ICM 2010
HYDERABAD • INDIA
REFLEXIONS
The daily newsletter of ICM 2010
August 27, 2010

On the footprints of Emmy Noether 3

Opinions 5

History of Mathematics in India 7

Indians Among the Exalted at ICM 2010

The presence of Indian mathematicians among the plenary and invited speakers at ICM 2010 has been significantly more than in the past. To be invited to deliver a plenary or an invited lecture at an ICM is considered highly prestigious.

While Prof. R. Balasubramanian of the Institute of Mathematical Sciences (IMSc), Chennai, delivered a Plenary Talk, Profs. V. Srinivas and T. N. Venkataramana of the Tata Institute of Fundamental Research (TIFR, Mumbai), Probal Chaudhuri and Arup Bose of the Indian Statistical Institute (ISI), Kolkata, and V. Suresh of the University of Hyderabad delivered Invited Talk. In fact, Prof. Balasubramanian's Plenary Talk is the first ever at an ICM by an Indian mathematician. Prof. Suresh is from a university and the last Indian mathematician from a university to a give an Invited Talk in an ICM was Minakshisundaram in 1958.

Prof. Balasubramanian is a world-renowned number theorist. His research interests encompass a wide spectrum of topics in analytic number theory, combinatorial number theory, elliptic curves and cryptography. In 1986, he solved the Waring problem for fourth powers in collaboration with J-M. Deshouillers and F. Dress.

Prof. Venkataramana has made significant contributions to algebraic groups and discrete subgroups. He proved the positive characteristic version of the Margulis super-rigidity theorem and obtained important results on cohomology of locally symmetric varieties.

Prof. Srinivas has done significant work in aspects of algebraic geometry and commutative algebra. His interests include algebraic cycles on singular algebraic varieties, projective modules, Hilbert functions and multiplicity and on aspects of algebraic geometry in positive characteristic. An important work by him, done in collaboration with D. Cutkosky, is the solution of Zariski's problem (Riemann-Roch problem for surfaces).

Prof. Probal Chaudhuri has made outstanding contributions in a number of important areas of current interest in statistics. His work in multivariate analysis related to developing geometric notions of multivariate quantiles is considered a major breakthrough in the area of multivariate nonparametric inference. More recently, he has developed methods that enable one to discover statistically significant features in the income distribution in different populations.

Prof. Arup Bose has made significant research contributions in resampling plans, sequential analysis and asymptotics, statistics of diffusion processes, rates of convergence, multinomial selection problems and strong laws. His work in resampling provides a deep and powerful impact on areas such as time series, linear models, general dependent models and nonparametric estimates.

Prof. Venapally Suresh has made outstanding contributions to the theory of quadratic forms. His work on Galois cohomology and u-invariants over function fields of p-adic curves is especially important and regarded quite fundamental.

Photos : Rahul V Pisharody

R. Balasubramanian

T. N. Venkataramana

V. Srinivas

Probal Chaudhuri

Arup Bose

V. Suresh

India and Evolution of Mathematics

Kim Leslie Plofker is a well-known historian of mathematics. Currently a Visiting Professor of Mathematics at the Union College, USA, she is the author of the recently published *Mathematics in India*. Plofker has also contributed a chapter on Indian mathematics in *The Mathematics of Egypt, Mesopotamia, China, India and Islam,* which she has also co-edited. She has also contributed to *A Descriptive Catalogue of the Sanskrit Astronomical Manuscripts* preserved at the Maharaja Man Singh II Museum in Jaipur, India. She co-edited the volume Studies in the History of the Exact Sciences in Honour of David Pingree.

Plofker completed her PhD from Brown University on 'Mathematical Approximation by Transformation of Sine Functions in Medieval Sanskrit Astronomical Texts' under the supervision of David Pingree. Much of the work Plofker and Pingree did was founded on the great early Indian textual scholars of Sanskrit tradition like Sudhakar Trivedi and Bapudevan Sastry.

She gave a Plenary Talk at the ICM 2010 titled 'Indian rules, Yavana rules: foreign identity and the transmission of mathematics'. In her talk she discussed the encounter of two cultures of mathematics, namely Yavanas and Indians, and the reactions of the cultures to each other. Yavanas (In Sanskrit means Greeks or any Western visitor) came into contact with Indians by crossing the Himalayas and travelling across the Arabian Sea.

In a conversation with **Richa Malhotra**, Plofker threw light on ancient Indian mathematics and her engagement with it. Excerpts from the interview:

What are the iconic contributions of ancient Indian mathematics?

Well, first of all, what everybody knows about is the decimal place value number system, which is now the universal number system. Though it wasn't the first place value system to be devised, it was the first that is definitely the ancestor of the universal decimal place value numbers. That has really made a difference to not just mathematics in general and practical mathematics but the progress of science by enabling calculations more effectively. The place value system had a great impact on Indian science and then, as it spread, had a great impact on doing science elsewhere in the world.

But that's one of the best known examples but some others, I think, are equally interesting. These are things that were Indian developments that may not have directly contributed. These were things that were developed in India and then later rediscovered or inspired and then redeveloped in other contexts. For example, the very sophisticated rules for dealing with algebra, computations with unknown quantities and symbolic notations for working with equations, the concept of equation [etc.]. All of these appear in India by at least in the first millennium of this era and equivalence structures are being worked out in a similar way in the West until about a thousand years later. So that's something very important. And

Photo: Rahul V Pisharody

Prof.Kim Leslie

of course the remarkable methods that you see by the Kerala School with infinitesimal quantities and various operations with infinite series.

I think one of the things that we may have to thank Indian mathematics for more than we realise is the structure of the organisation of mathematical knowledge; this distinction between arithmetic as the computation of known quantities and algebra as a parallel type of computation but with unknown quantities is something that appears very early in the Sanskrit tradition.

Which do you think is the most remarkable development?

The work on the infinitesimal series in the Kerala School about fourteenth century is just a really amazing synthesis of so much work -- not just infinite mathematical concepts they evolved but also the astronomical problems by people who were masters of all aspects of mathematical sciences and thought very originally of it.

What is the correct story about India and the origin of zero?

It is a very long story. It is hard to know exactly all the details of the origin of zero. Prof. R. C. Gupta, who will be receiving the [Kenneth O.] May Medal for history of mathematics has written a very good article called 'Who invented the zero?' In that he makes some crucial distinctions between different concepts of zero. Are we thinking of zero as just a place holder in a place value system as there is an empty digit of zero? Or we are still thinking of zero as something that plays a certain role in computations? Or are we thinking of zero fully integrated as a number, something on which you can perform arithmetic operations? If we go back to the first idea of zero as a place holder we do see that developing already in Babylonian texts although somewhat late -- sometime in the first millennium before the common era. When you have a base 60 number, written out in a form the way they did, and if you have got a missing digit then there is a place holder and they put a mark to indicate that.

When Greek mathematics and astronomy took over the Babylonian place value units for measuring things like time and angles – all of which were base 60 units – they took over a form of that place holder notation. But the integration of zero as a number being a part of a place value system that is also fully integrated with arithmetic, is definitely Indian. It is part of this trend, this mainstream in Indian mathematics, which is producing the sophisticated arithmetic and algebra that we are seeing in the medieval period. And as to actually when that happened is a tough call. I think we can see that this place value system of zero is clearly fully established at least in the scientific use in India by maybe around 3rd century of this era.

Prof. S. R. Sharma has made some interesting arguments in favour of the idea that the place value system, including zero, may have been developed in that era. So somewhere around then is when integration of zero into a number system gets going in the Indian tradition.

When did Indian mathematics become visible and how?

Certainly mathematics is something involving various types of calculations. There is a lot of awareness about it in Indian contexts, all the way back, when you have hints to the numbers in tens to hundreds to thousands and so on, and the importance of calculation is definitely recognized. The other two cultures start to understand something about Indian mathematics (well that's something I talked about in my Plenary presentation), and certainly as far as the West is concerned, after the incursions of Alexander. So, the Alexander expedition gets as far as India and gets home but that means that there is a sense of link between Greek culture and Indian culture. From then on Greek and other Western sources -- first in the classical theory -- then in the Muslim and then the modern European started to report back on what they understand as "Indian mathematics" and what things these foreign people – the Indians -- are doing in Indian mathematics.

Do you think it is important to recognise "who invented what" in mathematics?

Well of course we don't want it just to degrade into a priority dispute and argue about a few centuries or years here and there. But like everything else what we want to know or understand is how concepts developed, how things were transmitted, how they evolved. I think a thoughtful adaptation of foreign concept is historically just as interesting as the original development. So it is important to know who did what and when in the sense it is important to get all of the history right. Perhaps we were little over-influenced by the modern notion of priority, saying that the first who did it is better somehow, they deserve a medal. This isn't really how it worked.

In the pre-modern world everybody was borrowing everybody's ideas in mathematics and at that point that it was all very open source; everything went into a common pool of knowledge and you pulled it out and, if you thought it was interesting, you contributed it to your understanding. As regards the source where it came from, you didn't feel you were barred from adopting it just because somebody else thought of it first.

...continued on page 7

On the Footprints of Emmy Noether

Amalie Emmy Noether

The IMU General Assembly (GA) held at Shanghai in 2002 passed a resolution recommending continuing the tradition of the 1994, 1998, 2002 ICMs by holding an Emmy Noether lecture at the next two ICMs (2006 and 2010) with selections of the speakers made by an IMU-appointed committee. The Emmy Noether Lecture Committee for 2010 is chaired by Prof. Cheryl Praeger (University of Western Australia, Australia). She pointed out that the ICM Emmy Noether lectures were instituted to honour women who made fundamental and sustained contributions to the mathematical science. She said that possibly the first woman to give a lecture at an ICM was Emmy Noether in 1928. In the 1932 ICM, she gave a plenary talk and was definitely the first woman to do so at an ICM. The next woman mathematician to give a plenary lecture in an ICM was Karen Uhlenbeck in 1990.

From 1994 onwards an ICM Emmy Noether lecture was instituted. The first three speakers were Olga Ladyzhenskaya (1994), Cathleen Synge Morawetz (1998) and Hesheng Hu (2002). Following the Shanghai GA resolution, the next two Emmy Noether lecturers were selected by an IMU committee. Yvonne Choquet -Bruhat was the speaker at the 2006 ICM. This year's speaker is Idun Reiten of the Norwegian University of Science and Technology, Norway, who is speaking on Cluster categories. The GA only made the resolution that the Emmy Noether lecture should be held until the ICM in 2010. Praeger indicated that it would be good to hold this lecture at each ICM to honour women mathematicians.

Idun Reiten is a well-known Norwegian mathematician born on January 1, 1942. She got her Ph.D. in 1971 from the University of Illinois at Urbana-Champaign with Robert Fossum. Her research interests are in representation theory, commutative algebra and homological algebra. In collaboration with Maurice Auslander, she developed what has come to be known as Auslander-Reiten theory. In 2007, Reiten was awarded the Möbius prize. In 2009, she won *Fridtjof Nansen* reward for successful researchers, and the "Nansen medal for astonishing research. She speaks on `Cluster Categories' in the Emmy Noether lecture this year.

Let us take this opportunity to recall also the awesome persona of Emmy Noether.

Amalie Emmy Noether was born on March 23, 1882 in Erlangen, Germany. Her father was Max Noether, a professor of mathematics at the University of Erlangen. In Emmy's time, this University would not admit women students and she had to obtain special authorization to work there as an auditor from 1900 to 1902. She passed an examination in 1903 which enabled her to become a doctoral student at the University of Göttingen which was open to woman students. In 1907, she obtained her doctorate after which she assisted her father in giving lectures at Erlangen, as there were no university positions open for women. She taught at the University of Erlangen but was not paid for her services.

Noether started publishing her research work. Her first major work in theoretical physics in 1915 was a relationship between symmetries in physics and conservation principles – Noether's theorem. This work made Hilbert and Klein invite Noether to join them at the University of Göttingen in their research work on the general theory of relativity. The University opposed this saying 'How can it be allowed that a woman become a Privatdozent? Having become a Privatdozent, she can then become a professor and a member of the University Senate. Is it permitted that women enter the Senate? What will our soldiers think when they return to the university and find they are expected to learn at the foot of a woman?' Hilbert argued: 'I do not see that the sex of the candidate is an argument against her admission as Privatdozent. After all, we are a university and the Senate is not a bathing establishment.'

Although the University did not grant permission for Noether to enter as a Privatdozent, Hilbert announced her lectures as his, with her as his assistant. In 1919, Noether became a Privatdozent but never obtained a position of importance although her research and teaching were of high quality. Being a Jew caused her dismissal in 1933. She joined the Bryn Mawr College in the United States where she finally worked as a normal Professor. She passed away on 14 April 1935.

It is said about Emmy that 'she discovered within her the spirit not only to make major contributions to mathematics, but also to share her insights with students and colleagues so that they also made significant strides in their fields'. Albert Einstein stated: 'In the judgment of the most competent living mathematicians, Fräulein Noether was the most significant creative mathematical genius thus far produced since the higher education of women began. In the realm of algebra, in which the most gifted mathematicians have been busy for centuries, she discovered methods which have proved of enormous importance in the development of the present day younger generation of mathematicians'. Her paper in 1921 on the theory of ideals in rings is an essential contribution to modern algebra.

Geethanjali Monto

Emmy Noether's mathematics has been described as 'abstract, original and deep' by Mythily Ramaswamy. Noether herself is portrayed as 'solid and earth-bound'. She was one of the greatest mathematicians of the twentieth century, surmounting innumerable obstacles to pursue her love of mathematics and in the process made significant contributions to abstract algebra. She was a towering presence, with mathematicians from all over the world visiting Göttingen and coming under the influence of her mathematics!

`Emmy Noether was the centre of the most fertile circle of research at that time in Gottingen'

- Constance Reid

`When I explained the foundations of class field theory, he got very enthusiastic and said, "But, that is extremely beautiful, who has created it?", and I had to tell him that it was he himself who had laid the foundation and envisaged that beautiful theory'

-Hasse about Hilbert.

"Yesterday I received from Miss Noether a very interesting paper on invariant forms. I am impressed that one can comprehend these matters from so general a viewpoint. It would not have done the old guard at Göttingen any harm had they picked up a thing or two from her"

-Einstein wrote to Hilbert

Idun Reiten

Twelve Year-Old Girl, A Mathematical Pearl

Kaavya Jayram is 12 years old and is taking third year courses in the undergraduate mathematics programme at Stanford University. She was a participant in the ICM 2010 as well as in the ICWM held for the first time. In the ICWM, she presented a paper on the partition function which is to be published in the *International Journal of Number Theory*. Kaavya also plays the violin and is a voraceous reader. On the 25th August 2010, she talked to **Richa Malhotra** and **B. Sury.**

You have written a paper on partition theory. Have you met Prof. Andrews?
Yes, he is here and I have also met him in Florida when I went for a one-week conference in number theory.

Have you met other precocious kids there in the U.S. where you live? Are you friendly with any of them?
Well, there are plenty of home-schooled kids who take part in these math olympiads.

What are your other interests?
Outside of mathematics, I particularly like reading, especially Jane Austen and the Bronte sisters; I re-read them often. My favourite book is Jane Eyre. I like to read non-fiction also and have learnt the violin since I was 5 years old. During the ICWM, I played 3 pieces.

Are you also interested in computer science?
Not very much. My father is a theoretical computer scientist but it doesn't interest me that much.

What about physics?
I like doing it maybe just as a hobby.

Have you met Prof. Soundararajan?
Yes, I took a lot of classes with Prof. Soundararajan at Stanford; he gives me problems to work on.

Did you attend the talk of Fields Medalists here at the ICM? Did you understand what they said?
I could get a general sense but not the details.

How does it feel to be so young and attending college already?
I am not yet registered full time but took some courses.

How do you plan to spend time in India?
First of all, I came last December and visited people in IMSc, TIFR, etc. and there, they told me that I could take courses if I go there.

How does it feel socially?
You mean friends and stuff like that? I have older people like professors with whom I discuss math but there are also others home schoolers who are part of a book club and a chess club. I have friends from the book club.

When did you finish high school?
When I was 7. There is the bay area math association and they would invite professors who would give talks. After school, for one year I would attend such lectures. During that time, they would give problems over email. I kept in touch with the professors. After that I started taking classes at San Jose State University. I took classes for 2 quarters. After that Prof. Soundararajan

Photo: Rahul V Pisharody

Kaavya

asked me to take classes at Stanford.

Kaavya's mother: It came to a state where she exhausted all that San Jose had to offer in pure mathematics. They said she could get a degree in a year. But, she didn't want to take that option. She won't have time to do her research.

Shobha Madan: How did you discover your mathematical ability?
Kaavya's mother: Home schooling is where the child leads the path and parents just follow. Initially, she just changed her mind often. Her interest in math is her own. At 7, she became solely committed to math. Earlier she'd go to science meetings; for instance, she went to NASA. She was exempted many things in bay area.

Shobha Madan: I am so happy to know you!

It started this way. When my dad went to a conference, Manindra Agarwal was there in IIT Kanpur. I heard about his primality result and, we basically stayed up until midnight with him explaining the result. Next day, I went to a bookstore there and got a bunch of books on primality and ever since I have got hooked on to math and number theory in particular.

What age was that?
That was 2006; I was 8.

When were you born?
July 3, 1998.

Do you know Prof. Jaikumar Radhakrishnan at TIFR Bombay?
Yes, yes. My dad and he had been together in Rutgers. We went to TIFR. There, we met Prof. Raghunathan, Prof. Sujatha, and Prof. Parimala was there on Ramanujan Day.

> "Basically my parents or profesors aren't pushing or pressurising me or anything but they are only facilitating things."

What are you going to do now? Do you have any plans?
I am going to keep doing math. I am going to apply to go to the university full time next year. Either Stanford or Berkeley. There is also the issue about dorms – I don't want to stay in a dorm. I will stay somewhere nearby.

Since you just took some courses at Stanford without entering it full time, did you get time to solve problems in topology, etc. or just studied from a book?
Well, what I mean by saying I took the courses is that I solved problems and took the exam etc. I am not in a rush to join university full time. Prof. Soundararajan also told me that I should not join full time until I am 14 at least.
Kaavya's mother: Prof. Soundararajan is a kind of a mentor.

Is there any particular problem in number theory that fascinates you?
Well, two things I guess. There is the question of when p(n) is even and when it is odd and the other is the 3n+1 problem.

Do you like combinatorics also?
Next to number theory my favourite is combinatorics. Then algebra and the least favourite is geometry. I liked algebraic topology. There is a lot of combinatorics in it. I took Prof. Diaconis's course on combinatorics. He is a wonderful teacher.

How did you get to learn violin?
Kaavya's mother: For a silly reason. This violin teacher was the nearest to home. The teacher thought she has a natural bent and a knack to advance her career in this line.

How long are you going to be in India?
One and a half years. We will be in Bangalore and will keep shuttling to Chennai to meet Prof. Balasubramanian.

Do you want to say anything? Did you find things are much easier in the US than in India?
In India, I guess things like home schooling are not as easily accepted and younger people joining college, etc. also are not as easy; but I don't know really.

Sometimes when you are too grown up at your age, some people try to take advantage of your talents in some way and try to get things out of you without giving you credit? Did you experience such a thing?
Not really. I don't think I have experienced that.

Do you feel pressurised at all?
No, I don't. It's basically that my parents or professors aren't pushing me or anything but only facilitating things.

Have you read anything written by Ramanujan?
(Laughs) yes, I read a couple of papers by ramanujan. I also read a couple of papers by Dyson about cranks. The crank features in my work a lot. I also read a couple of papers by Prof. Soundararajan and Prof. Ono.

Who is your role model?
I have several male math. Role models - Prof. Soundararajan, Prof. Ono, Ramanujan etc. But I am always looking for a female role model. So far I found Prof. Parimala.

I see 'em – How do they see?

M.G.Nikhil

So far the International Congress of Mathematicians has witnessed awe-inspiring lectures from the distinguished award winners, panellists and plenary and invited speakers from across the world. A survey by Reflexions to find out people's opinions about the organization and proceedings at ICM 2010 during its first four days revealed diverse reactions that highlighted various aspects of the Congress. Here are some excerpts from the views expressed.

Mikhail Shchukin of the International Sakharov Environmental University, Belarus, opined that, "ICM has been a great adventure in my life. I am extremely happy to be here." He also thanked the organising committee for the invitation and the travel grant.

"My first acquaintance with Indian Mathematics was the beautiful story of Lilavati written by Bhaskaracharya. This story has greatly influenced me in becoming a historian of mathematics," remarked Mohammad Baghai of the University of Tehran, Iran. He has enjoyed the wide variety of mathematical topics presented at the Congress.

For Beatrice Pelloni of the University of Reading, UK, two events have been extremely amazing. "Award winner, Cedric Villani's talk and the lecture on the 'Life and Work of Chern' have been the best ones so far," he said.

Su Ion In of University of Colorado at Boulder, USA, is attending ICM for the first time. He said that the congress has put together great talks and discussions - all under one roof.

"The entire event is very well organised. The lecture halls are very close to each other which is good because I can get to lectures without much trouble," appreciated Dragutin Svrtan of the University of Zagreb, Croatia. He is immensely enjoying his experiences here at ICM.

Alan Durfee of Mount Holyoke College, USA, has been attending ICM without fail since 1974. This event is of great importance to him because it helps him learn the recent developments in the field of mathematics from the experts. "At home, we have National Associations meetings for mathematicians but I do not learn as much there as I do here," he adds.

Dimitri Shlyakhtenko of the University of California, Los Angeles, USA, is amazed to see so many mathematicians together.

Tinne Hoff Kjeldsen of Roskilde University, Denmark, has thoroughly enjoyed the special lectures on History of Mathematics, although she complained that the hall was too small and always packed.

Mohammed Abdul Rahim from Yanbu Industrial College, Saudi Arabia, was of the opinion that lot many talks focus on pure mathematics and only a few on applied mathematics. "The prayer room that has been allotted for us is probably the most thoughtful efforts of the organizers."

Oluwole Daniel Makinde of Cape Peninsula University of Technology, South Africa, opined that every lecture and talk has been immensely interesting and educative. "It is incredible to see so much participation in one place. The organization is doing a great job in transport and security services," he added.

Jean M-S Lubuma from University of Pretoria, Republic of South Africa, is deeply impressed by the politeness and friendliness of his Indian counterparts. "The organization is doing extremely well given its scale and complexity," he said. He particularly enjoys the talks presented by the laureates and award winners. "The idea of having a specific time everyday for talks by the laureates is great," he added.

According to Geetha Venkataraman of the University of Delhi, just the thought of having 3000 mathematicians in one place is extraordinary. She believes that it is a great opportunity to meet and interact with distinguished mathematicians. "The presentations by Irit Dinur and Smirnov were particularly interesting," she mentioned.

While we do not want to indulge in self-praise, we were particularly pleased to see that several participants complimented the efforts of the Newsletter Committee!

-ICM SNAPS-

Highly Composite

Prof. R. Balasubramanian is a well-known number theorist and the Director of the Institute of Mathematical Sciences, Chennai. He delivered a plenary talk in ICM 2010 which was tantalisingly titled `Highly Composite'. This is intended to be the short form for 'Highly composite contributions of the Indian number theorists'.

In this talk, Prof. Balasubramanian traced the development of analytic number theory in India after Ramanujan.

Number theory is one of the oldest areas of mathematics. With the kind of fascination that it carries, it is very natural that it continues to enjoy the attention of some of the greatest minds throughout history. India has enormously contributed to the subject with Ramanujan leading the way. Even after his time, the contributions of Indian mathematicians has been very significant. However, no good account of these contributions are available. No lecture could possibly give a detailed account of such a rich history of deep contributions spread over several decades. The purpose of his lecture was to bring out some marvellous contributions of Indian number theorists after Ramanujan.

S. S. Pillai and S. Chowla were two leading figures in number theory in the period immediately following Ramanujan. Some other Indian number theorists of the post-Ramanujan period who have made significant contributions are K. Ananda Rau, S. Chowla, T. Vijayaraghavan, K. Chandrasekharan Raghavan Narasimhan, K. Ramachandra, M. V. Subba Rao and R. Balasubramanian. Recently in an effort to bring out the collected works of S. S. Pillai, it was realized that some important contributions made by Pillai have not been archived. It was surprisingly found that there is no good biography of Pillai. Many of Pillai's unpublished manuscripts and correspondences with other mathematicians are now available, thanks to the effort of Prof. R. Thangadurai, Harish-Chandra Research Institute, Allahabad.

The first half of his lecture recounted this rich heritage. The second half of his talk was devoted to the deep and significant contribution of Ramachandra to analytic number theory.

Hyderabad Hooligan

Exploring Hyderabad during the Congress's off-day on August 23, **Shaun Maguire**, a student of Stanley Osher (who gave the invited talk on 'New Algorithms in Image Science' at ICM 2010 on August 24) at Caltech, had an amazing experience, which is narrated below in his own words.

Today was our only day off during the nine-day congress. I ate a healthy breakfast, laced-up my shoes tight, packed an umbrella and embarked on what I thought would be a stimulating but standard day of sightseeing. I took the hour-long bus into the old city, and started walking towards Charminar — a four hundred year-old mosque whose history explains much of Hyderabad's existence. Everything was going according to plan. After about 3 km of walking, a dude on a scooter pulled up next to me, from behind, and asked where I was from. This guy had a red beard and long hair! "Red" flags were obviously set off. I told him the USA and turned around to start walking again. I am a seasoned backpacker and have a lot of experience brushing-off crazies.

However, this guy spoke perfect accent-less English and asked me what I do for a living. The question struck me as odd so I told him I am a mathematician. He asked if I was in Hyderabad for the ICM. Okay, he obviously wasn't completely insane. We talked for a bit and despite the fact that he was nerve-rackingly attracted to me and undeniably sketchy, he posed an interesting proposition. He invited me to spend the day teaching mathematics to schoolchildren in the area. I have spontaneously done similar things in the past, and I consider myself to be a talented judge of character so I vetted him for a few minutes and became confident his proposition was legitimate.

Shaun Maguire with Kids

I asked him how often he does this, where the last person he picked-up was from, which school we will go to first, the name of the principle there, where he lives, how he makes money, etc. I used to play poker, so I applied the tricks I learned for reading people's honesty and checked for common tells, such as momentarily glancing away before telling a lie. Furthermore, he was quite small and his scooter had at most a 50cc engine, so I felt confident that I could either tackle him or roll off the back of his bike if things got out of hand. Anyways, some of the best days of my life started similarly and teaching mathematics is always rewarding, so I set off with him around 9:45am.I just got back after 13 hours with this creep — my first impression was solidified over the course of the day. However, I spoke to over 200 students in half a dozen classes at three schools. The kids ran the gamut in every sense of the word. One school was incredibly poor and in the boondocks an hour out of Hyderabad, one was a rich international school and the other was somewhere in between. I believe I sparked at least a couple of kid's imaginations. All-in-all, I believe the kids enjoyed themselves and have stories of a crazy American to bond over.

At one point, my new friend "VV" drove his scooter through a mountain of cow dung while he was looking over his shoulder to tell me a disturbingly profane story. I got SPLATTERED! With regards to the story, this was not the only one of this kind that he told me, but I didn't want to offend him while sitting on the back of his scooter in rural India. We ate a delicious south Indian feast for lunch at one of the schools.

We had the Hyderabad Ramadan special cuisine of Haleem for an afternoon snack and feasted on the equally famous Hyderabad Biryani for dinner. The latter two didn't live up to the hype, but were still enjoyable. I was the main attraction in a prayer session accompanied by about 300 people, including over a hundred dancing children. I was given countless trinkets. I gave a high-five to a guy while we were each speeding along on scooters because he had an awesome custom scooter horn. Speaking of scooters, I spent at least four hours on the back of VV's. I saw more than I ever could have hoped to. The roads are a disaster for daily driving, but have a nice scooter party vibe going on — a nightmare for residents, but amusing for tourists. But, importantly, I finally managed to depart from VV in an untraceable way.

Interested readers can find more about the incident in Maguire's blog at http://lavashaun.wordpress.com

Drama in ICM 2010

Sunil Mukhi

The award-winning play "A Disappearing Number" is woven around the life of the mathematical genius Srinivasa Ramanujan. It is a theatrical production with two interwoven stories, one historical and the other modern, and opens with a woman mathematics professor lecturing on a famous formula of Ramanujan. She gets carried away by her enthusiasm and starts to scribble formulae all over the board. In the meanwhile an actor, who will later play a physicist working in an area of particle physics called string theory, addresses the audience to point out that everything they are seeing – the set, the mathematics professor, the props – is fake, except the mathematics, which is real.

In the course of the play the main recorded events in the life of Ramanujan are surveyed – his letter to Cambridge mathematician G. H. Hardy presenting a series of astonishing mathematical formulae without proof, Hardy's swift reaction to invite Ramanujan to Cambridge, Ramanujan's hesitation and later acceptance of the invitation, his trip overseas, his joint work with Hardy, his problems with his health and the lack of Indian food, his suicide attempt and his return to India as a sick man with tuberculosis, followed by his tragic demise just short of his 33rd birthday. Truth is certainly stranger than fiction here and the play quite appropriately presents the events literally and in sequence. There are no revelations for anyone already acquainted with Ramanujan's life, but for others the narration should quite effectively convey this moving and remarkable true story of an incomparable genius.

A Scene from the Play

What makes this an effective piece of theatre is the interweaving of the historical account with a tale about fictional characters: the mathematics professor obsessed with her formulae and with the life of Ramanujan, the Indian-American working in the futures market who stumbles into her classroom by mistake and soon proposes to her, and the string theorist who helps bind the story together. None of the characters is especially compelling, but together they do manage to convey a sense of the excitement of mathematics. While the audience does not end up much wiser about how a sum of infinitely many positive numbers can add up to -1/12 (a subtle result due to Ramanujan that has actually played an important role in string theory), there are several musings about the nature of infinity that stimulate a sense of wonder. Infinity is presented in two distinct contexts: a sequence of whole numbers that increase without limit, and the fact that any two distinct continuous numbers always contain infinitely many other continuous numbers between them.

While Hardy is fascinated solely by Ramanujan's brilliance and originality at mathematics, the other characters constantly interact with India in some way or other, bringing out a complexity and diversity that provides a nice foil to Ramanujan's traditional background as a poor Brahmin. Several globalised Indian characters play a key role in these interactions including the hedge-fund manager and the string theorist but also a call-centre operator and a chambermaid at a London hotel.

The use of Indian dance forms, tabla music and rhythmic chants at critical moments in the play also brings the Indian context into the unfolding events in a novel way, as do the hilarious cinematic projections of Chennai traffic and more poignantly the shimmering river in front of which Ramanujan finally passes away.

The Flip Side of Impact Factors

Richa Malhotra

Impact Factor is the most widely used metric in evaluating scientific research but is it a true indication of the quality of journals? Prof. Douglas Arnold doesn't seem to agree. "Impact Factor" he said, "is easy to use, but is fatally flawed...It is a highly skewed distribution and a flawed statistics". One of the reasons for this, he pointed out, is the manipulation of citations by the editors of some 'high-impact' mathematics journals. Prof. Arnold was speaking at a Round Table discussion on 'The use of metrics in evaluating research'.

This special meeting was a follow-up on the June 2008 report *Citation Statistics* prepared by the International Mathematical Union (IMU) in association with the International Council of Industrial and Applied Mathematics (ICIAM) and the Institute of Mathematical Statistics (IMS).

To quote from the Executive Summary of the Report: "Using citation data to assess research ultimately means using citation-based statistics to rank things—journals, papers, people, programs, and disciplines. The statistical tools used to rank these things are often misunderstood and misused."

Speaking at the Round Table Prof. José-Antonio de la Peña pointed out the various uses and abuses of evaluating science. He considers the impact factor as a completely ill-conceived concept.

> The impact factor was created in the 1960s as a way to measure the value of journals by calculating the average number of citations per article over a specific period of time. [Garfield 2005] The average is computed from data gathered by *Thomson Scientific* (previously called the Institute for Scientific Information), which publishes *Journal Citation* Reports. *Thomson Scientific* extracts references from more than 9,000 journals, adding information about each article and its references to its database each year.
>
> (*Citation Statistics*, June 2008, p. 6)

Prof. Malcolm MacCallum highlighted the use of metrics other than impact factor, such as the bibliometric measures whose use was not found flawless either. But MacCallum likes the use of impact factor as it serves as a useful measure of how the journal is competing with other journals.

Citation data is inadequate due to several causes – self-citation by authors, neglect of some papers, reputation of the author, gender bias, etc. Prof. Frank Pacard gave an overview of the situation in France and highlighted that money for mathematics research is allocated by the French Government and is then distributed to the Departments on the basis of citations of the various departments of science.

Sir John Ball mediated the discussion. After the discussion people from Australia, Chile, Kenya and India, shared their experiences in their respective countries.

Sanskrit: Effective Transmitter of Mathematics

...continued from page 2

How did you come to learn Sanskrit?

It was a complete accident and just goes to show what happens when you start taking courses. I had always thought that India was interesting while growing up in New Jersey, in the United States in the 1960s and 70s. I didn't have any particular contact with it. I came out of my undergraduate degree in mathematics and I went to work as a computer programmer in the Boston area. I thought just for continuing the education -- we had a lot of that adult education -- where you can just take a class or something. The Harvard University extension school was offering night classes and I wanted to study a language that I haven't studied before and which has something I hadn't seen.

One of the courses being offered at Harvard was Sanskrit and I had no idea what it was, except that it has got something to do with India. But I took it. and it happens to many people. I don't know if that happens here, when people in the US have to study Sanskrit, many fall in love with it, especially when you have a mathematical mind, because it is such a logical language. For those of us who only learn ABCD which has almost no linguistic rhyme or reason to it, Sanskrit is a revelation and I loved it but at that time I realized that I wanted to get into the history of mathematics and science. I also didn't want to give up Sanskrit. So I told my Sanskrit teacher that this is my situation, is there some place where I can study the history of science? Is there mathematics or science in Sanskrit. We had no idea that in the history of math books Sanskrit was important. My teacher knew about David Pingree at Brown University.

> This is so different from the kind of pedantic Euclidean tradition as laid out in a step by step sequence.

What attracted you to ancient Indian mathematics?

Well the fact that usable Sanskrit text is written in verse and how the textual and pedagogical tradition had to accommodate that [attracted me]. The focus of Sanskrit is on orality in languages, in speech and in some scriptures put together deliberately. But how do you use that when you are thinking of these rules, these mathematical concepts, the texts as things that are supposed to be very concise.

With different meanings of verses that are nonetheless supposed to convey knowledge – how do you handle that? This is so different from the kind of the very pedantic or Euclidean tradition as laid out in a step by step sequence. We think of that as normal and it has some definitive advantages for explaining things. But it seems to me that in the classical Indian tradition in mathematics, one must be able to have that understanding without having every little thing spelled out for you.

Do you think Sanskrit as a language was particularly helpful to the way Indians studied mathematics and astronomy?

These counterfactuals are bit hard. How else would Indian mathematicians have done? Sanskrit helped them. In some ways I suppose, like anything else, it might have had its advantages and disadvantages. The focus on orality may have meant this idea that the text is supposed to be composed in verses.

The idea of having a text that is very dense and concise may have been very hard for people to understand sometimes. On the other hand, that very difficulty may have evoked people to continue to tackle the text who would have the ability to do it.

What other languages besides Sanskrit and Hindi do you know?

I have learnt some Arabic, Persian, Latin and a little bit of Greek. I picked up French and Dutch, and some amount of German, only for reading and conversing purposes. I am not a literary expert in any of those languages but I can read the math texts written in those languages.

Executive Organising Committee of the ICM 2010

(From left) A. Narne, G. Misra, R. Roy, T. Amarnath, R.Tandon, M.S. Raghunathan, S. Kumaresan, G. Rangarajan, R. Balasubramanian, S. Kesavan and D. Singh

REFLEXIONS Team

(From left) Richa Malhotra, B. Sury, Rahul V. Pisharody, Midhun Raj U., Geethanjali Monto, R. Ramachandran, Gadadhar Misra (sitting), Nikhil M. G., Sidharth Varma and Mohammed Anvar T.

Vishy Plays Mathematicians @ ICM 2010

Viswanathan Anand shares a light moment with his opponents during the game.

Reflexions in the hands of delegates @ ICM 2010

Delegates are reading *Reflexions,* the newsletter of ICM 2010.

Photos by Rahul V Pisharody

Kenneth Prize for R. C. Gupta

Richa Malhotra

Radha Charan Gupta is the first Indian to be awarded the Kenneth O. May Prize for his contributions to the history of mathematics. Prof. Kim Plofker, the author of *'Mathematics in India',* will present the award to Prof. Gupta on behalf of the International Commission on the History of Mathematics (ICHM). Prof. Gupta was chosen for the 2009 prize jointly with Prof. Ivor Grattan-Guinness of UK by the ICHM.

The award was presented to Prof. Grattan-Guinness at the 23rd International Congress of History of Science and Technology held in Budapest, Hungary. Prof. Gupta could not attend the Budapest Congress and will receive the award in his home country, India at the Closing Ceremony of the ICM on 27 August 2010.

Prof. Gupta's major contributions in the field include work on the history of development of trigonometry in India. He authored the chapter 'Historiography of Mathematics in India' in the book *Writing the History of Mathematics: Its Historical Development.* He was the President of the Association of Mathematics Teachers of India from 1994 until recently. He also founded the journal *Ganita Bharati* (meaning "Indian Mathematics") and has written several articles in the journal.

See You, Seoulmates!

The 2007-2010 IMU Executive Committee at the Abel Prize Banquet on May 22, 2007 in Oslo.

From left ro right: Z. Ma, Sir John Ball, M. Grötschel, C. Praeger, L. Lovász, M. de León, R. Piene, V. Vassiliev, S. Baouendi, M. Viana, C. Procesi

Announcement

Volume 1 of the ICM 2010 Proceedings will be sent separately, in the form of a DVD, to all the delegates when it is ready.

Newsletter Team

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