The Abel Prize Ceremony  
May 22, 2012

Procession accompanied by the “Abel Fanfare” (Klaus Sandvik)  
Performed by musicians from The Staff Band of the Norwegian Armed Forces

His Majesty King Harald enters the University Aula

Cow-call and Little Goats’ dance (Edvard Grieg)  
Tine Thing Helseth, trumpet, and Gunnar Flagstad, piano

Opening speech by Professor Nils Chr. Stenseth  
President of The Norwegian Academy of Science and Letters

Speech by Minister of Education and Research Kristin Halvorsen

Was it a dream? and The girl returned from meeting her lover (Jean Sibelius)  
Tine Thing Helseth, trumpet, and Gunnar Flagstad, piano

The Abel Committee’s Citation  
Professor Ragni Piene  
Chair of the Abel Committee

His Majesty King Harald presents the Abel Prize to Endre Szemerédi

Acceptance speech by Abel Laureate Endre Szemerédi

Libertango (Astor Piazzolla, arr: Storløkken)  
Tine Thing Helseth, trumpet; Gunnar Flagstad, piano, Erik Jøkling Kleiva, drums/percussion, and Nikolay Matthews, bass

His Majesty King Harald leaves the University Aula

Procession leaves

The Prize Ceremony will be followed by a reception in Frokostkjelleren.  
During the reception, Endre Szemerédi will be interviewed by Tonje Steinsland.
Many of his discoveries carry his name. One of the most important is Szemerédi’s Theorem, which shows that in any set of integers with positive density, there are arbitrarily long arithmetic progressions. Szemerédi’s proof was a masterpiece of combinatorial reasoning, and was immediately recognized to be of exceptional depth and importance. A key step in the proof, now known as the Szemerédi Regularity Lemma, is a structural classification of large graphs.

Szemerédi has made many additional deep, important, and influential contributions to both discrete mathematics and theoretical computer science. Examples in discrete mathematics include the Szemerédi–Trotter theorem, the Ajtai–Komlós–Szemerédi semi-random method, the Erdős–Szemerédi sum-product theorem, and the Balog–Szemerédi–Gowers lemma. Examples in theoretical computer science include the Ajtai–Komlós–Szemerédi sorting network, the Fredman–Komlós–Szemerédi hashing scheme, and the Paul–Pippenger–Szemerédi–Trotter theorem separating deterministic and non-deterministic linear time.

Endre Szemerédi has received many awards and honours for his contributions to mathematics and computer science. In 2008 he was awarded the Leroy P. Steele Prize for Seminal Contribution to Research by the American Mathematical Society. The same year Endre Szemerédi received the Rolf Schock Prize in Mathematics from the Royal Swedish Academy of Sciences.

He has held visiting positions at Stanford University (1974), McGill University, Montreal (1980), the University of South Carolina (1981–1983) and the University of Chicago (1985–1986). He was the Fairchild Distinguished Scholar at the California Institute of Technology in 1987–88. He is also a recipient of the Aisenstadt Chair at Centre de Recherches Mathématiques, University of Montreal. In 2008 Szemerédi was the Eisenbud Professor at the Mathematical Science Research Institute, Berkeley.

Szemerédi is a member of the Hungarian Academy of Sciences and of the US National Academy of Sciences.

In 2010, on the occasion of Szemerédi’s 70th birthday, the Alfréd Rényi Institute of Mathematics and the János Bolyai Mathematical Society organized a conference in Budapest to celebrate his achievements. In the book, An Irregular Mind, published prior to the conference, it is stated that “Szemerédi has an ‘irregular mind’; his brain is wired differently than for most mathematicians. Many of us admire his unique way of thinking, his extraordinary vision.”
Professor Nils Chr. Stenseth
President of The Norwegian Academy of Science and Letters

Your Majesty, Excellencies; Dear Abel Prize Laureate, Professor Endre Szemerédi, Dear friends of long-term fundamental science training and research; Ladies and gentlemen.

On behalf of The Norwegian Academy of Science and Letters, it is a great pleasure and honour to welcome you all to this year’s Abel Prize Ceremony.

The Abel Prize has several main objectives: First, it shall give distinction to mathematicians who have made a fundamental contribution to the development of the field of mathematics. Second, the prize – and the prize winners – shall inspire the research community in general and mathematicians in particular. Third, through the example set by the Abel Laureate, the prize shall motivate young people to become involved in mathematical research – and, in the broadest sense, convey to the greater public the importance of fundamental research and mathematics programmes. In the statutes of the Abel Prize, it is written that “the prize shall help enhance the status of mathematics in society and encourage children and young people to become interested in mathematics”.

The Abel Board supports several initiatives to stimulate interest in mathematics among children and young people. Allow me to mention two of the most important measures here: the Norwegian Mathematical Olympiad (the Niels Henrik Abel Mathematics Contest, informally named the Abel Contest), aimed at upper secondary level pupils, and KappAbel – the Nordic competition in mathematics for school classes (lower secondary school level; year 9 in Norway).

Whilst these kinds of competitions are important, the quality of the mathematics teaching in schools is even more important. Nils Henrik Abel had an excellent mathematics teacher – Bernt Michael Holmboe. To emphasize the important role teachers play, a teacher is honoured each year with the Holmboe Memorial Prize. I would also like to mention – and commend – the work the Abel Board does to support the outstanding mathematical work in developing countries, including supporting the Ramanujan Prize for outstanding mathematical work by a researcher from an emerging economy. I am pleased to welcome Professor Nang, last year’s winner of the Ramanujan Prize, to Oslo and this Abel Prize Ceremony.

Let me return to the Abel Prize: Most important of all, the Abel Prize – and the winners – shall inspire other mathematicians and aspiring mathematicians. Starting next year, a series of annual events, called The Heidelberg Laureates Forum, will be held. To this Forum talented young researchers from all over the world will be invited to meet former recipients of the three major awards in mathematics and computer science: the Abel Prize, the Fields Medal and the Turing Award.

The German entrepreneur Dr. Klaus Tschira has established a fund that will secure the future of these events between former prize winners and talented young mathematicians from around the world – for mutual inspiration. These conferences will be held in Heidelberg. The agreement was signed in The Norwegian Academy of Science and Letters this morning by Dr. Tschira and representatives of the other parties involved. This is an excellent example of industry–academia interaction. We need more people who can help to highlight top-level research of this nature and encourage excellence in science.

I would like to take this opportunity to thank Professor Helge Holden, chair of the Abel Board, for his dedication in promoting the Abel Prize to a very broad audience. After all, society – and especially our modern, knowledge-based society – is dependent on the kind of outstanding research we are honouring here today. Indeed, society is dependent on mathematics – at all levels. It is my conviction that the Abel Prize – with its many activities for young people – and now the commencement of the annual Heidelberg Laureates Forum – play a major role in emphasizing and strengthening mathematics training in schools. Increasing interest in mathematics among young people will give us even more talented mathematicians who will carry this illustrious field further.

This year marks the tenth anniversary of the Abel Prize. It is therefore still a relatively young award. But I dare say that it has gained the recognition that its founders originally hoped for – the establishment of the annual conference in Heidelberg is proof of that. This success is, in my opinion, the direct result of the prize committee’s ability to find worthy winners each year – worthy in the sense that there is general international consensus within the field of mathematics that the selections that have been made have all been greatly appreciated by the mathematicians all over the world. I would therefore like to take this opportunity to thank the Abel Committee, led by Professor Ragnar Piene, for their excellent work and dedication.

The Abel Prize and other similarly prestigious awards help to raise the status and recognition of science and fundamental research in society. Fundamental research is a long-term endeavour for each researcher. It is therefore important to have institutions that can preserve the knowledge generated and convey it to future generations of researchers: Our universities are such institutions, as is The Norwegian Academy of Science and Letters. The Abel Prize helps to draw attention to these institutions as the bearers of the long-term perspective of fundamental research.

Distinguished guests and most honoured prize winner, Professor Endre Szemerédi: Once again, I welcome you to this year’s award ceremony – a great day for mathematics and a great day for science and long-term fundamental research.
1. Mikhail Gromov receives the Abel Prize.
2. Lennart Carleson is received in audience by H.M. Queen Sonja at the Royal Palace.
3. John Milnor and his wife and H.M. King Harald and Tora Aasland, Minister of Research and Higher Education, is led into the banquet hall at Akershus Castle.
4. H.M King Harald and H.M Queen Sonja at The Abel Prize Ceremony in the University Aula.
5. John Torrence Tate inspires young KappAbel-winners at Oslo Cathedral School.
6. Isadore M. Singer and Michael F. Atiyah receive the Abel Prize from H.M King Harald.
7. Wreath-laying ceremony at the Abel Monument in Oslo.
10. Jean-Pierre Serre, the first Abel Prize Laureate.
11. Peter D. Lax gives his acceptance speech.
Professor Ragni Piene
Chair of the Abel Committee

Your Majesty, Your Excellencies, honored Laureate, dear colleagues and guests!

The Abel Prize for 2012 is awarded to Endre Szemerédi for his fundamental contributions to discrete mathematics and theoretical computer science, and in recognition of the profound and lasting impact of these contributions on additive number theory and ergodic theory.

Discrete mathematics studies phenomena or structures that are discrete, as opposed to continuous. Imagine the scene: we are outside one early morning. The light becomes gradually stronger, and then weaker again as night falls. We are observing a continuous phenomenon. If, however, we are in a dark cellar and switch on a light, we go from darkness to light, and back to darkness when we turn the light off: on–off–on–off. This is an example of a discrete phenomenon.

Examples of discrete structures are graphs, sequences, permutations, and geometric configurations. A graph is a set of points, or "nodes", where two nodes can be connected or not. The world wide web can be viewed as a graph, where the nodes are the websites and the relations are the hyperlinks. The mathematics of such huge structures forms the foundation of theoretical computer science and information theory. Communication networks can be described and analyzed using the tools of graph theory, and the design of efficient computational algorithms relies crucially on insights from discrete mathematics. The combinatorics of discrete structures is also a major component of many areas of pure mathematics, including number theory, probability, algebra, geometry, and analysis.

Endre Szemerédi has revolutionized discrete mathematics by introducing ingenious and novel techniques, and by solving many fundamental problems. His work has brought combinatorics to the center-stage of mathematics, by revealing its deep connections to such fields as additive number theory, ergodic theory, theoretical computer science, and incidence geometry.

In 1975, Endre Szemerédi first attracted the attention of many mathematicians with his solution of the famous Erdős–Turán Conjecture, showing that in any set of integers with positive density, there are arbitrarily long arithmetic progressions. This was a surprise, since even the case of progressions of lengths 3 or 4 had previously required substantial effort, by Klaus Roth and by Szemerédi himself.

A bigger surprise lay ahead. Szemerédi’s proof was a masterpiece of combinatorial reasoning and was immediately recognized to be of exceptional depth and importance. A key step in the proof, now known as the Szemerédi Regularity Lemma, is a structural classification of large graphs. Over time, this lemma has become a central tool in both graph theory and theoretical computer science.

Still more surprises lay in wait. Hillel Furstenberg gave a new proof of Szemerédi’s Theorem, which unexpectedly linked questions in discrete mathematics to the theory of dynamical systems. This fundamental connection led to many further developments, such as the Green–Tao Theorem, asserting that there are arbitrarily long arithmetic progressions of prime numbers.

In addition, Szemerédi has made many additional deep, important, and influential contributions to both discrete mathematics and theoretical computer science. Endre Szemerédi’s approach to mathematics exemplifies the strong Hungarian problem-solving tradition. Yet, the theoretical impact of his work has been a game-changer.
Your Majesty, Your Highnesses, members of The Norwegian Academy of Science and Letters, colleagues, family, friends and guests.

I am very grateful to the Norwegian Government, to The Norwegian Academy of Science and Letters, the Abel Committee, and the mathematicians who nominated me.

I had never thought that an honour such as the Abel Prize could be given to me. I am very happy and moved to be in Norway at this Ceremony.

Norway has given the world many extraordinary mathematicians. I would like to mention just three of them.

Niels Henrik Abel, who tragically died at very young age, was a towering figure in the world of mathematics at the beginning of the nineteenth century. He proved that there is no general algebraic solution for polynomial equations of degree at least five, in terms of explicit algebraic operations. By doing this he created group theory, one of the most important disciplines in mathematics. He also made a fundamental contribution to the theory of elliptic functions.

Sophus Lie, the world-class Norwegian mathematician of the second half of the nineteenth century, made extremely significant contributions to various fields of mathematics. His work is important in modern physics as well. Sophus Lie was the first who worked tirelessly to establish a prize in memory of Niels Henrik Abel. Everybody who worked to establish the Abel Prize performed a very valuable service for mathematics. They made mathematics more visible and surely helped to attract many young students to become mathematicians.

The magnificent Norwegian mathematician, Atle Selberg was one of the greatest mathematicians of the twentieth century. His work significantly shaped modern analytic number theory. The Selberg sieve method and the Selberg Trace Formula will remain an important part of mathematics forever. Atle Selberg received an Honorary Abel Prize. My wife Anna and I were fortunate to share pleasant moments with him and his Hungarian wife, Hedi, coworker of the great Hungarian scientist John von Neumann.

In Hungary mathematicians usually start to study mathematics intensively in mathematically oriented upper secondary schools. However my path was different. After finishing a regular upper secondary school, I first attended medical school. Very soon I realized that this profession was not for me, so I quit. For about two years I worked in a factory. By chance I met my upper secondary school friend Gábor Ellmann who told me that he and my maths teacher, Sándor Bende, thought that I should study mathematics. I took their advice.

At the University I have been fortunate to be helped and taught by Paul Turán, Paul Erdős and András Hajnal. Later I was also greatly influenced by the work of Klaus F. Roth. I never can be thankful enough to these icons. I strongly believe that without my coauthors, particularly Miklós Ajtai, András Hajnal and János Komlós, I would not be here.

Also, this award could not have happened were it not for the fundamental work of many older and young mathematicians who might have been influenced by some of my results and methods, but who have developed much stronger results and established deep connections between different branches of mathematics. Many of you are here with me now. I acknowledge my debt to you and to them all.

A beautiful thing about mathematics is that the effort and interaction of many can reach unimaginable heights.

Finally, I consider this award a recognition of the field of discrete mathematics and theoretical computer science.

Through interaction, discrete mathematics and theoretical computer science have flourished enormously in the last thirty years. The applications of the results of these disciplines vary influence our everyday life, mainly through the use of computers. Let me mention just a few applications of the computers such as the Internet and search engines and computer tomography or MRI in medicine.

Finally I would like to thank my wife for her love, help, patience, and good humor. I would also like to thank my family for its love and support, including the Italian branch.

I would also like to once again thank all of you who are present at this Celebration, which means so much to me.
Tine Thing Helseth

Trumpet soloist

Tine Thing Helseth, 24, started to play the trumpet at the age of 7, and is one of the leading trumpet soloists of her generation. Highlights of last season included orchestral debuts with the Gavle Symphony, NDR Hannover, BBC Scottish, Royal Liverpool Philharmonic, Swedish Chamber and Swedish Radio Symphony Orchestras as well as making her recital debut at the Carnegie Hall, New York, and further recital debuts in Berlin, Brussels and Luxembourg. She also gave her first performance at the Royal Albert Hall as part of Classic FM Live.

The 2011/2012 season will see her return to the Royal Liverpool Philharmonic and Danish Radio orchestras, and make debuts with the Australian Chamber Orchestra, the Orchestre Philharmonique de Monte Carlo, Stuttgart Philharmonic Orchestra, NDR Hamburg, Kollegium Winterthur Orchestra, the Symfonieorkest Vlaanderen Orchestra and Hong Kong Sinfonietta.

In April 2011 Tine signed an exclusive recording contract with EMI Classics. She will release two albums this season; a solo disc with RLPO, Storyteller and the debut album of her brass ensemble, tenThing. She has also recorded two discs for Simax, the first of which was named “Classical Recording of the Year” in 2007 by the Norwegian newspaper Aftenposten, and the second which went to ‘gold’ in the Norwegian classical chart after just three weeks.

In recognition of her outstanding performing abilities Tine has been the recipient of various awards including the 2009 Borletti-Buitoni Trust Fellowship, “Newcomer of the Year” at the 2007 Norwegian Grammy Awards (the first classical artist ever to be nominated), second prize in the 2006 Eurovision Young Musicians Competition, the Luitpold Prize as the most outstanding and interesting young artist of the year at the Kissing Summer Festival, and the prestigious Prince Eugen’s Culture Prize in Stockholm.