The Legacy of Shiing-Shen Chern

The Chern Medal Award was established in 2009 in the memory of the outstanding Chinese mathematician Shiing-Shen Chern (1911 – 2004). It was awarded for the first time yesterday at the 2010 International Congress of Mathematicians (ICM 2010) at Hyderabad, India. It will subsequently be awarded every four years at the quadrennial ICMs.

The Award will be given to an individual whose accomplishments warrant the highest level of recognition for outstanding achievements in the field of mathematics. All persons, regardless of age or vocation, are eligible for the Medal. The award consists of a gold medal and a cash prize of US$ 250,000. In addition, each Medalist may nominate one or more organizations to receive funding totaling US$ 250,000, for the support of research, education, or other outreach programmes in the field of mathematics. This is called the "Organization Award". The prize is jointly awarded by the International Mathematical Union (IMU) and the Chern Medal Foundation (CMF). The CMF funds the award.

The Chern Medal for 2010 was awarded to

The face of the genius

Louis Nirenberg of Courant Institute of Mathematical Sciences, New York University (NYU). There was a separate ceremony on August 20, to commemorate S. S. Chern, who devoted his life to mathematics, both in active research and education, and in nurturing the field whenever the opportunity arose.

Prof. Chern was one of the greatest geometers of the 20th century. In the 1930s and the 40s, Prof. Chern took the then dominant field of differential geometry, which deals with the mathematical description of geometrical shapes, including those in many dimensions, and turned into a vibrant area

of study. He obtained fundamental results in all the major aspects of modern geometry and founded the area of global differential geometry. His work exhibited keen aesthetic tastes in his selection of problems and in his breadth exemplified the interconnectivity of modern geometry and all of its aspects.

Today, these aspects have become fundamental to many areas of mathematics and even theoretical physics with the concepts of 'Chern Classes' and 'Chern-Simons Invariants' becoming highly significant in gauge theory and string theory.

Prof. Chern's name has an earlier Indian connection as well. In the late 1940s, Homi Bhabha had made an offer of faculty position at the Tata Institute of Fundamental Research (TIFR) to Prof. Chern. This was at the initiative of Prof. D. D. Kosambi, himself an eminent geometer those days before he moved to other areas of study. But apparently Prof. Chern declined that offer and moved to the University of Chicago in 1949 where he served till 1960 before moving to University of California, Berkeley, where he remained till 1979.

Accolades Paid to Chern at Congress

An event of the morning of August 20 was divoted to paying tribute to S.S Chern and his work. Speaking on the Chern Medal Award, László Lovász said that this Award lays emphasis on the achievement of the awardee and puts those mathematicians who are worthy of this as an example to the world. The Chern Award was instituted by Chern's family. It's a financial grant of half a million dollars split into two parts – half of which is a gift to the recipient of the prize and the other half at his disposal for philanthropic purposes and for supporting good causes in mathematical life. May Chu, Shiing-Shen-Chern's daughter, thanked Simons for his financial support (which is two-thirds of the amount) and for his steady and warm guidance in making this Medal a reality.

Simons was unable to be present at this ICM but spoke with the delegates through video in the form of a conversation with Dennis Sullivan. After Simons's video

presentation, May Chu made another small video presentation where many other mathematicians as well as friends and family members reminisced about Chern. This part of the event ended with a lecture by Prof. Robert Bryant on the mathematical work of Chern especially highlighting some parts which are no as well-known.

Chern's publishing career according to Bryant spread across six decades. Chern, as is well-known is a foundational figure in 20th

> *"Chern was one of the foundational fathers of 20th century mathematics"*
> **-** Robert Bryant

century mathematics. He also highlighted that Chern's work is rooted in classical differential geometry and that Chern provided excellent ideas that led to the development of global topology and analysis. Chern made contributions to several branches like integral geometry, complex geometry, Riemannian geometry and Finsler geometry which is not as well appreciated as some of his other work.

James Harris Simons – mathematician, money manager and munificent millionaire

Geethanjali Monto

'There was a brief period I thought I might like to be a Rabbi, but it fortunately came and went.' (James Simons' in an interview with Seed magazine)

James Harris Simons was born in 1938 in Massachusetts and is a mathematician who became the founder and CEO of 'Renaissance Technologies Corporation' in 1982. In October 2009, he announced his retirement as of 01 January 2010 from active management of the firm in order to focus more on his philanthropic pursuits.

He is known for his collaboration with mathematician S. S. Chern in creating the Chern-Simons theory which has applications in theoretical physics also. The Chern Medal Award was presented for the first time in this International Congress of Mathematicians, at the opening ceremony on August 19, in memory of Shiing-Shen-Chern. Simons has also worked on the Poincaré conjecture, which was solved by Grigori Perelman.

At a conference, Simons is reported to have talked on his relationship with Chern: 'When I was there (at Berkeley), he was always very encouraging and later on, when I proved some theorem in minimal varieties I called him and showed him this theorem. He said, "Oh, global! Global theorem is very good. It's rare to have a nice global theorem." Boy that was very very encouraging. I just wanted to run home and prove a million global theorems.
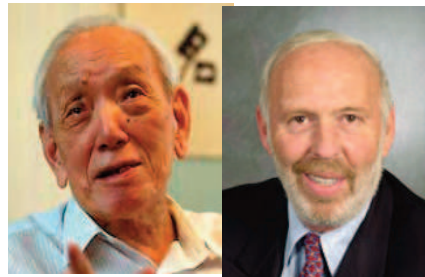
Chern   Simons

During these few years I was working on minimal varieties, when I had something that of being global, I would call him up – another global theorem...'

Simons' highly successful Renaissance Technologies investment fund employs mathematical models to analyze and execute trades. The company employs people from various countries irrespective of whether they are from academia or industry. It has made Simons one of the world's richest men – he uses this fortune to support research.

He and his wife are the founders of 'The Si-

$$CS_{U(n)}(\tilde{A}_\chi) \; - \; \text{modulo}(\mathbb{Z}/2)$$
$$= \frac{1}{2}\left(\dim\chi\,\eta(0,\mathfrak{D}) - \eta(0,\mathfrak{D}_\chi)\right)$$
$$= \frac{1}{2\pi\sqrt{-1}}\log\left[\frac{Z(0,\mathfrak{D})^{\dim\chi}}{Z(0,\mathfrak{D}_\chi)}\right]. \qquad (8)$$

mons Foundation' which backs research in basic science and mathematics. The foundation financed two-thirds of the investement towards the Chern prize. A new program has been launched in 2009 with a funding of US$ 40 million per year, to support 'research in mathematics and theoretical aspects of areas related to mathematics'. Seventy Simons Postdoctoral Fellowships were created. The Foundation also funds autism research.

Simons has been instrumental in creating Avalon Park, a nature preserve in Stony Brook. Nepalese health care is supported by the Nick Simons Institute. Simons also founded 'Math for America' in 2004 which focuses on improving public schools' math education, and supports and trains math teachers.

The donation to the Simon Center for Geometry and Physics at the Stony Brook University is reported to be the 'largest ever gift to any public college or university in New York state'. Simons' belief was that the new center will give many of the world's best mathematicians and physicists the opportunity to work and interact in an environment and an architecture carefully designed to enhance progress.

These are just a few of the achievements of this multifaceted personality. Only the future will reveal what the 'minister for math' still has up his sleeve.

Chern – Your Memory! People Reminisce

Simons: I was at Berkeley. In walked a tall Chinese with a tweed jacket. I asked someone who that was and you could have knocked me down with a feather when I learnt it was Chern. I had supposed that Chern was short for Chernofsky or something!

In 1968, I stumbled upon a three-manifold invariant and showed it to Chern who said, "That is a special case. We can make it more general". Chern saw a big generalization and then we started working together in spite of Chern being at Berkeley and I at Stony Brook. There were no email facilities at that time. When I de-

cided to leave mathematics, Chern said, "After all, he's not David Hilbert"! In the fall of 1972, when Chern came to the IAS and was leaving for Berkeley, he asked me to drive him to the airport instead of Andre Weil, saying that we could keep talking on the way and that Weil could come behind with the bags!

I met Chern last in September 2001, and thought that it was good I met him before it was too late. Maybe Chern was thinking the same thing about me too!

Susan Chern (daughter-in-law): He was reasonably tall

but with a large head!

Robert Bryant: He was just able to see lots of calculations!

Philip Griffiths: Elie Cartan was the leading geometer of early 20th century and his tradition was continued by Chern.

Calvin C.Moore: It is impossible to imagine differential geometry without Chern and the Gauss-Bonnet theorem for surfaces.

Rob Kirby: He had a presence, a gravitas! People just listened to him!

A.Weinstein: He had infinite patience and time.

Some tidbits about Chern

Chern knows calligraphy. In Weil's book `Number theory: an approach through history From Hammurapi to Legendre', there is a frontispiece of a warhorse from the tomb of emperor Tai-Zong and a calligraphy by Chern which means something like `the old horse knows the way'.

Chern once told someone, "if you do one thing that's good, that's all you can expect in a lifetime".

B.Sury

S.-S. Chern: The Daughter Speaks

Photo: Rahul V Pisharody

Prof. May Chu

Prof. May Chu is the daughter of one of the greatest mathematicians, Prof. Shiing Shen Chern. She talks to **Richa Malhotra** about her father and the award instituted in his name.

How did the idea of instituting the Chern Medal evolve?

It has almost evolved from a selfish standpoint, obviously. The family has a tremendous amount of respect for my father and his accomplishments within mathematics and his relationships to mathematicians worldwide, and his support for the field of mathematics. So we wanted to keep his legacy going and one of the ways of doing that is to do something which can continue, not just be a one-off situation where somebody gets one award and it's done! Our thought process is to have something which is ongoing. Like there is still the Nobel Prize named after Alfred Nobel; maybe the Chern Medal (we hope) would still be in existence 100 years from now and regarded. If that's the case I think then the family has done its work. I think that mathematics at that point will still be ongoing and active, and I hope that mathematical community be a very congenial kind of a place to work and that the Chern Medal has contributed in some way to that.

Did you discuss mathematics problems with your father?

Obviously, if you listen to the talks in mathematics, they are very different. It is not easy to understand and mathematicians, among themselves don't necessarily understand the other areas of mathematics. So my math went up to upper level (university level) and occasionally in the past when I was young, I would ask him for help with problems and things like that. But obviously, I do not understand any of what he did (laughs).

How was Prof. Chern as a father?

I think he was pretty much self-made, he didn't have a very strict father and mother who forced him to study all the time, he did things on his own and spent a lot of time in his younger days with his grandmother who probably spoiled him as much as she could. He didn't really think that people needed a very strict environment. He thought that people should find their own way, understand what they like to do, just automatically do things they like and enjoy and be very good at it. But I kept on telling him, in his later life, there is really a very special group of people who need a lot of discipline in order to be succeeding in life but my life was extremely carefree in the sense he let me do what I wanted to. He was not an overdoting father by any means.

What initiatives were taken to honour Prof. Chern, besides instituting the Chern Medal?

Well, for instance the Math Institute at Nankai University was renamed as Chern Institute of Mathematics and I think that is recognition of all of the effort and financial support that he gave to the institute over the years. In addition to that the Mathematical Sciences Research Institute at Berkeley has certain portions of it also, with my father's names in it. It is recognition of his contributions. There is also a Chern Chair and a Chern–Simon Chair in the University of California, Berkeley. So, there are these kinds of things that are associated with his name.

Next year Prof. Chern's birth Centenary is being celebrated. What initiatives are being planned?

The preparations are ongoing for one year. The Executive Committee has been formed. The two venues have been decided upon - the universities in China and Berkeley have already decided upon the dates. So, I think they should be pretty well-established.

Mathaloon

-Arghya Mondal

Making Sense of School Mathematics

Sidharth Varma / Nikhil MG

Relation between the discipline and school mathematics was the issue around which the panel discussion took place on the second day of ICM. Timothy Gowers, University of Cambridge who chaired the discussion said that the discussion would broadly revolve around mathematics at school and research level.

Carlos Bosch, Instituto Technologico Autonomo de Mexico, who spoke about the scenario in the Latin American countries of Brazil, Chile and Mexico said, "After the mandatory school, the majority of students lack the ability to solve problems and use algorithms." He expressed concern about the unqualified and under qualified training given to the teachers and that the teaching pool is inadequate. Speaking of the good practices in teacher training in Latin America, he referred to the La Ciencia en tu Escuela (Science in your school) project in Mexico which aims at changing the existing attitudes towards mathematics and science. In recent times, internet is being used to teach teachers, but access to computers and operational knowledge is hampering the progress. In the Chilean perspective lack of relationship between disciplinary knowledge and training techniques is the barrier.

Ivan Yashchenko from the Moscow Centre for Continuous Mathematical Education, Russia, pointed that training future research mathematicians should not be the only purpose of teaching mathematics at the school level. The researchers and the students of middle and high school work together in Russia, resulting in the level of mathematics being very high in general. Speaking of the current trends in the Russian Mathematical syllabus, he pointed out that there has been a decrease in calculus and theoretical geometry, and increase in discrete mathematics.

Presenting the three perspectives of mathematical education in Germany, H. Steinbring (University of Duisburg-Essen, Germany) elaborated on the various aspects of the learning and development process. "There is a difference between cultural conditions of professional mathematical research practice and in the school instruction of mathematics," he opined.

R. Ramanujam (Institute of Mathematical Sciences, India) had his

Photo: Rahul V Pisharody

Mathematicians takes part in the Panel discussion.

presentation focused on 'Live Mathematics and classroom processes'. Through his experiences with school children he concluded that there is a big gap between school mathematics and mathematics as a discipline. He added that in many countries people have begun to question the role of mathematics in compulsory school education. He also suggested a need for re-orientation of classroom textbooks and systematic education. By engaging student's attention, every child can be made interested in mathematics.

W. McCallum said, "The goal is to teach mathematics and not to get to the solution." He said the biggest problem in terms of attitudes of the people is that they think school mathematics is divorced from reality. He also said that Math Circles have taken off in the U.S. similar to that in Russia and teachers work in an environment solving problems given by researchers.

Majority of the audience shared the opinion that there is a need to have good textbooks. Researchers' engagement in writing textbooks or proofreading textbooks written by others is significant in teaching the teachers and students, besides the public. Steinbring also believed that teaching changes with economic and social conditions of the place. In response to a question from the floor, he said that change must come not only in the textbooks/curriculum, but also in the teaching, learning and understanding of the teacher. In conclusion, Gowers described the need of a continuous path from school mathematics to university mathematics.

Panchamahabhutam   Photo: Rahul V Pishoarody

Beautiful display of Indian arts, literature and the Shastras, by a group of classical dancers choreographed by C.V Chandrashekhar and Jaya Chandrashekhar, with a central theme of "Panchamahabhutam"- Jala, Vayu, Agni, Akas and Prthvi- filled the atmosphere at HICC's packed auditorium on Friday, August 20, the second day of the ICM 2010

Change of Schedule

Professor M. Sal Moslehian's talk entitled Refinements of operator Jensen's inequality scheduled for 26 August (17:00–17:15 hrs) has been shifted to **21 August (19:00–19:15) in Room No. T3**

Announcement

Participants of the ICM 2010are requested to prepare, in the form of a pdf file, and print the participation certificate at

mathstat-uohyd.ernet.in/icm2010/cert

using their access key.

DVD Show, Aug 21

LILAVATI - Traditions of Natya, Kavya, Ganita – 1989. Conceived and Choreographed by Chandralekha.

Show Timings: 18:00-19:00 and 19:15-20:15

Room No. G01+G02

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