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HYDERABAD • INDIA

REFLEXIONS

The daily newsletter of ICM 2010

August 22, 2010


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Polymath is Not Necessarily Folly Math

In 2009, Gowers started the polymath project, using the comment functionality of his blog to produce mathematics collaboratively. The initial problem considered was finding a second proof to the density version of the Hales–Jewett theorem. What follows is a conversation with Timothy Gowers, largely about the Polymath project.

Where did the idea of Polymath come from?

Actually, I have forgotten precisely, but it was some time between when I started my blog in September 2007 and when I remember mentioning the idea in a conversation in January 2009. So probably I thought of it in the middle of 2008: the idea occurred to me that the format would put pressure on participants to make their ideas public quickly, even if they were notfully formed, which is in complete contrast to the usual situation.

Email and arXiv have, over time, become indispensable tools for collaborative research across the globe. Do you see the Polymath library evolving into a preferred format for sharing ideas?

I think it is too early to say what will happen. If the process has some more successes, and especially if it is ever used to solve a very big problem, then it will take its place amongst the methods we use. But getting a suitable pool of participants and keeping them enthusiastic is challenging, and it is not clear how many projects could run at any one time.

Could the Riemann hypothesis be a candidate for a Polymath project? (It is one of the "million dollar" problems of the Clay Mathematics Institute.)

Light in darkness

I think the million dollar prize would disturb the process significantly if there was ever any chance of solving the problem. But one thing Polymath seems to be very good at is providing in a very short time a thorough survey of a problem, why it is hard, which approaches don't work, what is known, and so on. A Polymath project on the Riemann hypothesis that was undertaken with these more modest goals in mind could be very valuable.

What happens if one of the collaborators of the project breaks off, completes the solution, and announces the result independently?

It would be obvious to everybody that it was not independent. In practice, it was clear that this was not going to happen. In any case, it is difficult to compete as an individual with a group of collaborating mathematicians.

Does the process of proposing a Polymath project put some individual who has already thought about the problem and worked substantially on it at a disadvantage?

This is certainly a concern. To eliminate it, proposals for Polymath projects are now made some time in advance of the starting of a project, so that an individual can privately contact the proposer if this situation is in danger of arising.

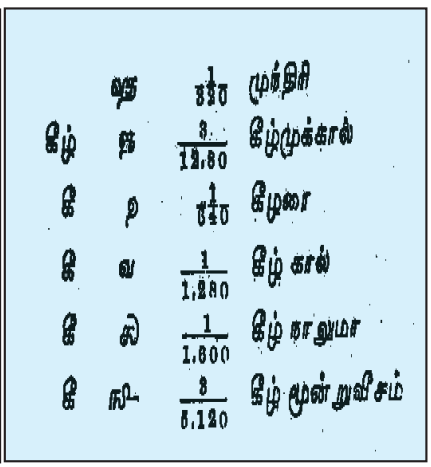
Does the recent activity centered on the announcement of the "P not equal to NP" problem possibly show that the Polymath idea is catching on?

I think what has happened there is not exactly the Polymath idea, but it is very much part of the same ethos. I also think that if the proof had had a serious chance of being correct, then people's behaviour would probably have been very different, but I'm not sure exactly how.

Does the success (or even proposal) of a Polymath project depend on the area?

There is an obvious advantage to problems with elementary statements, which is that the pool of potential participants is much larger. I think if there were to be a project in a subject that required a lot of advanced knowledge, then it would have to be run by a strong moderator who would work to persuade people to participate -- in contrast to the projects so far where participants have been self-selecting.

Christening Fractions Ancient Tamil Way:The Rationale?



Abel Lecture: Varadhan on Estimating Rare Events

Prof. S.R.S.Varadhan, FRS is an eminent mathematician who obtained his doctorate in 1963 from the Indian Statistical Institute (ISI), Calcutta, under the supervision of C.R.Rao. He moved to the Courant Institute of Mathematical Sciences, New York thereafter. He has won several awards including the Abel Prize in 2007. At the ICM 2010, he delivered the Abel Lecture on August 19 on `Large Deviations'.

Prof. Rajeeva L. Karandikar, Chennai Mathematical Institute gives a few words of introduction to the topic for a non-specialist.

The large deviation principle, formulated by Varadhan along with Donsker, deals with precise estimation of probabilities of rare events. The interest is such estimation arises while discussing, say probability of a huge downfall in the financial market, something that affects everyone. Another instance of a rare event: if Paul the Octopus pre dicts correctly the outcome of not only 8 matches (as the case was) but say 200 matches in a row. Interestingly, in his Abel Lecture Award Lecture at Oslo in 2007, Varadhan had also given the example of the probability of extremely large and extremely rare waves ("the hundred year wave") striking oil drilling platforms. The latest BP oil rig disaster immediately comes to one's mind.

Though the common perception is that this cannot happen, in all such cases, the exact probabilities of the rare event can be calculated. 'The Large Deviation Principle' deals with estimatiing such probabilities in a complex situation. In several situations, the underlying probabilities actually decay exponentially.

Foray Into Statistics: The Early Years

Prof. S. R. S. Varadhan of Courant Institute of Mathematical Sciences, New York, spoke to **R. Ramachandran** at the Tata Institute of Fundamental Research in Mumbai a few months after his Abel Award in 2007. However this interview has remained unpublished so far. Excerpts from the interview:

Besides your father, who was a mathematics teacher, do you recall any other strong influence in your early days that was responsible for your interest in mathematics?

There was a very good maths teacher in my high school, Mr. Swaminatha Iyer. Sometimes he used to ask us to come to his house to help us with solving difficult problems. Very supportive and encouraging. His attitude was solving problems was a fun thing to do and not to viewed as some sort of chore…

When you came into college were there any outstanding teachers who provided further encouragement towards your deciding to pursue mathematics?

One teacher was there, Saraswati. She was Saraswati Natarajan when she was there. She then divorced Natarajan and she is now settled down in the United States. She was a great maths teacher.

So when you left school you had already made up your mind to do mathematics. Is that right?

When I left school I went to intermediate. For two years I was doing maths, physics and chemistry. I didn't take biology. So medical college was out. So the choices were either maths, physics, chemistry or engineering. I wasn't interested in engineering that much.

So maths, physics and chemistry. I applied for all three but I got into statistics honours and so I got admitted there. If I hadn't got a seat in statistics and had got a seat in physics and would have probably ended up as physics professor or something.

You seem to have finished your college when you were 19. But how does that add up? From your year of birth, how did you have those two years of intermediate after 11 years of schooling and three years of college?

I think I did my schooling in less than 11 years because I didn't have to do 5th grade or 6th grade. I also remember being promoted in the middle of the year from the second grade to the third grade. I was considered to be too far advanced compared to the rest of the class. So I probably finished my school in 9 years and another five years in college.

But you actually didn't do any kind of post-graduation.

You see there was this scheme. The honours programme consisted of one year of study initially and the last two years the classes were combined with the Master's students. So you sat with them and you took the same exams.

> 'When you start your career as a graduate student...the natural thing is to take some theorem that has been proved in some context and see if you can generalize it. That's more or less what I tried to do.'

They got their Master's degree and you got your honours degree. And after six months your honours degree became a master's degree. The university actually took back the B. Sc (Hons.) degree and gave you an M. A. degree as there was no M. Sc in Statistics. They abolished this scheme in 1960. But I was in the 1959 batch. I don't even remember if there was a degree or it was just a letter or something. You had to apply to the university after six months and then they made you an M. A. I can't recall exactly how it was…

Was the choice of going to the ISI a conscious decision or was it because of the precedence of your seniors from Presidency College also having gone there?

There were various options open at that point. The natural option was to sit for the IAS and that sort of a thing. But IAS had strict age requirements. You had to be 21 or something. So I had to wait for two years anyway. What most people did was to teach for two years in some college and prepare for IAS.

Somehow that didn't appeal to me that much. I convinced my parents that it was worth trying out research for two years and if I don't like I could always drop it and sit for the IAS. So in some sense I still had that option open to do something I liked.

Any way, eventually when I went my idea was to do statistics and not so much mathematics because at that time statistics made you more employable. That's why I started out with applied statistics and statistical quality control.

When you went to the ISI it was a period of charged atmosphere of doing various things. Mahalanobis was there. What was the environment like at that time? I wanted to understand the entire milieu in which the institute operated…

The institute was a huge thing. Stat Math Research and Training , that was the central core as far as we were concerned. And C. R. Rao was the head of that. He was the head for forty years. And so

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Knowledge Quantum in Mathematics Teaching

Sidharth Varma &
Nikhil MG

Photo: Rahul V Pisharody

Jill Adler

Jill Adler, the Vice President of International Commission of Mathematical Instruction, spoke on the topic *Professional knowledge matters in mathematics teaching*. She emphasised on choosing good examples as part of good teaching and also how the objectives of mathematical teaching blur due to the research-oriented goals.

Spending quality time and effective time management is a necessity to make good teachers. "Being able to do mathematics/mathematical reasoning is important but not sufficient for being able to teach others to learn," opined Adler. Speaking of Elaborate Knowledge, she said that mathematical reasoning is to be induced in the students by unpacking all the possible ways of learning. "Teachers' mathematical work lies in enabling others to learn mathematical contents and process, in relation to each other, in increasingly more complex pedagogical contexts," she added.

Moving to a more detailed explanation of her talk, the mathematical education in the South African context was presented. Policy and curriculum change has shown the way ahead through knowledge sharing and skill sets in the country. Despite having a very high GDP, South Africa has shown poor progress in the educational sector. "Reform, Redress and Repair" was a remedy she proposed.

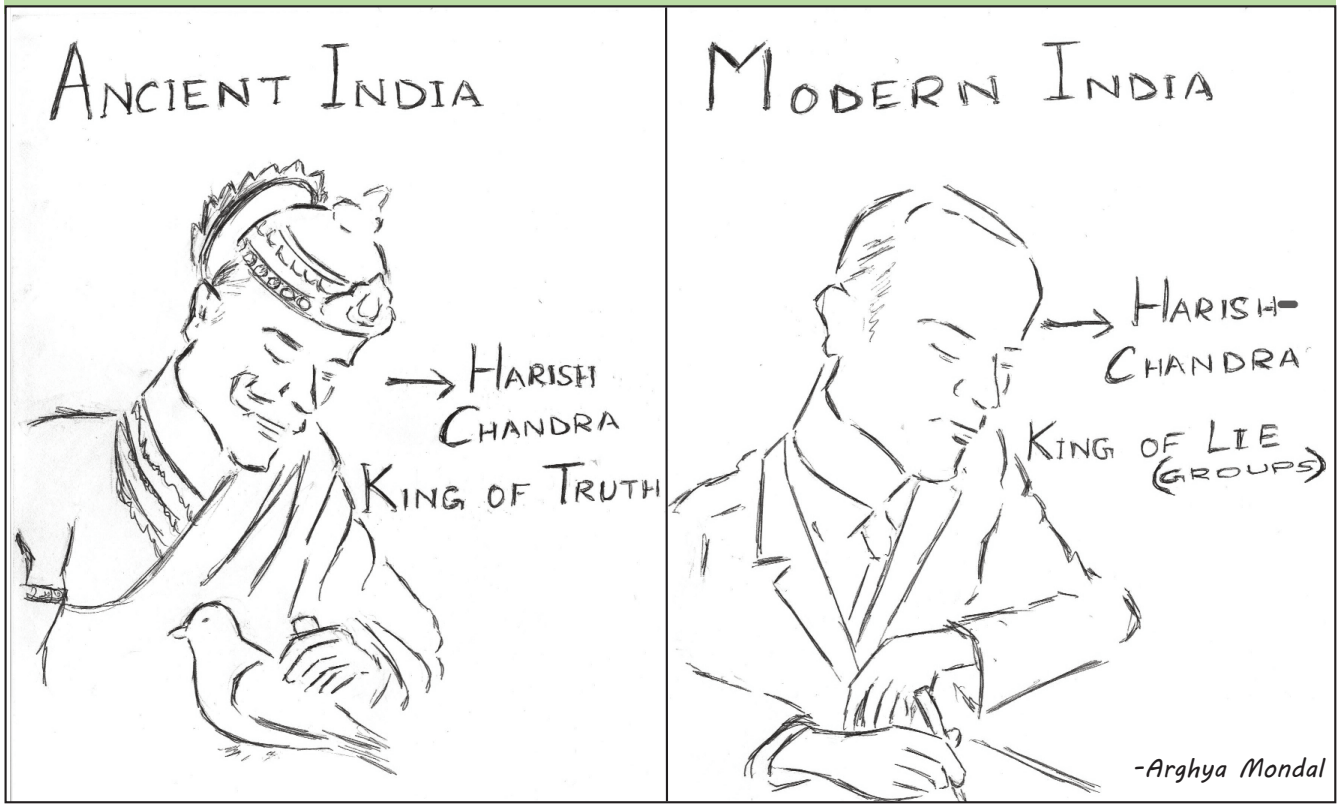
According to her, quality of an education system lies in quality of teaching the teachers. Curriculum innovations, raising teaching qualifications, proliferation of state and private interventions and professional development has taken off in South Africa.

The QUANTUM project focused on Qualifications for Teachers Underqualified in Mathematics started in South Africa and the UK as a development project and moved ahead as a research project. It aims at providing and improving teachers' education and involves working with teachers in classrooms.

As part of the QUANTUM project two tasks were performed amongst the grade 8 and 10 students. These tasks were designed to analyse visual interpretation and reasoning skills of the learners. The results suggested that teachers must be prepared to deal with both expected and unexpected responses. There needs to be mediation between learners and mathematics, and across learners. She expressed a need for more reasoning-oriented text books rather than identification-oriented ones.

Also stressed was the fact that professional knowledge matters in mathematical teaching in order to learn school mathematics from a teaching perspective. "Building variations into tasks, conjecturing and justifying" are means of effective mathematical teaching. She concluded that, a performance driven circle among students in South Africa and the economic mindset of teachers has hampered the growth of mathematics.

Mathaloon



'I was always interested in probability theory.'

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our contact with Mahalanobis was very little. He would come once in a while to see what we were doing and we all knew what he looked like and occasionally he would give some lectures. He left us to ourselves.

For you was he a kind of figure that you like to emulate and a kind of adulatory respect for him?

No we thought of him as a very good administrator who gathered donors and resources for the development of probability and statistics research in the country. We knew he had made some contributions in statistics years ago. But in more recent times his contribution had been more in national planning and advisory and administrative role rather than as a theoretical research mathematician. C. R. Rao -- we had admiration for him in that role. His work and his quality of leadership in a research institution…

Did you also ever have thoughts of working with C. R. Rao in any sense at any point of time?

In ISI you dont really work with anybody. What happens is that you are fairly independent. You can ask anybody anything you want and they will help you but you do your own thing and when it is time for you to write up the thesis and your work is more or less finished, then you find a person is the closest to your work and ask him to be your advisor. If I had stayed in statistics and not decided to work on applied statistics but in more theoretical statistics, then C. R. Rao would have been advisor.

But even that initial intent changed and you started working in more of formal probability theory.

Yes. I got interested in probability theory after about three or four months at ISI and slowly over time, after 8-9 months went, I was seriously interested in probability. And at that point I decided that I was going to work on probability. The natural person whose work was the closest to this was Prof. [Raghu Raj] Bahadur. But by the time I finished my thesis he had left. So C. R. Rao became my formal thesis advisor even though he really did not work in the area. I explained my work to him and he was quite appreciative.

But when you were shaping your approach to the thesis work were there other influences of people who were visiting the institute like Fisher and so on?

No. It was mostly I think people like Ranga Rao…

Now I wanted you to clarify the incident of Kolmogorov and your thesis about which there are various accounts. Was he really there when you were defending your thesis?

He was not really there. The way it was then, you submit your thesis and then your thesis is sent out for people to examine. People examine them in their offices and write reports. Based on the reports the institution decided to have an oral examination. At the point of the oral exam the thesis has been nearly approved. There is no formal examination per se. My thesis was ready by March or April of 1962 and Kolmogorov was visiting the institute at that time for a month. So it was C. R. Rao's intention to ask him to be one of the examiners and he agreed to be one. And it was just a seminar at which I gave a lecture on my work and he was in the audience.

So it was not an examination. It was just a seminar. There were a lot of other things discussed and there were a lot of other people. And after the seminar, he travelled and then returned to Moscow. And he said that he would write out the report. There was a bit of a delay and eventually it came.

Is it true that, as Varadarajan has written in his reminiscences in 2002, that Kolmogorov wrote that the thesis was not that of a student but that of a mature master and that the thesis deserved the D. Sc. and not just a Ph. D.?

I don't know because I never got to see the thesis report. We are never shown the reports. It is an administrative process and we are told we have been awarded the degree or not. That's it.

But on what grounds did you choose to work on the extension of limit theorems to n-dimensions?

When you start your career as a graduate student, you do one of two things. If you have the American system you will have an advisor who will tell you what to do. We didn't have that system. So what you have to do is to read the material and formulate your own problems. You don't have much experience; you don't know what you can do and what you cannot do.

So the natural thing is to take some theorem that has been proved in some context and see if you can generalize it. That's more or less what I tried to do. I was successful. I tried to extend it beyond to the non-locally compact situation in the Hilbert space. It was slightly different and I tried and developed that and in the end succeeded in doing that as well.

Then following Harish-Chandra's work you did some work on quantum operator theory and lie group representations with Varadarajan at ISI. But you chose to go to Courant Institute instead and you went back to probability theory…

I was always interested in probability theory. My interest was in Markov processes and I was studying that already at ISI with Ranga Rao and K. R. Parthasarathi. The theory of Markov processes required a lot of partial differential equations and Courant Institute is one of the strongest places for that.

Kyoto Prize for Lovász

The ICM is glad to announce that László Lovász, the President of the International Mathematical Union (IMU), has been awarded the 2010 Kyoto Prize in Basic Sciences for "*Outstanding Contributions to Mathematical Sciences Based on Discrete Optimization Algorithms*". Lovász is currently Professor, Eötvös Loránd University, Hungary. The Award was announced in June this year.

The Kyoto Prize is an international award instituted in 1985 by the Inamori Foundation, Japan to honour those who have contributed significantly to the scientific, cultural, and spiritual betterment of mankind. Each laureate is presented with a diploma, a 20K gold Kyoto Prize medal, and prize money of 50 million yen per category.

Announcement

Special lecture by Fields medalist Ngô Bảo Châu on **August 22 Sunday during 13:45 to 14:45 in Hall 4.**

Panel Discussion: Ethnomathematics, language and socio cultural issues on **August 22 Sunday during 15:00 - 18:00 in Hall 4.**

Newsletter Team

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"Mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true."

Bertrand Russell