhibitions at the interface of science, art and society, such as the “Nobel Portraits” by Peter Badge, Volker Steger’s “Sketches of Science” and the “Discoveries” series of themed exhibitions;

101

- the Teaching Spirit programme, which not only gives teachers the opportunity to experience the “spirit of Lindau”, but also enables them (through specially developed aids) to incorporate it in their teaching;
- the Innovation Forum, which strengthens the link between fundamental and applied research;
- the Lindau Alumni Network, currently under development, whose full potential has not come close to being fully exploited.

Looking ahead to the coming years, the following areas of emphasis are emerging:

- During his speech “The Role of Education and Health for Peace” in autumn 2012, Nobel Peace Laureate José Ramos-Horta called upon the Lindau Meetings to pay more attention to peace (the fifth discipline for which Nobel Prizes are awarded), and not shun this demanding, complex, and all-the-more-necessary area of debate. The council and the foundation intend to take up this challenge, with the knowledge that this is a task which demands a particular sense of responsibility.
- Education and the significance of education have long been a defining feature of the meetings. Structuring the content of the meetings—and of the Lindau projects—calls for a reflective understanding of the sustained effects of education, as does the issue of how

these effects are themselves achieved. Making a substantial contribution to the discussion on education and sustainability is another challenge we intend to embrace in the coming years.

We are convinced that science now and in the future can help humankind to escape from its “self-inflicted state of immaturity”, and thus is fundamental for a modern, open society wishing to profit from the prosperity that education brings. We also firmly believe that through the inspiring power of dialogue, the Lindau platform and the Lindau initiatives can contribute to “science diplomacy” and hence to a more peaceful and promising world of tomorrow.

The continuing development of the Lindau dialogue between the generations and the new outreach initiatives are dedicated to the same goals. They are both a token of appreciation for the Laureates and an acceptance of trusteeship. The objective of the outreach programme is not just to preserve this legacy, but to disseminate it. The exclusivity of the meetings and the breadth of the outreach are two sides of the same coin; their effect is thereby multiplied. On one hand, the Lindau alumni carry the spirit of the meetings out into the world as ambassadors. On the other hand, school and university students, teachers and lecturers and interested members of the public are invited to be inspired by

Nobel Laureates. Both act as catalysts for the exchange between science and society.

Trusteeship includes keeping the legacy up to date.

Trusteeship includes keeping the legacy up to date. We remain committed to the objectives that were the hallmarks of the meetings in the 1950s. They serve as a continuing incentive and obligation to the on-going development of the meetings and their outreach.

MEDIATHEQUE

- Laureate lectures from more than 60 years science history
- Web Streams
- Mini Lectures
- Topic Clusters
- Educational Videos

INNOVATION FORUM

- Nobel Laureates meet company chief technology officers
- analyses of future trends and developments
- exchange between science and industry

EXHIBITIONS

- science meets art
- broad target audience, easy access
- Nobel Portraits
- Sketches of Science
- Discoveries

SCIENCE COMMUNICATION 2.0

- Multi-language blog
- Twitter, Facebook
- Nobel Labs 360°
- Alumni Network

TEACHING SPIRIT

- Workshop programme for teachers
- Online teaching materials
- strengthening natural sciences education

PUBLICATIONS

- on the meetings
- on science & society
- on Nobel Laureates
- on education & sustainability



The outreach programme of the Lindau Nobel Laureate Meetings skillfully combines several components to a greater whole. Only the perfect interplay enables the necessary synergies to effectively reach a broad audience on many levels of society.

Discovering Treasures

Anders Barany & Wolfgang Huang

Mapping the rich history of scientific exchange in Lindau, the mediatheque provides countless connecting points to the major baselines and developments of contemporary science and research. A continuous extensive review and optimisation is in progress.

104 At the time of writing in December 2012, the mediatheque of the Lindau Nobel Laureate Meetings contained roughly 1,500 items, and more are being added every week. These items are divided into six groups: meetings, Laureate profiles, abstracts, videos, pictures, and topic clusters. If someone would open up every document and spend just two minutes on each, it would take about one week of full-time working hours. In addition, listening to all the lectures recorded as videos or presented as slide shows with sound files would add yet another five weeks.

These simple estimates identify one of the main challenges for the mediatheque: how to direct the interested visitor to special documents and topics of interest? A first step on the way to meet this challenge has been taken during the past year: the introduction of topic clusters. The first two clusters, on cosmology and sub-atomic particles respectively, went online just before the 62nd Lindau Nobel Laureate Meeting, and allowed in-depth preparation for participants. Consisting of short texts with links to lectures (or parts thereof) presented at the Lindau Meetings, they are complemented with so-called mini lectures. Together, they form an introduction and a link to another 50 lectures available in the mediatheque. More topic clusters are currently under development and in production, such as

“X-Ray Diffraction”, “Carbon”, “Molecules of Life” and “Life of Proteins”, as well as “Science, Ethics and Society” and “Currency in Crisis”. One of the challenges will be to lift as many of the hidden treasures as possible and illuminate cross-links, while at the same time avoiding too much overlap.

The mediatheque aims not only at an exclusive target group of university students and researchers, but also at a broad audience.

The mediatheque aims not only at an exclusive target group of university students and researchers, but also at a broad audience. For example, a school-teacher might want to use some of the lectures in the mediatheque for his students. Looking for interesting lectures, the teacher will very soon find that some are much too difficult for the students. With more than 250 lectures to choose from today, the teacher might very well give up before locating suitable lectures. So another challenge for the mediatheque is to find a way of categorizing the lectures, making it easier not only for the school-teacher, but also for the interested surfer, to find suitable ones.

The new mini lectures will become another important tool for teachers and pupils: they will combine the most interesting parts from different lectures into one educational video piece (approx. 8–12 minutes in length), enriched with didactic narration and vivid, yet precise, animations. Topic clusters and mini lectures will be designed with usage in schools as well as with modern “consumer behaviour” in mind: They provide yet another path of (easy) entry. Cooperation with selected expert partner institutions and authors will ensure the high (didactic) quality.

In the early years of the Lindau Nobel Laureate Meetings most lectures were presented in German. This was no problem at the time, because most students and young researchers then came from German-speaking countries. Today, English is by far the dominant language at the meetings. In order to make the historic parts of the mediatheque available for today’s meeting participants and visitors from all around the world, many of the lectures need to be transcribed and translated. Work in this direction has already begun; the challenge is to reach the target of around 500 lectures being available in German and English within the next two years. This will also include full transcriptions, which make scientific work, research and citations so much easier. Plus, we intend to add more languages, such as French, Spanish, Arabic or Chinese.

The current general technical environment for developing and running a rich web application with high bandwidth demand and yet rather limited resources is certainly a challenge of its own. The past few months have seen the rapid decline of technologies that have been reliable multimedia web standards for many years, especially Flash. Next up is a discontinuation of Java plugins by many browsers.

The current mediatheque is based on Microsoft’s Silverlight technology, which is a proprietary framework as well, and unfortunately not fully supported on Unix and most mobile device operating systems. Our analyses show that currently 87 per cent of the mediatheque visitors may access it without problems, leaving another 13 per cent with an unsatisfactory experience, or no access at all. The next major version of the mediatheque will offer at least partial access to these users. We also intend to develop a version that is accessible on all operating systems and all devices, without choosing the wrong path of particularisation by designing many different short-lived apps. In summary, the challenge is to provide full access to all users without diminishing the richness of features, and with the limited resources available.

mediatheque.lindau-nobel.org



[1] Anders Barany (leftmost next to John F. Nash and Edward Prescott at the 4th Lindau Meeting on Economic Sciences, in 2011) is chairman of the board of editors of the Lindau Mediatheque and has consulted the Lindau Council on the development from its very beginning. He is a member of the Royal Swedish Academy of Sciences and has served as secretary of the Nobel Committee for Physics and as vice-director of the Nobel Museum, Stockholm.

[2] Wolfgang Huang is director of the executive secretariat of the Council for the Lindau Nobel Laureate Meetings; he is also executive producer of the Lindau Mediatheque.

Learning by Viewing— Nobel Labs 360°

John C. Mather

In a world abundant with information and entertainment offers it becomes ever more challenging to excite widespread interest in science and research. The project Nobel Labs 360° comes up with a technically innovative and enjoyable approach.

106 First of all, my thanks to the Lindau Foundation for their inspiration and leadership in sharing the excitement of scientific discovery with the public and with future scientists! I have had the pleasure of twice participating in the Lindau Meetings, and recently worked with the Nobel Labs 360° project to show how we are building the world's greatest telescope yet, the James Webb Space Telescope (JWST).

For the future, I see the greatest challenges for all the sciences as continued public outreach and inspiration.

For the future, I see the greatest challenges for all the sciences as continued public outreach and inspiration. Outreach, so that the public knows why we are doing what we are doing, and what difference it makes for them today, and in the long-term future. Who knows what our destiny may be? It could be glorious, or not, depending on how we all behave. Inspiration, so that the most creative and inquisitive minds can pursue the scientific and engineering discoveries that are at the heart of so much of human prosperity, health, and progress. And, of course, national and local security depends on those discoveries too; scientists have been working with “the government” throughout recorded history.

At the Lindau Nobel Laureate Meetings, we get a truly abundant supply of knowledge and excitement, through the interactions of young scientists with the Nobelists, and through the lectures and video recordings we can now share with the whole world via the internet. But with seven billion inhabitants on earth trying to earn a living and have some fun, there are plenty of competing opportunities and demands on us all. How can we draw attention to our efforts at Lindau?

These days, word of mouth has become word of (computer) mouse, and ideas propagate across the internet. Our challenge is to find and match those interests, so that the efforts of our scientists, photographers, moviemakers, and writers are rewarded by the public. The world changes every day, so there is no one way to go, and everything is an experiment. Sounds scientific, yes? I think our partnership with Volker Steger in the Nobel Labs 360° is one of the most interesting I have seen. Computer viewers can see the scientific habitats of us Laureates and begin to experience being there in person, panning up, down, and all around, and seeing or hearing explanations of what we are doing. I was photographed in my office and in the giant clean laboratory where we are building the James Webb Space Telescope. It's an extraordinary thing to be there; the number of people who will go there is probably less than a hundred, but well over a thousand engineers are

designing the telescope, 10,000 astronomers will use it, and billions of people will see what we find with it.

Here at NASA we are experimenting with social media. Our experts tend to be much younger than the Nobelists, but we have huge numbers of followers of JWST and the Hubble Space Telescope on Twitter and Facebook, and I did a Reddit AMA (ask me anything) that was very popular too. We are clearly seeing rapid evolution of the social media.

Is the Nobel Labs 360° a success? I certainly think so technically; I love panning around the labs that are online already, and clicking on the links to explanations. Our Goddard Space Flight Center photographer, who worked with Volker, wants to get one of those cameras so we can do too these kinds of immersion presentations. My only worry is whether this is being followed by the young scientists who come to Lindau, and by the rest of the world. Measuring this is difficult, but it is important to know who is following us and how we can serve them as well as we can.

Here in the US, I heard Dean Kamen (the famous inventor of the Segway and many other things) talking about why he started the FIRST robotics competition. Titled “The Varsity Sport for the Mind,” the competition draws on the natural desire of young people to compete and be rewarded for it. Billions

of people follow professional sports, so why not do something that excites that degree of interest in science and technology? Kamen told us there is an ample supply of scientific and engineering information already, that what we need is more demand. His robotics competition does something about it, as do the various science and mathematics Olympiads around the world. Perhaps the Lindau Meetings' efforts can tap into that same competitive process. People already know the Nobel Prize as a competition, but it seems out of reach for them personally. Nobel scientists are sometimes seen as a bit like extraterrestrials, far from the comprehension of ordinary humans. If we could share our lives and our perspectives more widely, that would be a great challenge, with a great reward.

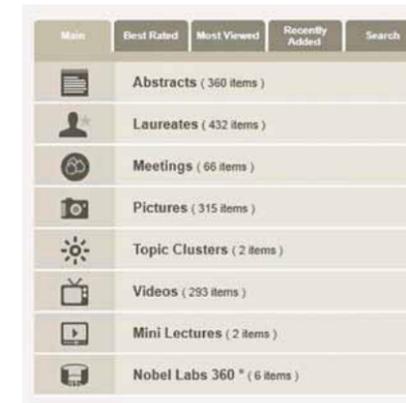


107 John Cromwell Mather was awarded the 2006 Nobel Prize in Physics jointly with George F. Smoot for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation. Their work was based on measurements made by the COBE (Cosmic Background Explorer) satellite launched by NASA in 1989. Since 1995, Mather has been the senior project scientist for the development of the James Webb Space Telescope at NASA. His fascinating workplace (picture: a 360°-spherical photo of his office) can be discovered online at the interactive multimedia site “Nobel Labs 360°” produced by the photographer Volker Steger in cooperation with the Lindau Nobel Laureate Meetings.

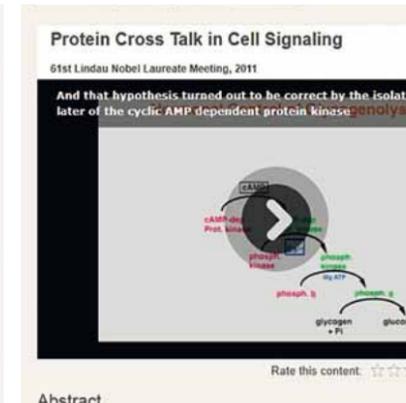


Nobel Labs 360°

The Mediatheque & Nobel Labs 360°



User-friendly menu navigation



Transcriptions of lecture videos



Educational mini-lectures

108 Two of our outreach projects are especially designed to convey information and knowledge in a compelling and entertaining way: our online mediatheque and the application Nobel Labs 360°.

The mediatheque meets highest contemporary demands for comprehensive information retrieval. But it is more than a multi-media archive of extensive contents that requires a targeted search; its various educative features facilitate the processing of the information stored.

The Nobel Labs 360° have been conceived to offer something different from the common means of knowledge transfer. Information search might not be the primary motivation to dwell on the diverting and entertaining images and films combined in the individual presentations of Nobel Labs 360°; but the playful interaction with the contents is almost casually highly educative.

THE LINDAU MEDIATHEQUE

Sharing the excitement and inspiration of the Lindau Nobel Laureate Meetings and staying tuned in to the topics discussed is significantly facilitated by our revised mediatheque. It contains video and audio recordings of the numerous lectures and panel discussions of the past 61 years, as well as profiles with short CVs and portraits of all Nobel Laureates who have been to Lindau. Furthermore, the programmes of past meetings, abstracts of lectures, and background information have been diligently compiled to complement this multimedia treasure trove. Significant progress has been made in providing English translations of the predominantly German contents of the early years of the meetings.

TOPIC CLUSTERS

Improving the convenience of the Lindau Mediatheque is an on-going project. A new editorial concept is being gradually applied to restructure all contents and install “topic clusters”. This basically means that all thematically related contents will be cross-linked to allow users to detect their requested information with just a few clicks. The contents of two of the major topics of the 62nd meeting, particle physics and cosmology, have already been clustered accordingly. This demands the continuous work and dedication of three editors.

MINI LECTURES

Adding so-called mini lectures to the mediatheque is yet another editorial concept put into practice. These videos provide the most relevant and essential information on select scientific topics in a compact format. Thus, they serve as introductions to the related contents available in the mediatheque for further and more detailed occupation. The mini lectures are also aimed at users who are unfamiliar with their topics, or not even scientists— school pupils, for instance.

The mediatheque is accessible online to anyone interested in science worldwide— free of charge. Senior scientists, young researchers, academic tutors, secondary school teachers, and students alike may access the mediatheque for information research or simply to engage in the scientific debates held in Lindau. Meeting participants can use the mediatheque contents to prepare themselves for upcoming meetings or to recollect and review memories and impressions of past visits.

mediatheque.lindau-nobel.org

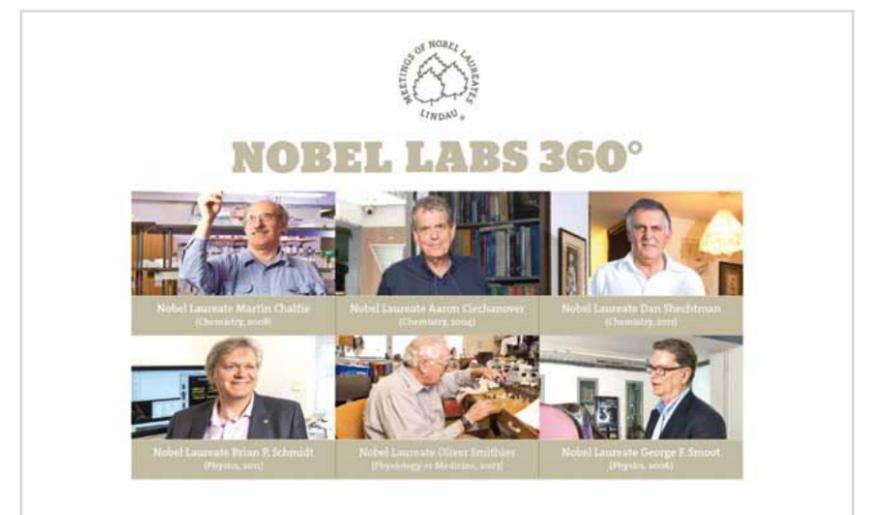
NOBEL LABS 360°

Nobel Labs 360° is a unique and unprecedented science communication project that merges portraiture, explanatory science journalism and 3D-like interactivity into a single experience—both educational and entertaining. State of the art technology was applied to combine 360° spherical panoramic photos with videos, images and text elements. The project closes the gap between photography and film in a multi-media context. The Nobel Labs 360° can be displayed in web applications, on personal tablet computers, or on large touch screens in museums or exhibitions.

Until today, seven Nobel Laureates have invited the photographer Volker Steger to visit their laboratories or working places to take 360° photographs and record short videos. The Laureates, their colleagues and staff gave interviews to present their labs and elaborated on their research projects, and they granted Volker Steger very personal insights into their lives as researchers. With all this multi-media information combined, research becomes truly vivid in Nobel Labs 360°— and the people behind it come to the fore.

Volker Steger’s 360° spherical panoramic images are generated from multiple photographs. Viewers can virtually move around in the depicted labs and surroundings to explore them in detail. This interactive experience is enhanced by embedded additional information like photos, video clips or audio files. Users can virtually access several rooms or locations of the Laureates’ labs and take a “panoramic lab tour” that is compelling, fascinating and educative all at once.

nobel-labs.lindau-nobel.org



The Challenge of Communication

Sir Richard Timothy Hunt

Owing to the manifold forms of expression of art, two distinctly different photo projects supported by the Lindau Meetings master the challenge of getting across why scientists and researchers are so fascinated about their work.

110 Every year there is a special meeting in the little town of Lindau on Lake Constance where Nobel Laureates get together and meet with young scientists. In most years, Laureates are invited from a single discipline—physiology or medicine, physics, chemistry, and economic sciences. Every so often, however, an interdisciplinary meeting allows Laureates to meet each other. So physicists can mingle with biologists, which otherwise rarely happens (even in Stockholm).

The main difference between art and science is the difficulty of communicating something beautiful.

Sadly, the early death of Pierre-Gilles de Gennes, a physicist with a great gift for studying apparently simple things that are hard to explain (like the stickiness of jam), deprived me of the chance to meet him at one of these “special” Lindau Meetings. He wrote a beguiling book I much admire called “Soft Interfaces”, about friction mainly, at the end of which he appended a charming note about scientific style, with comments about the differences between art and science. The main difference, he suggests, is the difficulty of communicating something beautiful. Any passer-by can appreciate the lovely tune played by an Indian flautist in Bogota, and it might stick in their head for ages. But only those who

have followed a long and highly-specialised apprenticeship can appreciate a beautiful new result in soft-matter physics. De Gennes also remarked on photography, which (as he points out) brought about a deep change in painting, but revealed the difficulty in extracting an impression from a particular image.

As you enter Lindau, you are confronted with enormous blown-up, black-and-white pictures of Nobel prizewinning scientists taken by Peter Badge. At first, these portraits don't look like much. They don't appear to have any particular style. Some are formal, some informal. Indoors, outdoors, close-up faces, whole figures, smiling, frowning, fixing the camera with an intense stare and in one case, even the face is hidden (albeit by another photograph which may or may not be a picture of the scientist as a younger man). It would be hard to guess, by looking, which were writers and which theoretical physicists. Go into the town and you will find swarms of young scientists, often clustered round a Laureate, curious to discover what they are like, perhaps with a faint, even an unconscious hope that something might rub off.

My peers and I growing up (scientifically) in Cambridge were exceptionally lucky. Nobel Laureates were thick on the ground there, and some of them even gave us lectures. One of them barbecued a lamb, Argentinian style. We learned, if we kept

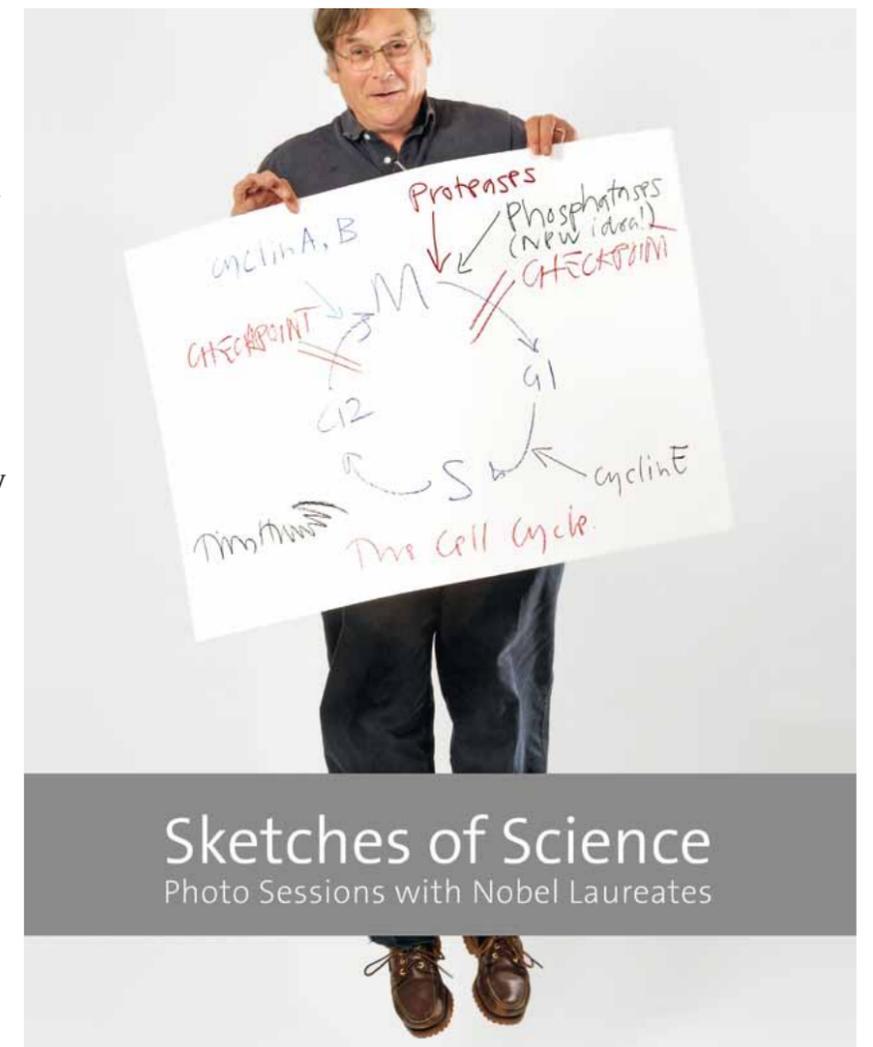
our eyes open and our wits about us, that there was little in common among these people apart, perhaps, for a serious respect for Nature and perhaps a shade of humility towards Her. Also a significant desire, in most cases, to keep it simple.

Clear understanding was more important than cleverness. One hopes that the Lindau experience goes some way to providing similar insights. The Laureates lecture, discuss, and eat with the students and everyone seems to be pretty happy. It isn't quite the same; there was more distance in Cambridge, and I certainly didn't dare approach one of these godlike figures until I was older and more experienced as a proper scientist.

Whereas Peter Badge has photographed, “collected” one might say, every single living Nobel Laureate including Nobel Peace Laureates, economists and authors, another photographer, Volker Steger, focuses exclusively on the scientist Laureates, mainly working at Lindau itself from a simple studio with a plain white background with pictures in colour. He doesn't explain his project until his victim enters this room. It's a challenge: given a large blank sheet of paper and some marker pens, please explain the discovery that won you the Nobel Prize, and then hold it up for the camera. Wow! Not so easy, and it's amusing to see how the various Laureates responded. Some wrote a page of

equations, others simple little diagrams, one simply a mouse, another even a blank sheet. Some Laureates hop, or stand on one leg. Some lie down, others sit on the floor. The majority smile, as if they enjoyed the exercise, but the challenge of communicating what is clear in your own head to someone else's mind is extremely difficult. It goes back to the business of the Columbian flautist, for whereas music can speak directly to the soul, almost regardless of cultural background, nationality or language, scientific ideas, especially new discoveries, do not, except for those already in the know. For them, “The disclosure of a single new fact suddenly can illuminate a quite distant area, hitherto dark”, but the rest of us miss the point.

Steger's “Sketches of Science” are thus a playful commentary on the main challenge for Lindau: the communication of ideas among people from a wide variety of backgrounds. This has long been a concern of scientists—recall that Michael Faraday used to give brilliant, popular lectures on electricity and chemistry to society ladies and gentlemen in the early-to-middle 19th century. The theory of evolution was publicly debated in Oxford in the very lecture room where my friends and I used to listen to lectures on science in the Christmas holidays. The queues to get in stretched far down the stairs and along the corridors of the museum, past the dinosaur skeletons; this was entertaining science.



Volker Steger's photo of Sir Tim Hunt, the 2001 Nobel Laureate in Physiology or Medicine, and his drawing of key regulators of the cell cycle, adorns the cover of the recently published art book on the exhibition “Sketches of Science—Photo Sessions with Nobel Laureates” (ISBN: 978-3-939201-04-5).

Exhibitions



112 The German photographers Peter Badge and Volker Steger each have their own specific approach to capture and visualise intellectual achievements. Whilst Badge chose to specialise in the classic genre of portraiture, Steger has developed more innovative forms of presentation. The diversity of their art is exemplified by the photo series “NOBELS—Nobel Laureates photographed by Peter Badge” and “Sketches of Science—Photo Sessions with Nobel Laureates”—the latter created by Volker Steger.

NOBEL LAUREATES IN PORTRAITS

Peter Badge’s ambition is to create a comprehensive gallery of unique personal portraits of each and every living Nobel Laureate. What began as a small collection in the year 2000 now encompasses over 350 portraits. His unobtrusive yet very expressive black-and-white portrait photos reveal the personality of the depicted and generate recognition for their scientific, literary or humanitarian achievements. Many of the photos were taken at the Lindau Nobel Laureate Meetings, but the project has also taken Badge all around the globe. In 2012, selected photos of the NOBELS series were on display in Cairo, Göttingen, Lindau and Brussels. The majority of Badge’s photos permanently embellish the foundation’s as well as the executive secretariat’s office in Lindau. Badge pursues his project with support from the Lindau Foundation and the Klaus Tschira Foundation.

CITY MUSEUM LINDAU

An extensive collection of Peter Badge’s photo portraits of Nobel Laureates was on display in Lindau’s city museum from May to October 2012. In the realm of the 62nd Lindau Meeting the majority of participants and guests took the opportunity to stroll through the venerable halls that are destined to later host a comprehensive exhibition on the Lindau Meetings.

CAIRO

Earlier last year, a selection of Badge’s portraits of German and Egyptian Nobel Laureates was exhibited in the offices of the German Academic Exchange Service DAAD in Cairo. The DAAD had helped to arrange the signing of a memorandum of understanding between the Lindau Meetings and the Egyptian government that regulates the participation of young Egyptian researchers at the meetings.

EUROPEAN COMMISSION HEADQUARTERS BRUSSELS

On the occasion of the awarding of the Nobel Peace Prize 2012 to the European Union, Badge’s portraits of Nobel Peace Laureates were shown in the Presidential Gallery of the Berlaymont building of the European Commission in Brussels from December 2012 to January 2013. The exhibition was opened in the presence of José Manuel Barroso, President of the European Commission, and Herman Van Rompuy, President of the European Council.

SKETCHES OF SCIENCE

In his photos, Volker Steger captures the spontaneity and creativity of Nobel Laureates. When they meet for a photo session, Steger challenges the Laureates to draw a colourful sketch of their award-winning scientific achievements and to present it in front of his camera. The resulting photos are as varied and different as the personalities of the subjects, but they each express the enthusiasm of scientists and researchers for their work. An exhibition of 40 photos of the series was launched at the Nobel Museum in Stockholm in June 2012. Thereafter, the photos were on display at Frankfurt Airport before moving on to the representative office of the State of Baden-Württemberg in Berlin from January to February this year. The exhibition will continue touring in Europe, Asia and North America throughout 2013 and 2014. Its next locations will be Heidelberg, Mainau Island, and Singapore. “Sketches of Science—Photo Sessions with Nobel Laureates” is a joint project of the Nobel Museum and the Lindau Foundation, supported by the Klaus Tschira Foundation. It also features audio and video material such as interviews with Nobel Laureates or excerpts from the Lindau Mediatheque, and introduces Steger’s second major project “Nobel Labs 360°”.

NOBEL MUSEUM STOCKHOLM

The distinguished Nobel Museum was the first location to show the exhibition “Sketches of Science—Photo Sessions with Nobel Laureates” featuring Volker Steger’s photos. Its director Olov Amelin and Lars Heikensten, Executive Director of the Nobel Foundation, both emphasised the common benefit of the Nobel Museum’s collaboration with the Lindau Nobel Laureate Meetings on this project.

FRANKFURT INTERNATIONAL AIRPORT

By courtesy of Fraport AG, the “Sketches of Science” were on display at Frankfurt Airport from December 2012 to January 2013. During the first week of December when the Nobel Prizes are traditionally being awarded in Stockholm, Lufthansa travellers departing from Frankfurt Airport to Stockholm had the opportunity to view the exhibition prior to boarding their flight—the exhibits were set up in the area of the departure gate.

BADEN-WÜRTTEMBERG REPRESENTATION OFFICES BERLIN

As the artist Volker Steger was born in the German federal state of Baden-Württemberg, the State Government and the Minister for the Bundesrat, Europe and International Affairs, Peter Friedrich, took pride in hosting the exhibition of his “Sketches of Science” in its representation offices in Berlin from 18 January to 7 February 2013. Baden-Württemberg’s Minister of Science, Research and the Arts, Theresia Bauer, attended the opening ceremony. On the occasion of the Elysée Treaty anniversary celebrations in Berlin, a delegation of the French Senate was received by the Minister-President of Baden-Württemberg, Winfried Kretschmann, and visited the exhibition.

“SKETCHES OF SCIENCE”—UPCOMING EXHIBITIONS

Heidelberg, Carl Bosch Museum
22 February—2 June 2013

Mainau Island, Mainau Castle
24 June—31 August 2013

Singapore
16 September—23 November 2013

Exhibitions

114



[1] The exhibition of Peter Badge's portrait photos of Nobel Laureates was opened in the presence of Singapore's President Tony Tan (depicted together with Countess Bettina Bernadotte, the lord mayor of Lindau Gerhard Ecker, and Peter Badge); it was also visited by Nobel Peace Laureate José Ramos-Horta [4, centre]. The council's vice-president Burkhard Fricke [2, right] travelled to Cairo to visit the opening of the exhibition of Badge portraits of Egyptian and German Nobel Laureates at the branch office of the DAAD [5]. [3] Peter Badge, Herman Van Rompuy, José Manuel Barroso, Countess Bettina Bernadotte and Wolfgang Schürer at the opening of the exhibition of Badge's Peace Laureate portraits in Brussels.

115



[1] Volker Steger, Countess Bettina Bernadotte and Sir Tim Hunt at the opening of "Sketches of Science" in Stockholm [3]. [2] Steger's photographs exhibited at Frankfurt Airport; [4] Olov Amelin, director of the Nobel Museum, Countess Bettina Bernadotte, Minister Theresia Bauer, Swedish ambassador Staffan Carlsson and Wolfgang Schürer at the opening of "Sketches of Science" in Berlin. [5] Jean-Pierre Bel, President of the French Senate, and Winfried Kretschmann, Minister-President of the State of Baden-Württemberg, on the occasion of a visit of the exhibition by a delegation of the French Senate.



Introducing Nobel Laureates

116 Meeting Nobel Laureates in person and learning more about their ground-breaking research findings must not remain an exclusive privilege of those who get the opportunity to participate in the Lindau Meetings. We feel committed to share this experience with the general public in Lindau.

UNDERSTANDING THE NOBEL PRIZES

It has become a tradition that we start a new year by hosting a public presentation dedicated to the recent Nobel Prizes. Reputable scientists give speeches to explain the research findings of the recently bestowed Nobel Laureates. The success of these events proves that the general interest in science and research is very notable. And it once again brings out the appeal and esteem of the Nobel Prize and its Laureates.

“The Nobel Prizes 2011”,
Lindau, January 2012

Supported by Schwäbische Zeitung
Moderator: Hendrik Groth, *Editor-in-Chief*

PRESENTATIONS

Physiology or Medicine:
Christian Huemer, *State Hospital Bregenz*

Physics:
Burkhard Fricke, *Council for the Lindau Nobel Laureate Meetings*

Chemistry:
Gregor Schnakenburg, *Institute for Inorganic Chemistry of the University of Bonn (Lindau Alumnus)*

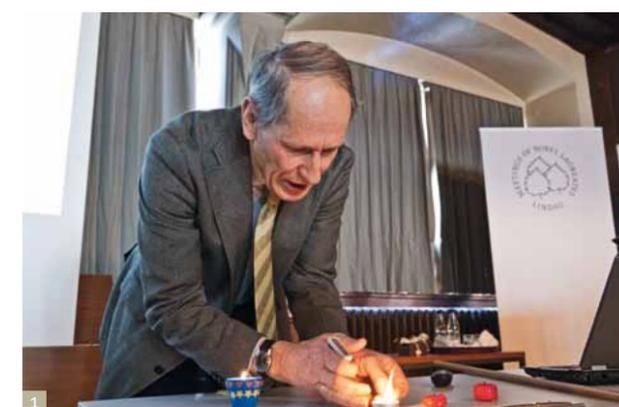
Economic Sciences:
Wolfgang Schürer, *Council for the Lindau Nobel Laureate Meetings*

NOBEL PEACE LAUREATE VISITS LINDAU

Throughout the history of the Lindau Meetings, many Nobel Peace Laureates have joined and enhanced the inter-generational dialogue: Albert Schweitzer, Willy Brandt, Linus Carl Pauling, Muhammad Yunus, Rajendra Pachauri, chairman of the prize-awarded Intergovernmental Panel on Climate Change (IPCC), and Unni Karunakara, president of the prize-awarded organisation Médecins Sans Frontières. With his visit to Lindau in September 2012, the former president of the Democratic Republic of Timor-Leste (East Timor) and Nobel Peace Laureate José Ramos-Horta continued this tradition. Even more, he made the suggestion to establish a specific forum for the discipline of peace. His proposal is considered as a valuable stimulus and will be further discussed.

At the invitation of the council and the foundation, José Ramos-Horta came to Lindau to give a talk entitled “Health and Education for a Better World”. Numerous interested citizens and invited guests took the unique opportunity to listen to him and engage in the subsequent discussion. The event was organised with the support of the city’s department of culture, the museum “friedens räume” and the regional newspaper Schwäbische Zeitung.

For decades, José Ramos-Horta, born in today’s capital Dili in 1949, has committed himself to the independence of his home country East Timor. In 1996, he was awarded the Nobel Peace Prize—jointly with his fellow countryman Bishop Carlos Filipe Ximenes Belo—for his efforts in finding a peaceful solution to the conflict in East Timor. Following the country’s independence, he was elected President of the Democratic Republic of Timor-Leste in 2007. He held this highest public office until May 2012 and presently serves as United Nations Special Representative and Head of the United Nations Integrated Peacebuilding Office in Guinea-Bissau. José Ramos-Horta is among the more than 260 members of our Founders Assembly.



- [1] Council Vice-President Burkhard Fricke used simple candles to explain how the 2011 Nobel Laureates in Physics, Saul Perlmutter, Brian Schmidt, and Adam G. Riess discovered the accelerating expansion of the Universe through observations of distant supernovae.
- [2] José Ramos-Horta during his talk at the old city hall of Lindau.
- [3] José Ramos-Horta and moderator Christoph Plate, deputy editor-in-chief of Schwäbische Zeitung, during the discussion following Ramos-Horta’s talk.

Enabling the Mission Education

Organisation & Account



Organisation

120	<p>The Council for the Lindau Nobel Laureate Meetings maintains an executive secretariat in Lindau that is responsible for the organisation and processing of the annual meetings and the diverse projects and activities in the realm of the Mission Education. This includes general management tasks and finances, organisational planning and processing, conception and coordination of infrastructure and logistics, participant and partner liaison and support, communications and public relations, as well as administration and secretarial services.</p>	<p>EXECUTIVE SECRETARIAT</p> <p>Director Wolfgang Huang</p> <p>Conference Management Susanne Wieczorek, <i>Deputy Director</i> Katja Merx</p> <p>Young Researcher Support & Academic Partner Relations Nadine Gärber Nesrin Karabag Karen Otto (since October 2012) Alexandra Wimbauer (until September 2012)</p> <p>Communications Jan Keese (until February 2013) Christian Schumacher</p> <p>Multi-Media Content Management Patricia Edema</p> <p>Guest Relations, Secretariat & Accounting Anke Elben Monika Reichert</p> <p>Additional Support Melachrini Georgas Vincenzo Hiemer (April–July 2012)</p>
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<p>SUPPORT</p> <p>Sincere thanks are due to:</p> <p>OFFICE OF COUNTESS BETTINA BERNADOTTE</p> <p>Barbara Wechs Carolin Kößler Sabine Neufang Florian Heitzmann</p> <p>OFFICE OF WOLFGANG SCHÜRER</p> <p>Andreas Böhm Karin Eijckelhoff Gabriella Hauser Melinda Dioszegi</p>

Account 2012

Expenditures

TRAVEL, BOARDING & LODGING		AV PRODUCTIONS & COMMUNICATIONS	121
Nobel Laureates	194,408.34	AV Productions	148,864.95
Young Researchers	334,807.91	Social Media Communication	32,117.50
Media	25,462.26	Website	11,496.56
Other	143,376.45	External Services	16,992.58
		Distribution & Monitoring	8,749.29
SCIENTIFIC PROGRAMME & YR SELECTION	19,526.64	Alumni Platform	15,730.35
		Mediatheque (IT, Content)	338,532.10
VENUES, EQUIPMENT & STAFF		OTHER MEETING COSTS	48,233.29
Locations (Rental Fees, Tents)	71,078.08	EXHIBITIONS	404,538.33
Technical Equipment	173,414.88	Sketches of Science, Nobel Portraits	
Other Equipment	17,761.46	PUBLICATIONS	40,888.43
Utilities, Signage, Services	34,965.70	Nobel Physicists, Nobel Peacemakers	
External Onsite Staff	45,970.54	ADDITIONAL EVENTS & PROGRAMMES	42,346.26
		(Teaching Spirit, Innovation Forum, Public Lectures, etc.)	
SOCIAL PROGRAMME	41,639.42	EXECUTIVE SECRETARIAT	
		Staffing, Wages and Salaries	576,039.95
PRINTED MATTERS	53,192.66	Operating Costs (Rent, Utilities, Maintenance)	32,167.68
		Accounting, Legal Services, Bank Services	35,318.01
		Hardware, Software, IT Services	88,263.73
		Communication	13,800.89
		Other Costs	32,588.19
		<hr/> TOTAL	<hr/> 3,042,272.43
		Total Meeting incl. Executive Secretariat	2,215,967.31
		Total Outreach	826,305.12

Account 2012

Revenues

122 Grants, donations, funds and donations in kind from the public sector (Bundesministerium für Bildung und Forschung (BMBF), Germany, Bundesministerium für Wissenschaft und Forschung, Austria, European Commission, Freistaat Bayern – Staatsministerium für Wissenschaft, Forschung & Kunst, International Lake Constance Conference (IBK), Land Baden-Württemberg, Stadt Lindau (B), U.S. Department of Energy), **from institutions aiding the advancement of science** (Deutsche Forschungsgemeinschaft (DFG), Deutscher Akademischer Austauschdienst (DAAD), Deutsches Krebsforschungszentrum, Elitenetzwerk Bayern, Fraunhofer – Gesellschaft zur Förderung der angewandten Forschung e.V., Helmholtz Association of German Research Centres, Max-Planck-Gesellschaft, Singapore National Research Foundation, Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e.V.), **from industry** (Artificial Image, AUDI AG, BASF SE, Big Image GmbH, Boehringer Ingelheim GmbH, Deutsche Bank AG, Deutsche Lufthansa AG, EnBW Energie Baden-Württemberg AG, ETO Group, Freiburger Lebensmittel GmbH & Co., Gebrüder Weiss GmbH, Hewlett-Packard, L.P., Intersky Luftfahrt GmbH, JonesDay, Jura Elektroapparatebau AG, Lindau Tourismus und Kongress GmbH, Lindauer Zeitung, LISTA Office AG, Lockheed Martin Corporation, Mainau GmbH, MAN SE, Mars, Incorporated, Meckatzer Löwenbrau Benedikt Weiß KG, Merck KGaA, Microsoft Corporation, MS Management Service AG, PricewaterhouseCoopers AG PwC, rose plastic AG, S.W.S. Simon-Security GmbH, SAP AG, Sennheiser electronic GmbH & Co. KG, Siemens AG, Sparkasse Memmingen-Lindau-Mindelheim, Spielbank Lindau, Staatliche Lotterieverwaltung (Bayern), Stadtverkehr Lindau (B) GmbH, Stadtwerke Konstanz GmbH, Stadtwerke Lindau (B) GmbH & Co. KG, Telekommunikation Lindau (B) GmbH, Vacheron Constantin, Volkswagen Group, Warth, Klein & Leutenecker, Zumtobel Lighting GmbH), **from charitable or non-profit organisations** (AKB Stiftung, Alexander S. Onassis Public Benefit Foundation, Bayer Science & Education Foundation, Carl Zeiss Stiftung, Christa und Hermann Laur-Stiftung, Deutsche Bank Stiftung, Deutsche Telekom Stiftung, Eduard-Rhein-Stiftung, Förderverein Römerbad e.V.,

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TOTAL	3,042,272.43
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Note: The calculated revenues refer only to the meeting and outreach projects included in the expense budget for the fiscal year 2012. Deficits have been covered by the Foundation Lindau Nobel prizewinners Meetings as guaranteed in a letter of indemnity to the Council for the Lindau Nobel Laureate Meetings.

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Challenges

126 If we could share our lives and our perspectives more widely, that would be a great challenge, with a great reward.

John C. Mather (page 106)

One of the challenges will be to lift as many of the treasures hidden in the Lindau Mediatheque as possible and illuminate cross-links, while at the same time avoiding too much overlap.

Anders Bárány & Wolfgang Huang (page 104)

The Lindau Meetings are a natural locus for discussion of the main issues in the evaluation of alternative paths of economic development and their implications for sustainability, along with the need for adaptation of any framework for measurement and evaluation to diverse local conditions.

Robert M. Solow (page 82)

On a broader front should the Lindau Council consider inviting, for example, recipients of the Fields Medal?

Andrew Holmes (page 68)

It is a challenge for Lindau to build on their relationships with industry. There is great potential here, but coming up with a programme that is both interesting for industry and Laureates, and relevant for students will take both thought, and some trial and error. Furthermore, I think one of the challenges for the programme in the future is to ensure that more of the younger cohorts of Nobel Laureates attend the meeting, as well as some of the few women who make up our ranks.

Brian Schmidt (page 24)

My challenge to the Lindau Meetings is to look forward, as well as into the past, and by doing so, contribute in an even greater way to the careers of young scientists and to the future of science.

Nicole Alexandra Larsen (page 32)

We need our best brains to tackle issues like energy security, climate change and ageing populations, to name but three, come up with innovative solutions and invent new products and services that will bring us future growth and jobs.

Robert-Jan Smits (page 76)

The outreach initiatives undertaken by the Lindau Nobel Laureate Meetings have an important contribution to make. Successful initiatives must meet the highest quality standards; they need a constant supply of new ideas, strong networks and a high level of commitment on the part of supporters and sponsors.

Gabriela Dür (page 84)

Upcoming Lindau Meetings

63RD LINDAU NOBEL LAUREATE MEETING
CHEMISTRY
30 June—5 July 2013

35 Participating Nobel Laureates

Peter Agre, Werner Arber, Martin Chalfie, Aaron Ciechanover, Paul Crutzen, Robert Curl Jr., Manfred Eigen, Richard Ernst, Gerhard Ertl, Walter Gilbert, Robert Grubbs, Theodor Hänsch, Serge Haroche, Harald zur Hausen, Avram Hershko, Robert Huber, Brian Kobilka, Walter Kohn, Sir Harold W. Kroto, Jean-Marie Lehn, Rudolph Marcus, Hartmut Michel, Mario Molina, K. Alex Müller, Erwin Neher, José Ramos-Horta, Bert Sakmann, Richard Schrock, Osamu Shimomura, Akira Suzuki, Roger Y. Tsien, John Walker, David Wineland, Kurt Wüthrich, Ada Yonath

64TH LINDAU NOBEL LAUREATE MEETING
PHYSIOLOGY / MEDICINE
29 June—4 July 2014

5TH LINDAU MEETING ON ECONOMIC SCIENCES
19—23 August 2014

65TH LINDAU NOBEL LAUREATE MEETING
INTERDISCIPLINARY:
PHYSICS, PHYSIOLOGY/MEDICINE, CHEMISTRY
28 June—3 July 2015

127

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CHALLENGES

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