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REFLEXIONS

The daily newsletter of ICM 2010

August 19, 2010

THE FIELDS MEDALISTS

Elon Lindenstrauss

Citation: "For his results on measure rigidity in ergodic theory, and their applications to number theory."

Lindenstrauss has made far-reaching advances in ergodic theory, the study of measure preserving transformations. His work on a conjecture of Furstenberg and Margulis concerning the measure rigidity of higher rank diagonal actions in homogeneous spaces has led to striking applications. Specifically, jointly with Einsiedler and Katok, he established the conjecture under a further hypothesis of positive entropy. It has impressive applications to the classical Littlewood Conjecture in the theory of diophantine approximation. Developing these as well other powerful ergodic theoretic and arithmetical ideas, Lindenstrauss resolved the arithmetic quantum unique ergodicity conjecture of Rudnick and Sarnak in the theory of modular forms. His work is exceptionally deep and its impact goes far beyond ergodic theory.

Professor, Hebrew University, 2008- , Professor, Princeton University, USA (2004-2010); Born in Jerusalem, 1970. B. Sc (Mathematics and Physics), The Hebrew University, Jerusalem, 1991; M. Sc. Mathematics, The Hebrew University, 1995; Ph.D. in Mathematics, The Hebrew University, 1999.

Awards: The Anna and Lajos Erds Prize in Mathematics 2009; Michael Bruno Memorial Award (given by the Rothschild "Yad Hanadiv" Foundation) 2008; European Mathematical Society Prize 2004; Salem Prize 2003; Clay Mathematical Institute Long Term Prize Fellow 2003-2005; Leonard M. and Eleanor B. Blumenthal Award for the Advancement of Research in Pure Mathematics 2001.

Ngô Bảo Châu

Citation: "For his proof of the Fundamental Lemma in the theory of automorphic forms through the introduction of new algebro-geometric methods."

In the 1960's and 70's Robert Langlands formulated various basic unifying principles and conjectures relating automorphic forms on different groups, Galois representations and L-functions. These led to what today is referred to as the Langlands programme. The main tool in establishing some cases of these conjectures is the trace formula and in applying it for the above purposes a central difficulty intervenes: to establish some natural identities in harmonic analysis on local groups as well as ones connected to arithmetic geometric objects. This problem became known as the Fundamental Lemma. After many advances by a number of researchers in 2004, Laumon and Ngô established the Fundamental Lemma for a special family of groups, and recently Ngô established the Lemma in general.

Ngô's brilliant proof of this important long standing conjecture is based in part on the introduction of novel geometric objects and techniques into this sophisticated analysis. His achievement, which lies at the crossroads between algebraic geometry, group theory and automorphic forms, is leading to many striking advances in the Langlands programme as well as subjects linked with it.

Professor,the Faculté des Sciences at Orsay. Born 1972 in Hanoi. After secondary school, he moved to France. He did his PhD in Orsay under the supervision of Gérard Laumon.

Stanislav Smirnov

Citation: "For the proof of conformal invariance of percolation and the planar Ising model in statistical physics."

It was predicted in the 1990s, and used in many studies, that the scaling limit of various two dimensional models in statistical physics has an unexpected symmetry, namely it is conformally invariant. Smirnov was the first to prove this rigorously for two important cases: percolation on the triangular lattice and the planar Ising model. The proof is elegant and it is based on extremely insightful combinatorial arguments. Smirnov's work gave the solid foundation for important methods in statistical physics like Cardy's Formula, and provided an all-important missing step in the theory of Schramm-Loewner Evolution in the scaling limit of various processes.

Professor, University of Geneva. Born in 1970 in St. Petersburg, Russia. He studied mathematical analysis with Viktor Havin at St. Petersburg State University. After graduating in 1992 he moved to the Caltech where he received his Ph. D. in 1996 under Nikolai Makarov. After short stints at the Institute of Advanced Study, Princeton and the MPIM, Bonn, Smirnov spent an important part of his career in Stockholm, where he came in 1998. Became professor at the Royal Institute of Technology and researcher at the Swedish Royal Academy of Sciences in 2001.

Awards: St. Petersburg Mathematical Society Prize (1997), Clay Research Award (2001), Gran Gustafsson Research Prize (2001), Rollo Davidson Prize (2002), EMS Prize (2004).

Cédric Villani

Citation: "For his proofs of nonlinear Landau damping and convergence to equilibrium for the Boltzmann equation."

One of the fundamental and initially very controversial theories of classical physics is Boltzmann's kinetic theory of gases. Instead of tracking the individual motion of billions of individual atoms it studies the evolution of the probability that a particle occupies a certain position and has a certain velocity. The equilibrium probability distributions are well known for more than a hundred years, but to understand whether and how fast convergence to equilibrium occurs has been very difficult. Villani (in collaboration with Desvillettes) obtained the first result on the convergence rate for initial data not close to equilibrium. Later in joint work with his student Mouhut he rigorously established the so-called non-linear Landau damping for the kinetic equations of plasma physics, settling a long-standing debate. He has been one of the pioneers in the applications of optimal transport theory to geometric and functional inequalities. He wrote a very timely and accurate book on mass transport.

Born in 1973 in France. After studying mathematics at École Normale Supérieure in Paris (1992-96), he became assistant professor there. He received his PhD in 1998. In 2000 he became a full professor at École Normale Supérieure de Lyon. In 2009 he was appointed director of the Institut Henri Poincaré in Paris, and part-time visitor of the Institut des Hautes Études Scientifiques.

The Rolf Nevanlinna Prize

Citation: "For smoothed analysis of Linear Programming, algorithms for graph-based codes and applications of graph theory to Numerical Computing."

Linear Programming is one of the most useful tools in applied mathematics. The oldest algorithm for Linear Programming, the Simplex Method, works very well in practice, but mathematicians have been perplexed about this efficacy and have tried for long to establish this as a mathematical theorem. Spielman and his co-author Shenhua Teng developed a beautiful method and proved that, while there may be pathological examples where the method fails, slight modifications of any pathological example yields a "smooth" problem on which the Simplex method works very well.

A second major contribution of Spielman is in the area of coding. Much of the present-day communication uses coding, either for preserving secrecy or for ensuring error correction. An important technique to make both coding and decoding efficient is based on extremely well-connected graphs called expanders. Spielman and his co-authors have done foundational work on such codes and have designed very efficient methods for coding and decoding. These codes provide an efficient solution to problems such as packet-loss over the internet and are particularly useful in multicast communications. They also provide one of the best known coding techniques for minimizing power consumption required to achieve reliable communication in the presence of white Gaussian noise.

Professor, Yale University. Born in Philadelphia in March 1970. B.A. in mathematics and Computer Science from Yale (1992), and Ph. D. in Applied Mathematics from M. I. T. (1995). His thesis was on 'Computationally Efficient Error-correcting Codes and Holographic Proofs'. He spent a year as a National Science Foundation (NSF) post-at University of California, Berkeley, and then taught at the Applied Mathematics Department of MIT until 2005.

Awards: Fulkerson Prize, jointly awarded by the American Mathematical Society (AMS) and the Mathematical Programming Society (2009); the Gödel Prize, jointly awarded by the Association for Computing Machinery (ACM) and the European Association for Theoretical Computer Science (EATCS) for the paper with Teng on 'Smoothed analysis of algorithms: Why the simplex algorithm usually takes polynomial time'.

Spielman has applied for five patents for error-correcting codes that he has invented and four of them have already been granted by the U. S. Patent Office.

The Gauss Prize

Citation: "For fundamental contributions to number theory, operator theory and harmonic analysis, and his pivotal role in the development of wavelets and multiresolution analysis".

Meyer has made fundamental contribution to a number of mathematical areas. Around 1970, he developed the theory of model sets in number theory, which has become an important tool in the mathematical study of quasicrystals -- space-filling structures that are ordered but lack translational symmetry -- and aperiodic order in general. Together with Ronald Coifman and Alan MacIntosh he proved the continuity of the Cauchy integral operator on all Lipschitz curves, a long-standing problem in analysis.

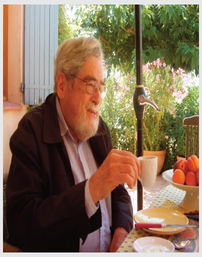
Meyer played a leading role in the modern development of wavelet theory, which has had a spectacular impact in information sciences, statistics and technology. Fourier analysis is a universal tool in applied mathematics, and due in a large measure to Meyer's work, wavelet theory has become the new name for Fourier analysis. He constructed the first non-trivial wavelet bases and wavepackets that dramatically extended the expressing power of wavelets. This led to many applications in practice – in image processing, data compression, statistical data analysis and elsewhere. Among the many applications of Meyer's work, the techniques for restoring satellite images and the image compression standard JPEG-2000 deserve particular mention.

More recently, he has found a surprising connection between his early work on the model sets used to construct quasicrystals -- the 'Meyer Sets' -- and 'compressed sensing', a technique used for acquiring and reconstructing a signal utilizing the prior knowledge that it is sparse or compressible. Based on this he has developed a new algorithm for image processing. A version of such an algorithm has been installed in the space mission Herschel of the European Space Agency (ESA).

Professor Emeritus at École Normale Supérieure de Cachan, France, Born on July 19, 1939. He graduated from École Normale Supérieure, Paris, in 1960 and became a high school teacher until 1963. He then obtained Ph. D. from Université de Strasbourg in 1966. He was his own thesis supervisor. He has been a professor at École Polytechnique, Université Paris-Dauphine and has also held a full research position at Centre National de la Recherche Scientifique (CNRS). France, He served as a professor at École Normale Supérieure de Cachanduring 1999-2009. He is a foreign honorary member of the AAAS. He has also been awarded a Doctorate (Honoris causa) by Universidad Autonoma de Madrid.

The Chern Medal Award

Citation: "For his role in the formulation of the modern theory of non-linear elliptic partial differential equations and for mentoring numerous students and post-docs in this area".



Nirenberg is one of the outstanding analysts and geometers of the 20th Century and his work has had a major influence in the development of several areas of mathematics and their applications. He has made fundamental contributions to the understanding of linear and non-linear partial differential equations (PDEs) and related aspects of complex analysis and geometry, the basic mathematical tools of modern science. He developed intricate connections between analysis and differential geometry and applied them to the theory of fluid flow and other physical phenomena.

Nirenberg's name is associated with several major developments in analysis in the last 65 years. His theorem with August Newlander on the existence of almost complex structures has become a classic. One of the most widely quoted results in analysis is that a priori estimates for general linear elliptic systems, which he obtained with Shmuel Agmon and Avron Douglis. His fundamental work with Fritz John on functions of bounded mean oscillation was crucial for later work of Charles Fefferman on the space of such functions. In collaboration with Joseph Kohn, he introduced the nation of pseudo-differential operator, which has been influential in many areas of mathematics. Other significant works of Nirenberg, which he has carried out in collaboration with others, have been on solvability of PDEs, existence of smooth solutions of a class of PDEs and equations of fluid motion of Navier-Stokes kind. He has published over 185 papers and has had 46 students.

Emeritus Professor, Courant Institute of Mathematical Sciences, New York University. Born February 25, 1925, in Hamilton, Ontario, Canada. After receiving his bachelor's from McGill University in 1945, he went to NYU from where he obtained his M. S. (1947) and Ph. D (1949), under the direction of James Stoker. Nirenberg then joined the faculty of NYU. He was one of the original members of the CIMS. He spent his entire academic career at Couran from where he retired in 1999.

Awards: American Mathematical Society's Bôcher Prize in 1959 for his work on PDEs, Jeffrey-Williams Prize of the Canadian Mathematical Society in 1987 and the Steele Prize of the AMS in 1994 for Lifetime Achievement. He was the first recipient in mathematics of the Crafoord Prize, established by the Royal Swedish Academy of Sciences, in 1982. In 1995 he received the National Medal of Science, the highest honour in the U. S. for contributions to science.

Abel Prize: The Norwegian Nobel Prize for Maths

The prize is administered by the Norwegian Academy of Science and Letters

R. Ramachandran

The Abel Prize is an international prize established in 2001 and awarded for outstanding lifetime achievements in mathematics. The prize is named in honour of the great Norwegian mathematical genius Niels Henrik Abel (1802-1829) who died at the young age of 26. Abel is often compared with the Indian mathematical wizard Srinivasa Ramanujan.

The prize is administered by the Norwegian Academy of Science and Letters and the winning candidate is selected on the basis of the recommendation of an international committee chaired by a Norwegian. The committee consists of five outstanding mathematicians appointed by the Academy upon recommendations by the European Mathematical Society, the International Mathematical Union (IMU) and the Academy's group for pure and applied mathematics. There are three IMU nominees and one each nominated by the other two bodies in the committee.

The current value of the prize is NOK 6 million (approximately $980,000), which is derived from the annual returns on the NOK-200-million Abel Memorial Fund established by the Norwegian government in 2001. That is, while the fund belongs to the state, proceeds from it are used by the Academy. The first Abel Prize was awarded in 2003.

Though the prize money will vary according to returns from the corpus fund, it will be similar to the amount of a Nobel Prize, the most coveted prize in the sciences, which, however, does not include mathematics. The Fields Medal of the IMU, which was given for the first time in 1936, is generally regarded as the `Mathematician's Nobel' and is extremely prestigious. But only mathematicians below the age of 40 are eligible for the Fields Medal and it does not have any monetary prize except for a symbolic amount. The Abel Prize, on the other hand, has no such restriction and is comparable to the Nobel Prize both in terms of value and the eligibility criterion.

The Prize was established as part of the events leading up to the celebrations of Abel's 200th birth anniversary, a little over 100 years after the idea was mooted in 1899 by the famous 19th century Norwegian mathematician Sophus Lie (1842-1899) shortly before his death.

In 1902, as the celebration of Abel's first centenary approached, three main tasks had been specified: to arrange a broad cultural commemoration of Abel, to raise a worthy monument in his memory and to establish an international Abel Prize. Though Lie had been the first enthusiastic proponent of establishing an Abel Prize, the idea died with him. Lie's suggestion for an Abel award every five years for outstanding work in pure mathematics had been inspired by the knowledge that Alfred Nobel's plans for annual prizes, made known in 1897 itself, would not include mathematics. Although the support to Lie's suggestion from leading mathematics centres in Europe was enormous, the contacts and promises were apparently tied too much to Lie personally and hence it could not be realised easily.

Niels Henrik Abel

During Abel's first centenary celebration, King Oscar II of Norway got interested in the idea and revived the proposal in close association with the Science Society of Christiania, now the Norwegian Academy of Science and Letters, and Norwegian mathematicians Carl Stormer and Ludvig Sylow. However, with the dissolution of the union between Sweden and Norway in 1905, the plans were once again dropped. It was revived only in August 2000 when an industrialist, Tormod Hermansen, the then CEO of Telenor, met Arild Stubhaug, who had written Abel's biography just the year before. Hermansen briefed the Norwegian Ministry of Education, Research and Church Affairs about the idea and Stubhaug made the proposal to the Department of Mathematics, University of Oslo.

The university took up the matter seriously and set up a working group comprising Professors Jens Erik Fenstad, Arnfinn Laudal, Ragni Piene, Yngvar Reichelt and Nils Voje Johansen, and the author Stubhaug. The working group submitted the proposal to the Norwegian Prime Minister in May 2001. "Norway is a small country. There are close connections and people who matter generally know each other. So we could lobby with the government and after some time we were very surprised to learn that the government had agreed to fund this prize," says Piene.

On August 23, 2001, during a speech at the University of Oslo, Prime Minister Jens Stiltenberg announced his government's decision to establish the Abel Fund. Though the prize has gained stature and prestige, no one thinks that it will replace the Fields Medal. "This is a different kind of prize and it is not meant to compete with the Fields Medal," points out Piene. "In fact, the IMU helped us in establishing the prize and its backing was useful in our lobbying within Norway, which was very important," she adds.

(From Frontline, April 20, 2007)

Why there`s no Nobel Prize in Maths?

R.Ramachandran

One of the oft-cited reasons for Alfred Nobel not instituting an award for mathematics is that the famous Swedish mathematician Gösta Miagnus Mittag-Leffler had run off with Nobel's wife. Though there is no evidence to support this story - because Nobel never married - it has assumed a life of its own. One comes across different versions of this: that the woman was not Nobel's wife but the one he had proposed to or that she was his mistress and so on.

Another story is that Mittag-Leffler, in the process of accumulating considerable wealth, had antagonised Nobel. Nobel, afraid that Mittag-Leffler might win the prize for mathematics, did not institute a prize for mathematics. This also seems far-fetched as there were greater mathematicians such as Henri Poincaré and David Hilbert around at that time.

Both the apocryphal stories were debunked in an article by mathematicians Lars Gårding and Lars Hormander in the journal Mathemetics Intelligencer in 1985. According to them, Mittag-Leffler and Nobel had almost no relation to each other. Nobel migrated to Paris in 1865, when Mittag-Leffler was still a student, and rarely returned to visit Sweden. There is no evidence of any animosity between them either. In fact, during Nobel's last years Mittag-Leffler is known to have been engaged in persuading Nobel to designate a substantial part of his fortune to Stockholm Hogskola (which later became Stockholm Universitet).

Apparently, Nobel had originally intended to do this but eventually formed the Foundation much to the disappointment of Hogskola. Following this, academic rivals of Mittag-Leffler at Hogskola alleged that it was Nobel's dislike for Mittag-Leffler that made him change his mind. This incident could have contributed to the prevalent myth with juicy bits thrown in.

"The true answer," say Gårding and Hormander, "is that, for natural reasons, the thought of a prize in mathematics never entered Nobel's mind." Nobel's final will bequeathed $9 million for a foundation whose income would support five annual prizes in fields which, except for medicine, were close to Nobel's interests. Economics was added in 1969. He perhaps simply did not care much for mathematics because it was not considered a practical science, which could benefit humanity (a chief purpose of creating the Nobel Foundation). His will speaks of prizes for those "inventions or discoveries" of greatest practical benefit to mankind.

As Peter Ross points out in Math Horizons (1985), "with the blossoming of computer science, statistics and applied mathematics in addition to mathematics itself, a strong case could be made for a new Nobel Prize in the mathematical sciences".

Mathamatics is a fashionable subject, says László Lovász


László Lovász

László Lovász, President of the International Mathematical Union (IMU), is the Fields Medal Prize Committee Chair for ICM 2010. He was the recipient of the National Order of Merit of Hungary in 1998. In 1999, he was awarded the Knuth Prize, Göedel Prize came in 2001 and the Wolf Foundation Prize in mathematics for outstanding contributions to combinatorics, theoretical computer science and combinatorial optimization.

Lovász has obtained ground breaking results in discrete mathematics which have had very significant applications in other areas of pure and applied mathematics as well as to theoretical computer science. He solved several outstanding problems including the perfect graph conjecture, Kneser's conjecture and the determination of the Shannon capacity of the pentagon.

He shares his experiences in conversation with **B.Sury**.

How was your term as President of the IMU?

It was a busy time. We had to prepare ourselves for some difficult decisions. Most prominent of these is the establishment of a permanent office for the IMU. That was a big step which we had to work out carefully so that the financial and other problems are solved. On the other hand, I think that the Executive Committee was very active and helpful and we had a very good working relationship between ourselves.

Were there any major decisions which were taken in these four years?

The permanent office was such a decision. We realized that we don't have the finances to rent an office and hire staff. IMU doesn't have much money and membership fees is small. So, what we decided is to ask the community for help. We announced that institutions can bid for the hosting of our office. The idea was that for a big research institute to spare a room and maybe some secretarial help would not be such a big deal. And we got a fantastic reply and generous offers. We started off with eleven or twelve offers and now we are down to the best three offers which are all very generous. Whichever is decided, I am sure, will give a good stable permanent location, secretarial help, internet connection… Tomorrow at the General Assembly, we'll approve the whole thing and then decide which of the three bidders will get the office.

You've been working in the US and you decided to move back to Hungary in 2007. What influenced your decision?

We (me and wife) always considered it to be somewhat temporar. We liked it very much there, but somehow we decided that when we are getting close to retirement we want to go back to our home country. We thought that we should give a few years to re-integrate before we retire. If you just retire and go back, you may not have the connection.

Another element of the decision was that our son turned fourteen when we moved back. He was very good in math and there is a special school in Budapest for mathematically talented kids. Both my wife and I went to this school H́. So we thought it would be good for him to go to that school. And that worked out in the end and he enjoyed the school and got excellent preparation for his mathematical studies at the university.

How did Hungary come to have such a strong tradition in combinatorics?

I think in this particular field, mainly combinatorial graph theory which is a branch of combinatorics H́ just one or two Hungarian mathematicians started to work on it back before World War II, even before World War I actually. Then they had students and some of the students were absolutely outstanding people. König was the Founding Father of this school and he wrote the first text book in the world on graph theory. Paul Erdös was one of his students. He is very well known and there are books written about him. He is one of the most influential mathematicians in the twentieth century. Through his work many people became interested because the way he did mathematics was always absolutely open. He liked to sit in a room with people and chat with them and raise problems. In particular he liked if there were young people, high school kids there. They were new subjects, but some of the problems that he raised were actually accessible without a lot of background knowledge. That's how many of these young people got interested in this field.

And he was travelling…he had some arrangement that he could travel around the world and come back to Hungary, because Hungary was behind the Iron Curtain. I wouldn't say it was impossible to travel but how much travel you could do was limited. And he always had the newest information.

Who was your inspiration?

When I was fourteen, I was looking for a high school to go to. That's when this class for mathematically talented kids was formed. My teacher recommended me to go to this class, which was fantastic. I consider it the best move in my life. An excellent school with excellent other kids and very good teachers H́ I really liked it. After that, it was sort of automatic.

Has computer science helped you in your career as a mathematician?

I was always interested in computers. Hungary didn't have a lot of computing power in those days. Computers were very rare when I was a university student. But we got interested in algorithms at least on a theoretical level. So at least theoretical computer science started, which actually is quite closely related to graph theory; in many points, it has connections. In a sense, graph theory may be one of the most important mathematical backgrounds of computer science just like say, mathematical analysis is the background for physics.

Computer science was beginning to grow in the late sixties, seventies. It became a separate subject. It was recognized that there are mathematically very interesting and in fact basic problems in computer science which in a sense, I think every mathematician should know about because they influence the way we think about mathematics. It was a very exciting time because combinatorial mathematics and computer science grew side by side and it was almost impossible to separate them.

Is there a lacuna in the teaching and learning of school mathematics nowadays compared to your school days?

If you ask about it in Hungary, I would say that the situation has changed with respect to mathematics because in those days, mathematics was considered to be 'the' subject to study because there were no political sides. So you didn't have to put up with all sorts of political pressures if you wanted to do mathematics. It was international. A mathematical result is recognized in the same way all over the world but if you do say, archaeology then clearly Hungarian archaeology has limited interest. Some interest outside, but it is limited. And also, mathematics didn't need a lot of expensive equipment like physics. So mathematics was a very fashionable subject.

Then the political situation changed, democracy came, capitalism was re-established. So many young people want to go into finances, banks, stock markets and these sort of things. There is a decrease in interest which is all over the world, you can feel it all over the world. I don't know how it is in India but in Hungary and in the West, it is unfortunate because somehow there is this feeling that, you don't have to put up with all those really hard studies that you have to do if you do a hard science.

...Continued on Pg 8

Princeton Woman Professor Makes Waves

Geethanjali Monto

Ingrid Daubechies, whose birthday was yesterday, is the first woman President (2011–14) of the International Mathematical Union (IMU). She is also among the first four women to be plenary speakers at the International Congress of Mathematicians (ICMs). Emmy Noether gave a plenary lecture at the 1932 ICM in Zurich, Karen Uhlenbeck at the 1990 ICM in Kyoto, and Ingrid Daubechies and Marina Ratner at the 1994 ICM in Zurich.

Daubechies was born in 1954 in Belgium and is now settled in the US (from 1987) after her marriage to Robert Calderbank, also a mathematician. She has been a Fellow of the MacArthur Foundation from 1992–1997. She is the first woman Professor of Mathematics at Princeton University, New Jersey – she works in the Department of Mathematics and in the Program in Applied and Computational Mathematics there. Her research interests include time–frequency analysis (especially wavelets) and its applications in mathematics and other sciences, engineering and art.

Ingrid Daubechies

Daubechies is a mathematician and a physicist, winning several awards such as the Louis Empain Prize for Physics (1984), the Leroy P. Steele prize for exposition (1994) for her book Ten Lectures on Wavelets, the American Mathematical Society Ruth Lyttle Satter Prize (1997), and the IEEE Information Theory Society Golden Jubilee Award for Technological Innovation (1998).

She is the first woman to receive the National Academy of Sciences Medal in Mathematics (2000) – the award honoured her 'for fundamental discoveries on wavelets and wavelet expansions and for her role making wavelets methods a practical basic tool of applied mathematics'.

In September 2006, the Pioneer Prize from the International Council for Industrial and Applied Mathematics was awarded jointly to Ingrid Daubechies and Heinz Engl. The citation for Daubechies read: '...Daubechies' best known achievement is her construction of compactly supported wavelets in the late 1980s. Since that time she has advanced the development of biorthogonal wavelet bases. These bases are currently the most commonly used bases for data compression. Daubechies' name is widely associated with the biorthogonal CDF wavelet.

Wavelets from this family are currently used in JPEG 2000 for both lossless and lossy compression. Her continuing wavelet research also resulted in pathbreaking work including the discovery of Wil son bases. This discovery led to the existence of cosine packet libraries of orthonormal bases and Gaussian bases. These are now standard tools in time frequency analysis and numerical solutions of partial differential equations.'

Daubechies (Yes She Is!) The New IMU President

Your work has a lot of theoretical content and also concrete applications. To what do you attribute this achievement?

Mainly to curiosity... As long as I can remember, I've been interested in understanding how things work. I am also interested in making connections – if I learn something new and it reminds me of something else, I try to really clarify this, I like to really understand and articulate this kind of hunch. At first such hunches are at the level of ``science fiction".

You have to really work in order to make the link explicit, and then you disentangle it and you find structure. You find ways of connecting things that might not seem connected before or leading to a very important application. This is something that I like to do.

At present, I'm involved in collaborations with people in different branches – in biology, in psychology and recently even in art history – mainly because I really like to listen and learn from people who are experts in what they do. I enjoy learning more and then I like to think about the problems they have or connections that could be made. That's how I find the problems that I work on – by curious listening.

The applications of mathematics are not widely known...

They are and they aren't. All the engineers who work with mathematics, of course, know – they use mathematics. What is not as widely known, I think, is how things that develop in one field can be really useful in another field. I was talking to somebody here who used to work in ecology, plants and insects and their interactions and relationships. And now she has moved to a different institution and works in models for cancer research but the mathematics she is doing are the same.

So, on the one hand, you can have the same mathematics that you use in quite different applications. On the other hand, you also have applications that require a completely different branch of mathematics.

I am involved in an application in biology where we extensively use differential geometry. Data analysis is becoming increasingly complex and people are realizing that more than just using probability and linear algebra, they need to bring in topology and differential geometry and combine that with probability. Every branch of mathematics can be applied and applied mathematicians actually need to know as much pure mathematics as they can. When you work in applied math, the problem decides what mathematics you need to learn. I am an applied harmonic analyst, but I am now working on this problem where I need more differential geometry and so, I have a post-doc teach me differential geometry and it's great because as I said, what I really enjoy is learning new things.

School children don't understand mathematics, the formulae...

I don't know about India. But in Europe and America, too much of mathematics in high school has become formulae, very divorced from other things in science or applications or when applications are brought in, they feel very artificial. They use words of an application in economics or so but in practice, it still seems very far from the problems that people have in their lives.

Do you have any suggestions for improvement?

When you want to do serious applications, you need more math than what you usually see. So, bringing in these baby applications is not necessarily a good way. They have to be there too, but mathematics is more about finding ways to think about a problem and of solving.

I was on leave in Belgium the first six months of this year and I became very involved in setting up a framework for a contest. It's going to be for high school students this fall. We will pose math problems but not math along the conventions of what they see in high school but nevertheless accessible to students from high school. They are not considered easy but are not problems in which a lot of computation has to be done. They have to think. We are going to challenge classes to think about them together.

We are hoping to attract a lot of attention from school children and we are hoping to show them that it isn't that the math that they see in high school is not math, but it is a very technical kind of math that may be a good preparation for calculus and engineering and sciences but there is so much more to mathematics than that. Plus, there may be students who don't like that technical aspect but who would be great mathematicians.

...Continued on Pg 7

Korea Wins The Bid For ICM 2014

Geethanjali Monto

The next International Congress of Mathematicians (ICM 2014) will be hosted by Korea. This decision was taken by voting at the 16th General Assembly (GA) meeting held in Bangalore, India from 16–17 August 2010. The GA usually meets every four years at a place and date which is in proximity to that year's ICM. The 2010 ICM is to be held at Hyderabad from 19–27 August.

The first ICM in 1897 established certain objectives of the Congress, the first two of which were: (1) To foster personal relations between mathematicians of different countries; (2) To present in the lectures of the plenary sessions and the different sessions an overview of the current state of the different areas of mathematical sciences and their applications, and to discuss specific problems of particular importance.

Since the first ICM held in 1897 at Zürich, these Congresses and their General Assemblies have travelled all over the world from Paris (1900) – UK (1912) – Strasbourg (1920) – Oslo (1936) – USA (1950) – Nice (1970) – Vancouver (1974) – Kyoto (1990) – Berlin (1998) – Beijing (2002) – Madrid (2006) – India (2010), to name some.

The ICM 2014 Site Committee comprising of László Lovász (IMU President), Zhi-Ming Ma (IMU Vice President), Martin Grötschel (IMU Secretary) and Manuel de Léon (Chair of previous ICM) visited the three candidates or bidders namely Montreal (Canada), Rio de Janeiro (Brazil) and Seoul (South Korea). Manuel de Léon said that the Site Committee found the three bids really good with a strong involvement of the local mathematical community, good financial provisions and convenient congress centres. The Executive Committee decided to recommend Seoul as the site for the next ICM 2014.

Speaking to Hyungju Park, Chair of the Seoul ICM 2014 organizing committee and Professor and Chair of the Department of Mathematics, POSTECH just before the announcement of the site for ICM 2014, on their bid for the same: 'Korean mathematical society decided to bid for ICM 2014 in 2007. At the beginning of July in 2007, the Korean math society formed a bidding committee for ICM 2014 and I was the Chair of that bidding committee. The reason we decided to make that effort was…Korea was a late starter in modern mathematical research. We started very late and even until 1980's, for example in 1981, we had only 3 papers that were published in international mathematical journals from Korea.

So Korea was in a very difficult situation, had a lack of resources, had a lack of mathematicians and also a lack of students. Somehow, things started to change from late 80s, early 90s. Now for example in terms of quantity, let's say, in 2008 when we look at the statistics, Korea ranked eleventh in the world in terms of number of publications. So in this span of 20–30 years, Korea made an almost unprecedented progress in mathematics, not just in quantity but quality. Now some high quality results are coming from Korea. In 2008, we had 2500 mathematicians who are members of the Korean mathematical society. Of these 1100 or 1200 were professors in mathematics. So the Korean mathematical community has grown in size also. But we felt that we need to go forward and really get involved in the core of mathematical research. We wanted to encourage our young researchers in the positive direction and so for that we needed more mathematics jobs, academic jobs, more post doctoral positions and research grants and mathematics. For that we needed something that can act as a pivot and we thought that this ICM in Korea would do that. Our motto or keyword for this effort was 'dreams and hopes for late starters' meaning Korea was a late starter. However we think we made such rapid progress in a short span of time and came to where we are, and if we have the ICM, maybe we can inspire those developing countries that are still in a difficult situation experiencing lack of resources. So we thought we would put our emphasis on that.

We wanted to prove our earnest intention not just verbally…we actually offered to provide 1000 mathematicians from developing world to attend the ICM if it is approved, so that those mathematicians from the developing world who may not have been able to experience ICM would be able to experience it and bring it to their home countries and inspire their younger generations. It can beneficial. And the government was very enthusiastic in supporting us and has granted us budgets for the bidding efforts and everything. After the IMU Executive Committee recommended Seoul as a candidate city for the ICM, the Korean government, for example, increased research grants for mathematics and they have also established more research centres where young post docs can get training. The whole infrastructure in mathematics is being rapidly changed because of the ICM. So we think a lot of good things for mathematics in Korea and also in the developing world are happening. Hopefully the traditionally passive member countries of IMU may get more involved in IMU activities, so that more balance in terms of distributing resources and mathematical research geographically or area-wise will occur by this Korean ICM.'

In his presentation at the General Assembly, Hyungju Park described the 'story of Korea' in terms of its economy, education, culture, accessibility and history of mathematics. 'In 2008, Korea ranked eleventh in SCIE publications in math, almost tripling its publications in 10 years…In IMO (International Mathematical Olympiad), Korea is now steadily ranking third or fourth...Math is becoming a very popular subject in Korea. When kids enter college, they take a college entrance exam and they choose their majors. The most popular area right now is medicine and the second popular subject is mathematics in major universities. This is something we didn't expect before. So definitely math is becoming a very popular subject and we think that our ICM efforts contributed to that also. We are telling young students that math is a fascinating subject and there are things that are happening.'Regarding Government encouragement for the 2014 ICM, Park said that 350,000 dollars have been awarded to the bidding committee for its bidding efforts most of which they spent in organizing national conferences, so that international scholars could visit them in Korea and also that young Korean mathematicians could attend the national meetings. This year, the Government provided another 350,000 dollars most of which was used to aid large scale participation of Korean mathematicians in the 2010 Hyderabad ICM.

From left to right : Hyang-Sook Lee, Jeong Han Kim, Hyungju Park

Family No Hindrance For a Woman Mathematician

...Continued from Pg 5

...We tend to teach math by asking students for a suspension of disbelief. 'If you become an engineer, you will need this stuff! Don't worry if you don't understand how this will be useful and so on. You just believe us, you'll need it.' I don't know if that's a very good way to teach. Now I happened to enjoy math a lot even in such courses because I was good at it and I was good at playing with these things. But I think I would have enjoyed a different type of math course even more. So with this contest, we want to try to get kids to see that mathematics is more than only what the textbooks in high school contain.

Is mathematical research done differently in the US and Europe?

The structure of how people get into their careers is different. In the States, you have graduate programmes. You apply to a graduate programme without having identified an advisor with whom you intend to work. Once you are in the programme, you try to find a match with an advisor. In Europe, the funding is done in such a way that you have to have a match with an advisor even before you start. So you find an advisor, the advisor may have money and so you make that match. I regret that a bit because on the one hand, it means that you are really married to that advisor form the start. It also means that you are much less involved in a programme where there are a lot of different interests and money and people and different branches of mathematics.

In a good graduate programme in the States, you have students talking to each other who are interested in number theory or analysis or yet other topics. People may still decide what field they are going to go in. That, I like better in the States. On the other hand, becoming a mathematician and the way you do research is the same everywhere –you think about problems, you learn about what's going on and you try to think about new ways of doing things.

Research in mathematics is also a much more social thing than many people realize. In the exception where somebody sits in seclusion for many years and comes out with great results – it happens, but it is exceptional – people talk a lot to each other and explain with their hands and make sketches and so on. They use a lot of metaphors, they have hunches and they have to make it rigorous but it is a much more intuitive and social field than people realize. I think we should convey that much more.

Are there any special challenges facing women professionals, especially in developing countries?

The important thing is to make sure that the profession gets set up in such a way that it is possible to combine having a family. In many cultures, women are still the most important care-givers to young children. It's perfectly compatible with being a mathematician. There's no problem in having to think about mathematics and take care of children. It is

Ingrid Daubechies

a problem if the whole responsibility for minding the children 24 hours out of 24 comes on the shoulders of one person. Then you cannot be anything else. If there is a structure in the society where it is very well possible to be a mother but also have time for other pursuits, then there's no problem.

Through child care or through extended family…there are many ways in which this can be solved. Once that is possible, then women can think about mathematics. It's actually very little known that in the nineteenth century, in Britain for instance, there was a magazine with math problems for women, a Ladies Almanac. This was, of course, for women who had some leisure time, women who were reasonably well off or middle class. They had time on their hands and if they were interested in math, then they would do math problems. So there was a demand for math problems in a women's magazine.

To have a career path in math for women, you have to have a society where a career is possible at the same time as having a family, because most young women want to have a family. Well, most young men too, but for young men – if the society is such that if they have a wife who takes care of the children, then of course, they can have a career. But if women don't have the possibility of a framework in which they can have a family and a career that involves their brain then…There are too few women in mathematics now. If we get more women, it will be more obvious to young smart women that it is possible.

As the next IMU President, how do you plan to manage all these new responsibilities?

When I am new President, I will have some relief from my duties at Duke. I negotiated that when I knew that this was a possibility. I think it will be very interesting. I am very interested in how emerging countries develop mathematics. There is enormous potential in young people and they are interested. In a sense, mathematics is easier for an emerging country to develop than physics or chemistry because you need to have a big layout in materials and labs and lot more money. In mathematics, once you build a nucleus of people who can work together, then the sky's the limit!

I like the idea of fostering mentoring relationships that I heard mentioned at the IMU General Assembly. For instance, in my case, my children are now at university in the United States. That means that they are basically independent. Even in other countries, children become independent after university. At some point in your life, you still have plenty of energy and you actually have more money than when you were young. And many of us are idealistic and would like to help. So CDC (Commission for Developing Countries) could be an organization that identifies interesting opportunities where people who want to take part of a sabbatical to help could then contribute some of their own resources but for an already well-identified target. And not just to go and give lectures for a week or so – that doesn't achieve anything – but to go for a longer visit, build mentoring relationships that can be sustained. So I think a lot is possible and we could, within one generation, see a big difference there, and make a big difference.

Where do you see mathematics heading in the future?

In mathematics, developments come from people making connections between sub-fields in mathematics. If you look, for instance, at Fields medals in past years – very often, they come from connections that didn't exist and had not been established. But I also see new applications requiring structures that people who build the applications grope for and try to build, but that require a better setting and that will lead to new fields and constructions within pure mathematics. And I see both of them happening.

The most spectacular things will come from applications; there will be plenty of things that will come from biology, for instance. But the interesting ones are not the ones that I can describe to you now. They are the ones that will grow out of applications because we need them. And thirty years from now, people will trace back to those first applications. If I could describe them now, they would not be as interesting as I expect them to be.

Geethanjali Monto

Continued from Pg 4

'The Exciting Question in Applied Mathematics Today Is to Understand Complex Large Structures'

László Lovász

Buy the way mathematics is taught in the classroom overwhelms certain children...

Mathematical education is of course a difficult thing and every country tries a different method. There are some big swings but not necessarily in the good direction.

Does winning in mathematical Olympiads assure that you become a good researcher?

There is a very strong correlation. Of course, people have all sorts of problems and also lose interest or become interested in something else.But if you look at the Math Olympiad gold medalists, a very large number of them became leading mathematicians.

Are some countries at an advantage when it comes to mathematical research compared to others?

Mathematical research may be a good area where countries can catch up easier than say an expensive biological research. It's a lot more difficult to provide facilities for that. There are some, not too many, institutions in the developing world which are on level with the best; Tata Institute for example, IMPA in Brazil, Tsinghua University in China which are really on level with the world's best institutions. And hopefully there will be more. There are other ambitious places Ĥ I hope they will be successful.

Do you think a mathematician has more longevity in professional research than other scientists? They say that 'mathematics is a young person's game'. Is it true?

There is some truth in that, but it is not that simple. When I was young, I had the great fortune of being able to meet Erdös fairly regularly and sit in the room with other people and get these problems. I got the mathematical problem and I never questioned it. I thought that if Erdös asked the problem, it must be an important problem and I started to work on it. Nowadays I have to figure out which problems are important. I think over sixty, one has more experience, and therefore maybe I can help in this respect to figure out which problems are important. Maybe the style of doing mathematics is a bit different for older people and younger people but at least for a while I would like to do mathematics and I hope I can do it in a useful way.

Mathematical talent is actually recognizable at a rather early age. I have seen this in many cases in young kids. There's one who thinks in a different way; the others are just sleepy. If you are multiplying some numbers, they ask 'why are you doing it like that?' That means that these students can start studying mathematics early. I am not in favour of sending kids early to the university. I think it's much better if there is some organization or some people who are giving them some problems that sort of enriches what they learn but not necessarily by pushing it past through university. I know that in the United States that's the way to do. That's of course one of the reasons why we decided that maybe our son should go to the Hungarian system.

Mathematics is easier for young people because you don't need equipment. In many sciences you have to fight for this equipment and then of course seniority and influence and connections and other things matter much more. On the other hand, in mathematics it is important to have an environment which tells a young person what to think about and what are the important problems and what is the direction in which the science of mathematics goes. I should say, luckily, the culture in mathematics is quite good in this respect. So, senior people are usually not only willing but quite eager to get younger people working. If there are good senior people around, young people will get those problems. And there's more time because old people have a lot of responsibilities besides research.

So I think there's truth in that but I don't think it's like with forty, you should retire and go to sail around the world.

Where do you think mathematics is headed in the future?

That is always very difficult to predict because mathematics has its internal logic which is driving it forward. There are some big developments which come entirely from the internal need. There have always been such developments. It is also driven by applications. The one thing I see is that the need of applications is nowadays a little bit different, maybe because they are developing. So to me, now, the exciting general question in applied mathematics is to understand complex large structures. That seems to be where the application of mathematics is heading.

And also possible applications in history or something where you have a structure of interacting people. History is determined by how ideas or inventions or religions or diseases are spreading. This is a complex structure which we are starting to understand but we don't really have an established theory. Of course there is brain research or internet research or ecology or global warming. In all of these, the trouble is there are very large structures where you cannot just write up a few equations and solve them and that tell you what's going to happen. So that's what to me a big challenge in front of mathematics is.

Bailing out :
A young mathematician was visiting the university of Chicago and was unfamiliar as yet with the local ways of communication.
Walter Baily came up and introduced himself briefly as - ``Walter Baily" to which the visitor replied, ``no ! no! I am so-and-so."
After Baily smiled and left him, the visitor caught hold of someone nearby and, pointing towards Baily, asked ``could you tell me who that is?"
On being told that the person was Walter Baily, the visitor quipped, ``but he thought I was Walter Baily!"

What's Today At ICM

09:30-12:30, Halls 3 & 4 - ***Opening Ceremony***

Award of Fields Medals and the Nevanlinna, Gauss and Chern-Prizes

12:30-14:00 - ***Lunch***

14:00-16:30, Hall 4 - ***Laudations***

Chair: J. Palis Junior
14:00-14:25 Work of Elon Lindenstrauss
14:30-14:55 Work of Ngô Bao Châu
15:00-15:25 Work of Stanislav Smirnov
15:30-15-55 Work of Cédric Villani
16:00-16:25 Work of Daniel Spielman

16:45-17:45, Hall 4 - ***Abel Lecture***

S. R. S. Varadhan, Courant Institute of Mathematical Sciences, New York University, USA
Large deviations
Chair: K. R. Parthasarathy

An ode to the prime number theorem :

Numbers in their prime
for no reason or rhyme
show up at a rhythm
with probability 1/logarithm.
If this is a law they knew,
they also break quite a few
but that is not a crime!

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