





The Abel Prize Ceremony

25 May 2004

Procession accompanied by the “Abel Fanfare”

Sidsel Walstad, solo electronic harp

MUSIC: Klaus Sandvik

Their Majesties King Harald and Queen Sonja enter the Aula

“Vær velkomne med æra”

Sidsel Walstad and Cecilie Løken

MUSIC: Geirr Tveitt

Opening by Professor Lars Walløe

President of the Norwegian Academy of Science and Letters

“Billy Jean”

Sidsel Walstad, Mocci Ryen and Børre Flyen

MUSIC: M. Jackson

The Abel Prize Award Ceremony

Professor Erling Størmer

Chairman of the Abel Committee

The Committee's citation

His Majesty King Harald presents the Abel Prize to Sir Michael Atiyah and Isadore Singer

Speeches of thanks by Sir Michael Atiyah and Isadore Singer to the Norwegian Academy of Science and Letters

“Halling”

Sidsel Walstad, Cecilie Løken, Mocci Ryen and Børre Flyen

MUSIC: E. Grieg

Departure of Their Majesties

Procession leaves the Aula

Professor Lars Walløe

President of the Norwegian Academy of Science and Letters

On behalf of the Norwegian Academy of Science and Letters, it is a great pleasure to welcome you to the presentation of the Abel Prize for 2004.

In 1898 the Norwegian mathematician Sophus Lie argued for the creation of an international mathematics prize in Niels Henrik Abel's name. Some years before that, Lie, along with Ludvig Sylow, was responsible for publishing Niels Henrik Abel's collected mathematical works. Both men were internationally known mathematicians in their day, with Sophus Lie number two in fame and influence after Niels Henrik Abel. The initiative in connection with the centenary of Niels Henrik Abel's birth went nowhere, perhaps because Sophus Lie died already in 1899. One hundred years after 1902 the opportunity presented itself again, and the Abel Prize was established. Today it will be presented for the second time to two outstanding mathematicians. It is a great pleasure to welcome Sir Michael Atiyah and Isadore Singer to Oslo.

The Abel Prize was created by the Storting, Norway's parliament, for the purpose of rewarding outstanding research in mathematics. It was also created with the expectation that such a prize, with the interest and attention it would hopefully attract, would encourage individual researchers and research communities worldwide.

Sophus Lie is best known for his theory of transformation groups. After Lie had published his first volume on these mathematical objects, the book was reviewed by an American mathematics journal. The reviewer wrote: "There is probably no other science which presents such different appearances to one who cultivates it and one who does not, as mathematics. To the noncultivator it is ancient, venerable, and complete; a body of dry, irrefutable, unambiguous reasoning. To the mathematician, on the other hand, his science is yet in the purple bloom of vigorous youth, everywhere stretching out after the 'attainable but unattained', and full of excitement of nascent thoughts." I know from my

own experience that a good mathematics teacher in school and at university is able to communicate some of the excitement that the reviewer writes about, also to those of his or her pupils and students who will not become research mathematicians.

Thus, the Abel Prize has a purpose besides encouraging and rewarding outstanding research in mathematics. It is intended to arouse the interest of the young in mathematics and related scientific subjects. Mathematics is a key to understanding as well as being able to contribute to a vast array of professions in a modern technological society. It is therefore crucial for young people to want to learn the subject. For this reason, it is a pleasure to have with us the winners of this year's Abel and KappAbel contests at this ceremony.

Like most of the other sciences, mathematics is an international activity. Therefore it is also a pleasure for us to have the winners of a major maths contest for young people in Berlin and a related contest in France here with us as our guests.

Once again, honoured guests, I welcome you to this ceremony and to the other events held in conjunction with the awarding of the prize.

Professor Erling Størmer

Chairman of the Abel Committee

The Abel Prize for 2004 is being shared by Sir Michael Atiyah from the University of Edinburgh and Isadore Singer from the Massachusetts Institute of Technology. They are receiving the prize for having discovered and proved the index theorem, which links together topology, geometry and analysis, and for playing an extraordinary role in building new bridges between mathematics and theoretical physics.

Allow me to give you a simplified picture of the basic ideas of the index theorem, to give you a feeling for what it states.

In topology, we translate the essential properties of geometric objects into algebraic formulas. To a topologist, a circle is the same as a triangle, which in turn is the same as a rectangle. All three can be drawn by moving the pencil from one point and around the figure without crossing the figure anywhere. In differential geometry we avoid figures with corners, like triangles and rectangles. Instead we concentrate on geometric objects that are nice and smooth, like circles and ellipses. For these we study finer properties, such as curvature, which we can determine through the derivation of functions.

In the part of mathematics called analysis, we look at quantities that change. If we take the example of a car driving on a road, the speed is a measurement of the change in the length of road the car has driven, whereas acceleration measures the change in the speed. In mathematical language, this sort of thing is formulated using differential equations. The theory of such equations is an important part of mathematical analysis.

These three disciplines, topology, differential geometry and analysis, come together in the Atiyah-Singer index theorem. This theorem states that on the basis of the shape of the geometric area where the equations are defined, we can determine a numerical quantity – the index – that provides information about

the solutions. The index can tell us whether any solutions exist, and if so, how many. This information is crucial, since it is often extremely difficult to find explicit solutions to differential equations, and so it is good to know whether there are any and how many.

The index theorem was proved in the early 1960s and is one of the most important mathematical results of the twentieth century. It has had an enormous impact on the further development of topology, differential geometry and theoretical physics. The theorem also provides us with a glimpse of the beauty of mathematical theory in that it explicitly demonstrates a deep connection between mathematical disciplines that appear to be completely separate.

After it was found in the 1970s that the index theorem had applications in theoretical physics, Atiyah and Singer were tireless in their attempts to build bridges between mathematics and physics. They showed physicists how they could apply differential geometry and analysis, especially in the areas of quantum field theory and string theory, and they taught mathematicians how the insight of physicists can be utilised in the study of mathematical problems.

I would like to conclude by saying that Sir Michael Atiyah and Isadore Singer have demonstrated mathematics at its very best and are worthy winners of the Abel Prize.

Musicians

Sidsel Walstad ELECTRONIC HARP

Sidsel's repertoire embraces music from the early baroque to the most contemporary of new compositions. Her musical diversity is unique. She performs as a soloist, as a chamber musician, as well, as in orchestra settings.

She has developed her own niche in performances with the electric harp! Sidsel joyfully experiments with new and exciting musical expressions, and her performances are stimulating for the audience, filled with surprises and energy.

In 2003 and 2004 Sidsel receives a work grant for young/newly established artists from the Norwegian Council for Cultural Affairs. The grant will give her an outstanding opportunity to further develop her abilities and more closely study the harp. She will also continue to explore the electric harp; the musical possibilities presented in this unique instrument, and extend the music to a broader audience!

Sidsel is the solo harpist in The Norwegian Opera, and she has recently been offered the solo harp position in The Norwegian Radio Orchestra.

Cecilie Løken FLUTE

Cecilie is resident in Stockholm where she works as a soloist and Chambermusician. Her international debut as a soloist was in 1994 when she performed a widely broadcasted concert in Zurich, conducted by Mariss Jansons. She has won several competitions, such as "Princess Astrid's Music Prize" (1993) and has since then been soloist with many orchestras in Europe.

Cecilie has held positions as principal flautist in the Royal Opera in Stockholm (1999-02) and The Norwegian Opera (1997-99). Her musical diversity spans from playing with Barbara Hendricks at Versailles Castle to playing jazz with Bendik Hofseth and Jai Shankar at the club "Blå".

Mocci Ryen VOCAL

Vocalist and song-writer Mocci Ryen has developed a unique sound influenced by jazz, pop and soul and specializes in the musical field of Electronica. Her rooster includes collaboration with a number of international musicians including Sir Paul McCartney, a large number of international performances, recordings and TV appearances and has released a number of albums. Also cultural ambassador for the Norwegian AIDS telethon in 2001

Børre Flyen PERCUSSION

Børre is a freelance musician based in Norway. He is well known from Norwegian TV and the children's programme "Kykelikokos". He has played with The Norwegian Radio Orchestra and The Jens Wendelboe Orchestra. He has also played with a number of well-known Norwegian artists, such as Anne Grete Preus, Morten Harket, Silje Nergaard, Ole Edvard Antonsen and Hege Rimestad. Børre played in the orchestra in the musical Full Monty at Chateau Neuf in Oslo and is currently engaged as musician at the theatre "Edderkoppen" in Oslo.

The Abel Fund: Activity Profile

The statutes of the Niels Henrik Abel Memorial Fund stipulate that in addition to the Abel Prize and associated events, the return on the fund is to be used for activities aimed at young people. In keeping with this objective, the Abel Fund has promoted its activities along the following main lines:

The Abel Prize

This primarily includes the actual awarding of the prize and associated national as well as international events.

The Abel Symposia

One or two Abel Symposia are organised each year. The topic may be selected broadly in the area of pure and applied mathematics. A topic of historical or pedagogical importance may also be chosen. The symposia are to be on a very high level academically speaking and serve to build bridges between national and international research communities. The Norwegian Mathematical Society is responsible for the events.

Activities aimed at young people

This is a high-priority area. The Abel Board has appointed a separate committee for young people that is responsible for activities aimed at this target group.

Each year two major mathematics contests are organized in Norway, the Niels Henrik Abels Mathematics Contest and KappAbel. Both receive financial support from the Abel Fund.

The Niels Henrik Abel Mathematics Contest, usually just called the Abel Contest, is for upper secondary school pupils and is organised by the Norwegian Mathematical Society. Under the name HRH the Crown Prince's Prize, this is a competition with traditions going back to the founding of the Norwegian Mathematical Society in 1918. Due to low participation it was

discontinued in the mid 1970s, but was re-established under its present name in connection with the sesquicentenary of Abel's death in 1979. After preliminary rounds and finals, the six best contestants get to participate in the International Math Olympics (IMO).

KappAbel was first held in Froland in 1998 and was then a competition for pupils in lower secondary school in Aust-Agder County. KappAbel quickly went national and is today a competition for school classes in the Nordic countries. It is organised by Froland Municipality in collaboration with the Norwegian University of Science and Technology (NTNU) in Trondheim.

Bernt Michael Holmboe Memorial Prize

The Bernt Michael Holmboe Memorial Prize, to be awarded for the first time in 2005, is for the promotion of excellence in teaching mathematics. The prize will be given to one or more mathematics teachers or a mathematics department in a Norwegian primary or secondary school. B.M. Holmboe was the teacher who discovered Abel's prodigious talents and inspired him to further studies.

The Norwegian Mathematics Council will be in charge of selecting the winners, and the prize of NOK 50,000, as well as expenses connected with work on the prize, is financed by the Abel Fund.

International collaboration

In partnership with the International Mathematical Union, the Abel Fund supports one or two clearly defined projects for activities in the areas of teaching and research aimed at developing countries.

Professor Jens Erik Fenstad
Chairman of the Board, the Niels Henrik Abel Memorial Fund

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