



CONNECT

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Newsletter of the Indian Institute of Science



FROM THE EDITORIAL TEAM

Greetings!

CONNECT began its journey on 1 January, 2014 and as we approach its first birthday, we take the opportunity to reflect on our eventful journey thus far and also to think about the path that lies ahead.

The idea of the newsletter was conceived by P Balam, the then Director of the Indian Institute of Science (IISc). He believed that a one-hundred-and-five year old institution on the forefront of research in diverse areas of science and technology

deserves a platform to showcase its research facilities and other resources as well as highlight some of the important events taking place on campus. He was also keen that this platform be used to throw light on the Institute's past, one that has, after all, shaped the present.

And so CONNECT was born. The name of the newsletter reflects another role, a social role, that it aspires to play. CONNECT seeks to begin a conversation among members of the campus community and with our alumni as well as with the outside world. While it would be presumptuous for us to suggest that we are anywhere near achieving what we set out to do, we would like to believe that we are moving in the right direction.

For us, the journey has been thoroughly enjoyable, but it has not always been an easy one. The learning curve has been steep; we have made mistakes. But all along the way, we have had the enthusiastic support of Balam as well as the current Director of the Institute, Anurag Kumar. CONNECT has also benefitted greatly from the guidance it has received from AG Menon, the former Chair of the Archives and Publications Cell (APC), and from TA Abinandanan,

the present Chair of the Cell.

As we move forward, we would like to hear from you to help us evolve without losing sight of our goals. Please do write to us at our email address which is, as always, on the last page of the newsletter.

To mark the final issue of the year, we have some bonus reading. In this issue, we feature interviews with two fascinating visitors to campus — Lian Pin Koh, an ecologist using drones for wildlife conservation, talks to Bharti Dharapuram and Jahnvi Phalkey, a science historian, talks to Megha Prakash; Maneesh Kunte reveals the history of quasicrystals and their IISc connection; Debadrita Paria tells us about the Notebook Drive; Karthik Ramaswamy continues his series on the history of the Main Building of the Institute; some of our new faculty introduce themselves; and we also report on interesting events and news from the campus.

Happy reading!

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CAMPUS VISITORS

LIAN PIN KOH: Using Drones for Conservation



Drones are unmanned flying objects that have earned a reputation for being killing machines. But one man is trying to give them an image makeover. He is Lian Pin Koh, an ecologist at the University of Adelaide. Koh is spearheading an effort to use drones for

wildlife conservation. His drones, unlike their military counterparts, are more like model toy gliders with just three parts: an airframe, an auto-pilot device the size of a credit card and a digital camera to take pictures. Koh was at the Indian Institute of Science (IISc) in September where he gave a plenary talk at the Student Conference on Conservation Science (SCCS). He also conducted a workshop on 'Conservation Drones for Dummies' at the conference. CONNECT caught up with Koh during his visit to find out more about the use of drones for wildlife conservation.

Q How did the idea of using a drone for wildlife surveillance come about?

I took up the hobby of flying remote control (RC) gliders when I was working in Zurich, Switzerland. Switzerland has fantastic mountain-tops and is an excellent place for flying them. I was doing that for a year or two and became quite proficient at it. One day, over a cup of coffee with a colleague, Serge Wich — a primate biologist working in Sumatra — we discussed the idea of using an RC plane to fly over the rainforest to see if we could detect orangutan nests in the canopy. So our first project was in Sumatra looking for orangutan nests to estimate their population.

"I took up the hobby of flying remote control (RC) gliders when I was working in Zurich"

Q What was the response to your initial efforts?

When we went into this, we were just stumbling along. Initially, there wasn't much interest from my colleagues; many regarded it as something frivolous. But Serge and I were very passionate about it. And the funding from the National Geographic Society gave us some encouragement; so we pressed on.

After we went to Sumatra, we posted a video on YouTube and it received a huge response from all over the world. This really encouraged us. One or two years later, I had the opportunity to do a TED talk and I was also invited to Washington DC to give a talk at the World Wildlife Fund (WWF)-Fuller symposium about this work. It was then that my colleagues took notice and began to think of this as something more respectful.

"Initially, there wasn't much interest from my colleagues; many regarded it as something frivolous."

Q Where has the technology been applied so far?

Our first project in Sumatra is the kind of work that many of our ecologist colleagues want to do — flying over the forest, taking pictures, getting data from the canopy as well as from the ground.

There is another group of users, like the WWF-Nepal, Wildlife Conservation Society (WCS)-Belize, etc, who want to patrol protected areas. In Nepal, they are patrolling the Chitwan National Park to look for poachers and their camp sites. In the coast of Belize, for example, we are experimenting with UAVs (Unmanned Aerial Vehicles) as a cost-effective means of patrolling protected marine areas to prevent illegal fishing. In Australia, it is being used to monitor post-fire regeneration of vegetation.

"In Nepal, they are patrolling the Chitwan National Park to look for poachers and their camp sites"



Q What have been the challenges along the journey?

The most challenging part of our mission at ConservationDrones.org [an organization co-founded by Koh promoting the use of drones for wildlife conservation] is training people who do not have any background in flying remote controlled planes. I remember that when we first went into Nepal, we were expecting them [WWF-Nepal personnel] to pick up the skills after a short training period. That didn't work very well. Eventually, we figured out that, to successfully introduce drone technology, we have to phase it over a period of time.

A lot of airframes that we brought to people on the ground were not really suitable for operating in harsh environments. After many trials, now the airframe has changed to withstand hard landing and repeated use.

Also, when we started, the only available UAVs cost tens of thousands of dollars. Nowadays there are many small startups building their own units and selling them for three to five thousand dollars. I think there is a huge opportunity here for local conservation groups and university students to build their own stuff. Besides being cheaper, it is also a way to raise awareness of these [conservation] issues and train local students.

"I think there is a huge opportunity here for local conservation groups and university students to build their own stuff"

Q Earlier this year, Kenya and South Africa banned the use of drones for conservation fearing misuse. Should we worry about the threat to our security and privacy?

I think it's largely a knee-jerk reaction by some governments. If you think about it, satellite images are widely available and can be used as surveillance tools. Of course, they [the governments] recognize risks; there is risk in every technology. As people understand the technology better, they will become less fearful of it. I don't think it is going to be an issue in the long-term. I personally think the promise far out-weighs the risks in this case.

Q Do you think the use of the word 'drone' is a problem? Maybe it threatens people given its military connotation?

We had that discussion early on when we were planning to create this organization [ConservationDrones.org]. I was quite adamant about using the word 'drone' to keep it status quo and not shy away from using the word. In the end, we decided to have 'conservation' in front of 'drone' to make people understand that drones can also be used for good.

What I hope to see in the future is that when the word drone is mentioned, people think of conservation drones rather than military drones. I think it is already happening. When I googled 'drone' in 2011 it was all just military drones, but when I did it more recently, it is mostly conservation drones [he smiles].

"What I hope to see in the future is that when the word drone is mentioned, people think of conservation drones rather than military drones"

Q What's next for you?

I think I'm at a very exciting stage of our conservation drones project right now. It is only very recently that we are being recognized for our work. So we are now able to bring conservation drones to mainstream research. Since I moved to Australia recently, I'm establishing collaborations with different groups wanting to use these drones for their own research. I've been leading a dual life for a long time; I've been doing this drone stuff and I've also been carrying on with my tropical ecology research. Thankfully, I have a very good team of postdocs and graduate students. In a way, I'm doing my work through them.

-- Bharti Dharapuram



JAHNAVI PHALKEY: Writing The History of Indian Science



Jahnavi Phalkey, a historian of science, is Lecturer in History of Science and Technology at King's College, London, UK. In 2013, she wrote a book called 'Atomic State: Big Science in Twentieth-Century India', an insightful account on the history of nuclear physics in

India, published by Permanent Black. Phalkey was at the Indian Institute of Science (IISc) recently to lay the groundwork for a travelling science exhibition that she is curating. The exhibition will open in 2017 and one idea under consideration is to tell the history of Indian science through the story of Bangalore. Phalkey spoke to CONNECT about the exhibition that she is going to curate, the importance of institutional archives and ways of creating awareness about the history of science.

Q Can you tell us about this exhibition that you are putting together?

It all began with the Science Museum in London asking me to join them as Lead Scholar and External Curator on an exhibition about science in India. Earlier this year, I shared some ideas with them; one of the ideas we are keen on developing is to tell the history of science through the city of Bangalore. I am here to test the feasibility of that idea and visited many institutions of science, engineering and also technology here. I am looking for interesting historical objects and identifying key people to understand their perspectives on why science thrives in the city.

"I am looking for interesting historical objects and identifying key people to understand their perspectives on why science thrives in the city"

Q You are a historian and a writer. According to you, how important are institutional archives?

I think archives are absolutely necessary for a

historical sensibility to survive. The absence of archives makes it difficult or sometimes even impossible to write robust and proper histories of modern India, which includes history of science — my own field.

We, in India, haven't placed enough importance to retaining historical objects. We do see some of that happening in the cultural sphere — temples are being preserved, but very often heritage buildings are not. We celebrate cultural icons, occasionally even some scientists, but we do not preserve their records or for that matter, institutional records.

"We, in India, haven't placed enough importance to retaining historical object"

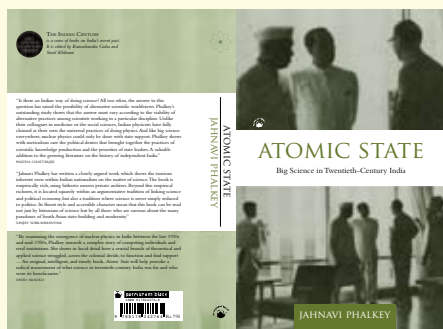
Q What more can be done at IISc archives?

I used the archives for my first book and I am really glad that it exists. I think that having it is a step in the right direction. All I can say is that, for a one-hundred year old Institute, you have to think about a collection policy. Second, you have to pay more attention to collecting objects.

"For a one-hundred year old Institute, you have to think about a collection policy and pay more attention to collecting objects"

Q Do you see it as a problem of not having a mechanism in place?

We cannot get away by saying there is a problem of mechanisms because for these very institutions that I am studying now, many of which were established in early 20th century and some even before that, records from the early years are available. For example, the India Office Collections and the British Library have all their records until 1949-50, but beyond that they haven't been systematically collected. So there have been mechanisms that for one reason or the other, were abandoned.



Phalkey's book on the history of Indian nuclear physics

Q When you wrote your first book, how did you overcome these challenges – of limited access to personal papers and institutional records?

I was lucky. TIFR [Tata Institute of Fundamental Research] had just opened their archives and IISc was beginning to set up theirs. Apart from these archives, I sourced material from families of scientists and to get these papers I had to build trust with them. For example, I was interested in the work of RS Krishnan here. So I went to his family who were kind enough to share his papers with me. Without their support, an entire chapter could not have been written! I also looked at IISc archives as well as Cambridge archives to collate and corroborate Krishnan's work abroad and in India. If I knew he was interested in someone's work, I'd visit that university and look at letters and the personal collection of that scientist to see what Krishnan had written to him. Luckily, I have been able to reconstruct many of these events because of substantial research grants during my PhD. I could travel to various archives with these travel grants. If I did not have them, writing these stories would have been considerably difficult!

Q What needs to be done to engage people in history of science and communicate its importance?

One way ahead is to establish a good history of science department in the country. Secondly, India needs a strong community of historians of science and a professional society to represent them. The Indian National Science Academy (INSA), New Delhi, has a commission, a journal and has recently instituted a Young Historian of Science Award,

which is a wonderful start but historians of science have to take the lead!

We also need to nurture our existing science museums by supporting historical collections. I think exhibitions, to an extent, also create historical awareness. There are other ways to foster a public debate: for example, DD [Doordarshan, India's state-run television network], carried a thirteen-episode show called '*Bharat ki Chhap*' directed by Chandita Mukherjee and others from NID [National Institute of Design, Ahmedabad]. They traced the history of science in India by going back in time.

We also need more science journalists alongside TV shows about science with a historical perspective.

To summarize, I think we need a public debate, an academic environment for research, and we need focused work through places like museums, journals, television and the classroom.

"The Indian National Science Academy (INSA), New Delhi, has a commission, a journal and has recently instituted a Young Historian of Science Award, which is a wonderful start"

Q As a field, where does the study of the history of science stand in India as compared to other countries?

In India, history of science is not an established discipline even though there are very good people working in the field. There is no university degree awarded in the history of science. This is really a surprise. But in the US and in Europe, many universities do. This must be said while keeping in mind that the discipline is young and small globally.

"In India, history of science is not a well established discipline and there happens to be no university degree in history of science"

Q Tell us about your interests outside history.

Other than writing history, I am increasingly drawn towards documentary filmmaking. And then reading never stops!

-- Megha Prakash



FEATURE ARTICLE

CRYSTALLOGRAPHY AT THE INSTITUTE: Part II - Quasicrystals

The architecture of the *Darb-e-Imam* mosque in Iran is a mathematical wonder with tiles arranged to form a



Darb-e-Imam mosque in Isfahan, Iran
(Courtesy : www.marinaalin.com)

unique pattern of pentagons. 550 years later, a similar pattern was observed in a curious kind of crystal called

quasicrystals, whose discovery led to a Nobel Prize in Chemistry in 2011.

In the eighties, Dan Shechtman, an Israeli scientist on sabbatical in the USA, was working on metallic glasses which were obtained by the rapid solidification of molten alloys. While observing the crystal structure of an aluminium-manganese alloy by diffraction, Shechtman observed a strange five-fold symmetry which led him to discover quasicrystals.

The history of science, however, would show that other scientists, including experimentalists at the Indian Institute of Science (IISc), came oh-so-close to making this discovery. In 1973, Kamanio Chattopadhyay, currently a professor at the Materials Engineering Department in IISc, had been studying aluminium alloys for his PhD at the Benares Hindu University (BHU). While he was investigating aluminium-nickel alloys, Chattopadhyay reported pentagonal crystals, but was unable to explore them further due to the lack of facilities.

A few years later, GVS Sastry, a research scholar, also at BHU, was studying aluminium-palladium alloys. He and his collaborators saw some strange diffraction patterns, but assumed them to be a metastable phase of the alloy.

Shechtman, however, took extra care to ensure that he was actually looking at a new kind of crystal. He reported his observations in a paper in the *Physical Review Letters* in 1984. Even so, the discovery faced resistance from scientists like Linus Pauling.

Shechtman's paper, written before he achieved his rock star status, was published in a physics journal and might have gone unnoticed by material scientists at IISc, but for

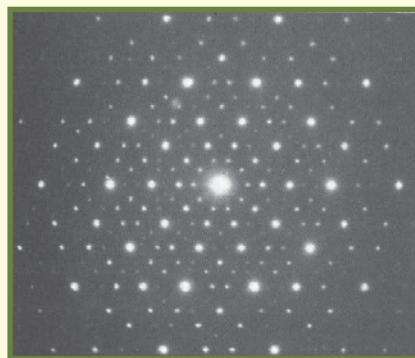


Shechtman's lab notes
(Courtesy: www.tikalon.com)

a lucky meeting of two friends. Chattopadhyay, who had just moved to IISc as an Assistant Professor then, recalls going to meet Rahul Pandit (now Professor, Department of Physics, IISc) one Friday in January 1984 to compare weekend plans. Pandit too was looking for Chattopadhyay at the time, albeit with a different purpose: he had just received a preprint of Shechtman's paper.

Excited by the paper, Chattopadhyay recalls that he was "at the laboratory at 7:30 am the next morning". He asked N Thangaraj, a PhD student working with S Ranganathan, the then Chair of the Materials Engineering Department (formerly Department of Metallurgy), to help him work on Shechtman's aluminium-manganese alloys. Before long, they managed to reproduce Shechtman's results and expanded their study to other alloys, kicking off a most fruitful collaboration.

During the course of these studies, they also noticed additional patterns which the group published in 1985 in the journal *Scripta Metallurgica*, followed by a more detailed paper in *Current Science*. They



Diffraction pattern for an icosahedral crystal
Chattopadhyay et al. (1987) *Acta Metallica*. 35(3):727-733.
Source: Kamanio Chattopadhyay

were helped by Shrikant Lele, then a professor at BHU and an expert crystallographer, who spent a summer at IISc. Looking back at that paper, Ranganathan now feels that it was modest in its claims. The diffraction patterns displayed quasiperiodicity in one direction and regular periodicity along the other axes (corresponding to a two-dimensional quasicrystalline structure), which was hitherto unknown. These crystals also had a faceted structure.

Another group working at the National Institute of Standards and Technology, USA, led by Leo Bendersky reported the same results in September, 1985. These two groups are now credited with the joint discovery of the decagonal phase.

This early work, which did not garner as much recognition as it may have deserved, did, however, set the stage for a strong pan-Indian school in quasicrystals to be established. Ranganathan jokes that the IISc-BHU collaboration, in particular, was like a virtual “twinning”, a reference to a particular kind of crystal structure wherein two crystals intergrow symmetrically.

Chattopadhyay and Ranganathan continued to make contributions to the field with a number of papers studying quasicrystals in different systems and guiding many students to their PhDs. Many of these investigations were carried out in collaboration with researchers from across the country and around the world.



Ranganathan (left) greeting Chattopadhyay (right) on the latter's 60th birthday

During this period, Ranganathan also realized that one of the aluminium phases that they were looking at was actually an example of a one-dimensional quasicrystal, with vacancies in the crystal lattice (or lattice sites with atoms missing) lining up in a Fibonacci pattern. Thus, scientists at IISc were the first in the world to discover one- and two-dimensional quasicrystals after Shechtman's Nobel-winning discovery in three dimensions.

Before Shechtman made his discovery, many theoreticians had also been considering the problem of five-

fold symmetry, starting with tiles, like in the archway of the Iranian mosque.

To tile a surface perfectly without gaps using only identical tiles, one would need rectangular, triangular, square or hexagonal tiles, i.e., tiles that have a 2, 3, 4, or 6-fold symmetry. Three-dimensional crystals follow the same rules.

In 1974, the famous British physicist-mathematician, Sir Roger Penrose showed how a surface could be completely covered using tiles with 5-fold symmetry. But there was a catch – it would require tiles of more than one shape and the pattern would be asymmetric and non-repeating or *aperiodic*. This demonstration led to the question as to whether crystals too could exist with 5-fold or 7-fold symmetry.

Even earlier, Alan Mackay, a famous British crystallographer had been considering the problem of 5-fold symmetry in 3 dimensions. In 1962, he published a theoretical paper on how a series of icosahedrons (a 3-D structure with 12 vertices and 20 triangular faces arranged in 4 rows of 5 each, leading to a 5-fold symmetry) could be arranged in a solid in an almost regular fashion. Mackay continued working in this area and in 1982, published a computed diffraction pattern for a 3-D Penrose tiling. Interestingly, Shechtman's 10-fold symmetric diffraction pattern matched Mackay's pattern.

But neither Mackay nor Penrose were working with actual materials. The physical validation of Mackay's and Penrose's thought experiments would earn Shechtman his Nobel Prize almost 30 years later.

Quasicrystals caught the public attention in 2011 when Dan Shechtman won the Nobel Prize in Chemistry. The interesting properties of quasicrystals (some of which are common to intermetallic compounds in general) also generated significant interest with reports of companies employing quasicrystals coatings to manufacture non-stick cookware.

But apart from their potential uses, there is an aesthetic appeal to the structure of these quasicrystals. As Ranganathan puts it, quasicrystals' beauty emerges from “the divorce between order and periodicity”, a divorce which forced a paradigm shift in the way we understand materials.

NOTE: My research on the history of crystallography in IISc took an unexpected detour into the world of quasicrystals. Stay tuned for more on crystallography.

-- Maneesh Kunte

RESEARCH FACILITIES

FLUORESCENCE ACTIVATED CELL SORTING FACILITY

The Fluorescence Activated Cell Sorting (FACS) Facility at the Indian Institute of Science (IISc) was established in 1997 with support from the Department of Biotechnology (DBT), Government of India. R Nayak and MS Shaila (retired professors from the Department of Microbiology and Cell Biology) and many other faculty were instrumental in establishing the Facility. It is now run by a dedicated Divisional FACS committee. The committee comprises Paturu Kondaiah (Professor, Department of Molecular Reproduction, Development and Genetics), R Manjunath (Associate Professor, Department of Biochemistry), KN Balaji (Professor, Department of Microbiology and Cell Biology), Dipshikha Chakravorty (Associate Professor, Department of Microbiology and Cell Biology), Annapoorni Rangarajan (Assistant Professor, Department of Molecular Reproduction, Development and Genetics) and Dipankar Nandi (Professor, Department of Biochemistry). This facility is a central resource centre of the Division of Biological Sciences, IISc. It is actively involved in providing sample acquisition, analysis and cell sorting services for researchers at the Institute.

FACS is synonymous with flow cytometry and the key principles involved are: (i) Fluidics, i.e. cells are in a sheath fluid for laser interrogation, (ii) Optics, i.e. laser beams excite and the emitted fluorescence signals are collected and (iii) Electronics, i.e. the fluorescent signals are converted to electronic signals and the data is processed and analyzed using computer software. In fact, the discovery of the FACS technology by Leonard Herzenberg and others in 1969 represents one of the triumphs of inter-disciplinary research covering engineering, physics, biology, computer science and others. It is possible to collect quantitative single cell analysis of several parameters (physical and chemical) simultaneously at rates of tens of thousands of cells per second. In addition, subpopulations of cells with desired characteristics can be "sorted" or collected with high purity for cell based assays and functions. In conjunction with fluorescently labeled monoclonal antibodies, FACS is a core

technology for biomedical research. It has proved to be enormously useful in immunology, cancer diagnostics, isolation of stem cells, monitoring the progress of bone marrow transplants, AIDS diagnosis (enumerating CD4+ T cell counts) etc.

When the FACS Facility began in IISc, there were two flow cytometers for advanced scientific research; now, it has six. Of these, four are flow cytometry analyzers (BD FACScan, BD FACS Calibur, BD FACS Canto II and BD FACS Verse) and two are cell sorters (BD FACS Aria II and Beckman Coulter MoFlo XDP). All the flow cytometers are operator assisted. The facility also has seven offline analysis systems for data analysis by flow cytometer users. Several users are actively supported in their research on a daily basis. Four-hour long slots, booked ahead of time, are provided on each analyzer on any given day.

Many different kinds of routine analyses of samples are carried out at the facility. They include cell cycle analysis, stem cell side population analysis, multi-color sorting and cell surface analysis. Other than routine experiments, this evolving facility supports researchers in exploring more advanced flow cytometry applications. Some of these experiments that are carried out include investigations on spermatogenesis, cell kinetics, bacterial and ecological population dynamics, bio-compatibility of novel materials, stem cell differentiation, as well as studies on virus-like particles and nano-particles.

The FACS Facility has contributed to many important research findings that have led to several significant publications from IISc. It is used by biologists and researchers from other fields as well. It has provided its services to over thirty laboratories from the Division of Biological Sciences and many laboratories from other departments (Inorganic and Physical Chemistry, Materials Research Centre, Organic Chemistry, Mechanical Engineering and others).

Details of the instruments at the Facility

Flow Cytometry Analyzers:

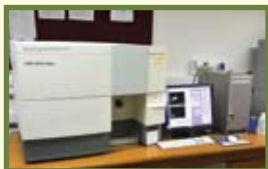
BD FACScan

- Single laser (488 nm blue) with 3-color parameters.
- Mac Operating system with CellQuestPro Software for acquisition and analysis.



BD FACS Calibur

- Two lasers (488 nm and 635 nm) with 4-color parameters.
- Mac operating system with CellQuestPro Software for acquisition & analysis.



BD FACS Canto II

- Configured with three lasers (488 nm, 633 nm and 405 nm) and 8 fluorescence parameters.
- Windows XP operating system with FACS Diva Software for acquisition and analysis.



BD FACS Verse

- Three lasers with 8 color parameters; Windows 7 operating system with FACS Suite software for acquisition and analysis.
- Automatic universal loader as a special feature.



Fluorescence Activated Cell Sorters:

These cell sorters are used to sort a wide range of samples including bacteria, yeast and mammalian cell lines.

BD FACS Aria II

- Three lasers (488 nm, 633 nm and 375 nm near-UV lasers) with 9-color parameters.
- Windows XP operating system with FACS Diva Software for acquisition, analysis and sorting.
- Can sort up to 4 different populations at the same time.



Beckman Coulter MoFlo XDP

- Three lasers (488 nm, 350 nm and 640 nm) with 10-color parameter.
- Windows XP operating system with Summit Software (5.2) for acquisition, analysis and sorting.
- Kaluza software for offline analysis of flow cytometry data.
- Can sort up to 4 populations at the same time.



More details about the equipment as well as contact information are available at: <http://mcbl.iisc.ernet.in/facilites.html>

-- William Surin, Omana Joy, Veena Papanna and members of the Divisional FACS Committee



CAMPUS COMMUNITY

THE NOTEBOOK DRIVE: Making a Difference

When Kareemsaab was still in school, it seemed unlikely that he was going to study for long, even though he was a good student. His parents were unwell and his working brother refused to pay for his fees and books. Luckily for him, his dream of getting a good education was rescued by the Notebook Drive (NBD), an initiative started by student volunteers at the Indian Institute of Science (IISc). NBD took it upon itself to fund Kareemsaab's education. With its help, he completed his schooling and also his diploma, and is now employed with a reputed company. "Frankly, if it would not have been for NBD, I would have been a panipuri wallah today. Just keep supporting us. People like us really need you!", says an overwhelmed Kareemsaab.

NBD was born in 2002 when a small group of enthusiastic and dedicated students from IISc came together with the goal of helping under-privileged students in government schools. "NBD, through its activities, aims to enhance the learning experience of these students", explains an NBD volunteer.

Today, NBD has grown into a small movement with over a hundred dedicated volunteers working in 28 government-run schools in and around Bangalore where they are involved in a wide range of activities.

Notebook Distribution: Every June, volunteers from NBD equip school children with notebooks and stationery for the entire academic year. "The government provides them with textbooks, but many of them do not have the money to buy notebooks and stationery," a volunteer tells CONNECT.

English Communication Classes: NBD conducts English Communication classes in a few schools all round the year.

Mentorship Programme: Every Sunday morning, on the campus of IISc, NBD volunteers teach science and mathematics using hands-on learning methods. This "extra" engagement is aimed at making students more curious towards these subjects.



A team of NBD volunteers

Teacher Training Programme: NBD started this programme with the goal of reaching more students through their teachers. Science and mathematics teachers from government schools are trained in basic science experiments to give them a flavor of how classroom teaching can be made more interesting. These one-day workshops use materials and objects from our daily lives.

Computer Initiative: As part of this initiative, computers have been set up in many schools. NBD also organizes computer classes in these schools to teach students how to use them.

Scholarship Drive: To help students who dropout of schools due to financial difficulties, NBD, under this programme, supports fifty students every year by paying for their college education.

Career Guidance Programme: Under this programme, one-day sessions are conducted to guide students appearing for their board exams and they are also given career advice.

Sports Fellowship: NBD has initiated this fellowship keeping in mind the importance of outdoor activities in the overall well-being of students.

NBD has organized events in many schools on Teacher's Day, Children's Day and Environment Day. These events have made students more active participants in learning as well as provided them with an opportunity to think about larger issues that are not necessarily part of their curriculum.

Many students who have received NBD's scholarships are doing well in their studies. Sushmitha and

Lakshimikanth passed their diploma and are pursuing B.Tech. Jyothi, Radha and Keerthana passed their second PUC with distinction and are doing their B.Com. Some of these students are preparing for their CA exams as well.

The results of these initiatives in the various schools targeted by NBD are already bearing fruit and the schools are pleased. The Principal of *Bharatiya Vijnana Mandira* in Bangalore, one of the schools supported by NBD, is especially happy about the spoken English and computer classes. The students have been receiving training in conducting science experiments. They have also received material help in the form of notebooks and geometry boxes which go a long way, considering the students' background. "This is a great job as our students come from financially backward classes," she says. Taking a holistic approach towards education, NBD is also training students in dance this year.

Namratha, a science teacher at the Bagalkunte Government High School, also in Bangalore, is equally delighted. She says that NBD has provided students with notebooks, worksheets, experiments and science videos on CDs, and even laptops. NBD also conducted a science exhibition, in association with Agastya Foundation, where the children learnt about the working of various models, reaction of chemicals, application of centrifugal and centripetal devices and so on. "This programme has created a curiosity towards science among most of the students; they came forward with many ideas like building their own working model of washing machines, rockets, sprinklers, LPG gas stoves etc," she says. NBD also conducts practical classes on Saturdays in the school which helps the science teachers conduct experiments in difficult topics provided in the syllabus.



Children's Day activities

NBD seems to be having longer term effects on the students too, in Namratha's opinion. She believes that students are now more inclined towards choosing science in their

higher studies.

NBD volunteers are committed towards student learning and are emotionally engaged with them. This en-

gagement has also helped them. "I thank NBD for giving me a chance to revisit my childhood. In the past few years, it has made at least a few hours of my day more meaningful and satisfying. Playing with the children brought out the kid in me while teaching them; I became an educator getting a keen insight into how the education system works," says one of them.



Mentorship Programme

The efforts of NBD have been recognized by many, including the alumni of the Institute. One of them, Gajanana Birur, a scientist at NASA/JPL in California, USA, and also a founder of Birur Educational Foundation for Children (BEFC), a local NGO, is impressed. He says, "The education outreach of NBD to underserved primary and high school students around Bangalore has had a tremendous social impact on wider society. This effort has set an example for other students in colleges and universities across the country." For the alumni, it has also been a trip down memory lane. As Birur says, "...thanks to the sustained effort of NBD over ten years, the youthful IISc student-day idealism has been rekindled in the alums." Explaining the importance of the initiative, Birur's colleague at NASA/JPL, also an alumnus of IISc, Murthy Gudipati says, "Knowledge is freedom; education gives knowledge."

In order to sustain its activities, NBD relies on voluntary contributions from faculty, staff and alumni of the Institute. While many have donated to this cause, the amount of money raised is insufficient and disproportionate to the resources required. NBD hopes that as their work and success gains more recognition, people, particularly those from the campus community and alumni of the Institute, will loosen their purse strings and contribute more generously towards this important cause.

To learn more about NBD and make a contribution to it, please contact: notebookdrive.iisc@gmail.com

-- Debadrita Paria¹

¹ Debadrita would like to acknowledge the NBD team for its input

CAMPUS NEWS

The Science Media Center @ IISc is up and running

The Indian Institute of Science (IISc) and Gubbi Labs, a research collective, have joined hands to establish the Science Media Center (SMC) @ IISc. SMC, which officially came into existence on 1 August, 2014, is run by a team of IISc alumni and is located at the Entrepreneurship Centre, IISc.

The primary mandate of SMC is to communicate path-breaking research and innovations at the Institute to the general public through weekly press releases. So far, it has sent out almost 70 releases, many of which have led to publications in newspapers like *The Hindu* and *The New Indian Express*. A complete list of its releases can be found at SMC's website: <http://iisc.researchmedia.center>.

Faculty interested in availing this free service can contact SMC once his/her research paper is published in a peer-reviewed journal or even when it has been accepted for publication; the latter option gives the SMC team more time to prepare a press release.

To prepare a press release, a member of SMC's well-

trained team reads the published paper (or the accepted draft of the paper) and interviews the researcher. A typical press release summarizes interesting aspects of the research in about a page or two. Though every press release is itself of publication quality, media houses are encouraged to develop their own stories based on the release. To facilitate this, contact details of the concerned researchers are also added to each release.

In order to ensure that the science reported is accurate and reliable, each release goes through a two-stage vetting process before finding its way to the press — first by the concerned faculty and then by the Archives and Publication Cell (APC) on behalf of the Institute.

The SMC Team



Madhukara Putti



Sandhya Sekar



Madhurima Das



HS Sudhira

-- Sandhya Sekar¹

¹ Sandhya Sekar is a founder-member of SMC

IISc partners with UK Centre on green initiatives

In a ceremony held at the Indian Institute of Science (IISc) on 1 October, 2014, United Kingdom's Centre for Ecology & Hydrology (CEH) and the Indian Institute of Science (IISc) signed an agreement committing them to identify opportunities for the development of collaborative research programmes. The agreement was signed on behalf of IISc by its Registrar, Mohan Das and on behalf of CEH by its Director, Mark Bailey.

The new partnership will focus on key environmental challenges such as water security, the impact of air pollution, soil health and sustainability. "This link with the leading environmental science institute in the UK offers huge opportunities for making significant advances in understanding our soil and water systems and how they can be best managed to provide essential ecosystem services", said Pradeep Mujumdar,

Professor, Department of Civil Engineering, IISc.

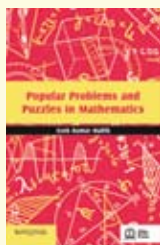
The two organizations will identify opportunities for bilateral exchange of research scientists, and appoint joint staff and studentships. An initial project for CEH scientists is to work with an IISc team to monitor soil moisture at the IISc catchment near Mysore, Karnataka. CEH will supply a state of the art Cosmic Ray Soil Moisture Measuring Device, COSMOS and train IISc staff and students on its use.

The event was also attended by Anurag Kumar, the Director of the Institute.



IIScPress-CUP release first book

The first book born out of the collaboration between IIScPress, the publishing arm of the Indian Institute of Science (IISc), and Cambridge University Press (CUP) was released on 3 September, 2014 at the Solid State and Structural Chemistry Unit (SSCU) Auditorium. The book,



Popular Problems and Puzzles in Mathematics, is written by Asok K Mallik, a retired Professor from IIT Kanpur. It was released along with another book, published independently by IIScPress, **Aerobasics: An Introduction to Aeronautics** by SP Govinda Raju, a retired Professor from the Department of Aeronautical Engineering, IISc. Both the books, part of the newly launched Popular Science Series of IIScPress, were released by Anurag Kumar, Director of IISc. Also



Book release ceremony

present on the occasion were Kota Harinarayana, the DS Kothari DRDO Chair, Aeronautical Development Agency, Bangalore, and B Sury from the Indian Statistical Institute, Bangalore.

The authors were introduced by GK Ananthasuresh, Professor, Department of Mechanical Engineering and the Chair of IIScPress. A vote of thanks was delivered by TA Abinandanan, Chair, Archives and Publications Cell (APC) and member of IIScPress. Abinandanan is also the editor of the Popular Science series. Anurag Kumar, as well as the two authors and guests of honours, spoke on the occasion.

IIScPress, established in 2008 and CUP, the world's oldest publishing house, will co-publish books in diverse areas of science and technology by tapping into the existing expertise in research and teaching at the one-hundred-and-five year old Institute. Elaborating on the agreement, a press release from CUP stated that "the books will be written by eminent academicians, researchers and subject experts in science, technology and engineering". It also stated that a total of 15 academic titles will be published over a span of three years, all focusing on advanced research in diverse areas of science and technology.



Back in August, 2013, IIScPress and Cambridge University Press (CUP) entered into a co-publishing agreement. CONNECT spoke to **GK Ananthasuresh**, Chair of IIScPress, about this collaboration.



Q Why did IIScPress collaborate with CUP? What does CUP bring to the table?

IIScPress forged a collaboration with CUP through an MoU because they have a lot of experience in publishing and in distributing technical books in India. They are committed to excellence in publishing. What attracted IIScPress to CUP the most was that they promised to distribute the books in India at affordable prices and in a timely fashion, in addition to selling them globally. Furthermore, they have an Asian imprint called Foundation Press. Some books that are India-centric could be published through this imprint.

Q Can you reveal the names of any forthcoming titles?

The first book of this collaboration is "Popular Problems and Puzzles in Mathematics" by Asok Mallik. Two volumes on solid mechanics and continuum mechanics by CS Jog, Professor of Mechanical Engineering, IISc, are also in press. There are more in the pipeline, but it would be too early to talk about them.

Q Do you have any message for faculty in IISc who are thinking about writing a book?

What should be attractive to them is the timely publication of Indian editions at affordable prices. CUP has a rigorous review process and they maintain high standards in publication. They also have a good marketing and distribution network. As far the usual terms and conditions go, CUP is quite competitive. A principal goal of IIScPress is to bring out quality books for postgraduate education in India. We have arguably one of the best rosters of courses taught by able faculty. It will be really wonderful to bring out half a dozen books per year written by IISc faculty (and also people from outside IISc). With more people becoming authors of IIScPress books, we create a brand name for IIScPress, which has its own advantages.

-- Karthik Ramaswamy



HELLO!

In this section, some of the faculty who have joined the Indian Institute of Science (IISc) recently introduce themselves.

Partha Pratim Talukdar (SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE)



I joined the Supercomputer Education and Research Centre (SERC), as an Assistant Professor in July 2014. The warm and friendly people on campus, the late night snacks at Prakruthi, encounters with monkeys near the Centenary Visitors House — I am loving it all here at the Institute! Before I came here, I was a postdoctoral fellow working with Tom Mitchell on the Never Ending Language Learning (NELL) project at the Machine Learning Department in Carnegie Mellon University (CMU), USA. I completed my PhD in 2010 in Computer and Information Science from the University of Pennsylvania, USA. Between graduate school and CMU, I also spent a year in Microsoft Research. I did my bachelors from BITS, Pilani and was born and raised in Guwahati, Assam.

Even though we routinely use a lot of background knowledge when making intelligent decisions in our daily lives, Artificial Intelligence (AI) systems do not traditionally have access to such broad-coverage knowledge. My research is focused on overcoming this bottleneck by automatically harvesting knowledge from Web-scale datasets. If successful, this has the potential to make a significant impact on intelligent decision making systems. To address these challenges, I draw upon and contribute to the areas of Machine Learning, Big Data analysis, and Natural Language Processing. I am very excited to be working on this emerging and exciting area of research. Interestingly, I was first inspired to work in learning and language during a YEFP (Young Engineering Fellowship Programme) summer fellowship at IISc back in 2002. I occasionally also moonlight in cognitive neuroscience. And I am very excited to see IISc's growing strength in this area.

I enjoy travelling; Alaska and Iceland have been my top destinations so far. Radiolab and The Moth are my favorite podcasts, and I cherish Bhupen Hazarika's lyrics.

Bhavana Kanukurthi (DEPARTMENT OF COMPUTER SCIENCE AND AUTOMATION)



I am an Assistant Professor in the Computer Science and Automation Department (CSA). I joined this lovely Institute in May 2014. I received my PhD from Boston University in 2011. After that, I worked as a postdoc at UCLA. My area of research is Cryptography.

My research focuses on building cryptographic primitives which provide strong security guarantees even under powerful adversarial settings. This research becomes particularly relevant in today's world where data storage and computation is increasingly moving to the Cloud. As we store, access, and run tasks on this data, several security challenges surface. Can we make sure we have reliable access to our data in its entirety? While it is impossible to always guarantee this, can we at least guarantee timely detection when things go wrong? For example say you store some important tax documents on the Cloud. If the file is lost (i.e., corrupted and unrecoverable), you would want to detect the loss immediately and not a year later. Furthermore, can we guarantee privacy of the data while running some computations on it? Can we guarantee security even if the data we store depends on the cryptographic key intended to secure it? Can we provide these security guarantees while minimizing the possible overhead – in storage size, computation time, communication costs and so on. These are some of the questions which I explore in my research.

Since my move to Bangalore early this year, I have come to love all that this beautiful city has to offer — cafes, galleries, restaurants and, particularly, what's left of its green spaces! In my spare time, I love traveling and trekking. I am as much an admirer of history and architecture as I am of mountains and lakes.

Prasanta Ghosh (DEPARTMENT OF ELECTRICAL ENGINEERING)



I joined as an Assistant Professor in the Department of Electrical Engineering (EE) in August, 2014. Before I became an Assistant Professor, I was a DST-INSPIRE faculty in the same Department from January, 2013.

This was the second time I joined IISc. The first was way back in January, 2004, when I joined the Electrical Communication Engineering (ECE) Department as a Masters student. I received my MS (Engg) degree in 2006. Following that, I went to do my PhD in electrical engineering from the University of Southern California (USC), Los Angeles, USA, which I completed in 2011. After my PhD, I worked in the IBM Research Lab, Delhi, India as a research scientist before joining IISc as a DST-INSPIRE faculty.

My broad research interests include understanding human speech communication and building engineering models for speech technology solutions. This begins with the understanding of human speech production, which involves analyzing and modeling articulatory gestures involved in speaking. Some of the key research questions include — how do humans co-ordinate the motion of different speech articulators including tongue, lips, jaw, velum and glottal vibration seamlessly to produce natural sounding speech? Can we find out the coordinated movements of articulators from a given speech acoustics? The answers to these questions would in turn help us design an algorithm for synthesizing natural speech using computers. Technologies developed from this line of research would also be useful in providing feedback to the language learners to correct their articulation. Another part of my research is to understand the human speech perception and its relation to speech production. Computational models derived out of these findings would be useful for technologies such as speech recognition and compression.

Besides research, I spend my time in diary writing, watching documentaries and listening to music.

Aditya Gopalan (DEPARTMENT OF ELECTRICAL COMMUNICATION ENGINEERING)



Hello! I am glad to have joined the Department of Electrical Communication Engineering (ECE) as an Assistant Professor this July. Going by the litres of fresh oxygen I have breathed, the kilometres I have walked within campus and the number of cups of coffee I have had since then, life in the Institute is certain to be interesting!

I received my PhD degree in Electrical Engineering from the University of Texas at Austin in 2011, following which I was at the Technion in Haifa, Israel for a postdoctoral stint. As a colleague in my department likes to say, I was on my way back to India from the United States when I decided to take a short break in Israel — one that didn't prove to be as short as it should have been.

My research interests span networks, algorithms, control and learning. I am especially interested in the study of decision making and optimization under uncertainty, which finds concrete application in several modern day autonomous systems such as Internet recommender systems, personalized search, automated trading, robotic control, etc. My doctoral work dealt with the design and analysis of effective wireless scheduling algorithms which use incomplete network information. Alongside, I also helped develop simple, yet fast algorithms for disseminating information across large networks with mobility. A primary theme in my current work is sequential decision making in complex environments with incomplete information, environments in which optimal behavior must be learnt with scarce, often complex feedback.

When I am not staring at the ceiling directly above me (read usually at work), music is a constant and satisfying companion; I study and play the guitar often. Running and swimming are activities that I try to engage myself in on a regular basis. I also have fond memories of cooking and do keep up with it as and when I find time.

I look forward to a wonderful time here at the Institute.



EVENTS ON CAMPUS

CONFERENCE ON BIOINSPIRED CHEMISTRY

An Indo-German Conference on Bioinspired Chemistry (IGCBIC-2014) was held at the Indian Institute of Science (IISc) during 10-12 September, 2014. The conference was organized by G Mugesh, Professor, Department of Inorganic and Physical Chemistry (IPC) with financial support from the Science and Engineering Research Board (SERB), New Delhi. It was aimed at facilitating collaborative research between India and Germany in the area of bioinspired chemistry. During the inauguration, TK Chandrashekar, Secretary, SERB, spoke about a new overseas postdoctoral fellowship opportunity for Indian students to undertake research in several areas of science, including materials, energy and sustainable chemistry. Around 20 speakers from both



the countries delivered lectures on topics ranging from supramolecular chemistry to bioinspired synthesis and their applications in protein and nucleic acid research, low-cost diagnostics, healthcare, drug delivery and other biomedical applications.

-- Megha Prakash

CLIMATE CHANGE QUIZ



The 6th inter-collegiate quiz competition on climate change was organized by the Divecha Centre for Climate Change in collaboration with the Centre for Atmospheric and Oceanic Sciences (CAOS) on 23 September, 2014 in JN Tata Auditorium at the Indian Institute of Science (IISc).

Held annually, this quiz competition is hosted under the Centre's outreach educational activities. It was envisioned in 2008 by a group of faculty from IISc because colleges in India lacked well-structured courses in climate science.

The quiz seeks to motivate college students to pursue careers that address climate change issues and promote awareness on climate science, a fast-emerging and multidisciplinary science. *"The impact of the activity is such that one of the winners from the quiz hosted last year joined us at Divecha as a PhD candidate,"* Govindasamy Bala, Professor at CAOS, told CONNECT.

This year saw around 80 colleges, both science and engineering, register for the quiz. Students from these colleges came not just from Bangalore, but from many places across Karnataka like Tumkur, Mandya and Kolar. Given the large number of participants, the students wrote a multiple choice written exam before the oral quiz.



The quizmasters for the event were J Srinivasan, Chair, Divecha Centre for Climate Change and Govindasamy Bala. The quiz consisted of multiple rounds on various topics related to climate science and climate change. They included topics like clouds and climate dynamics, carbon dioxide and climate change, paleoclimate, renewable energy etc.

The event also included an audience quiz, a poster session and screening of documentaries on climate change. Anurag Kumar, Director of IISc, gave away prizes to the winners of the quiz. Addressing the participants and audience, he said that such activities sensitize people towards this pressing issue.

-- Megha Prakash

CONFERENCE ON THE SCIENCE OF CONSERVATION

The Student Conference on Conservation Science (SCCS) Bangalore, a sister conference to SCCS-Cambridge, was held at the JN Tata Auditorium, Indian Institute of Science (IISc) during 25-28 September, 2014. SCCS Bangalore, which began in 2010, was organized by a conglomerate of institutions and co-hosted by the Centre for Ecological Sciences, IISc.

It brought together young researchers in the science and practice of biodiversity conservation. The conference facilitated interaction and exchange of research ideas and methods. It also served as a platform for sharing knowledge and experience related to conserving wildlife.

The conference played host to plenary talks by eminent environmentalists and conservation biologists. Sunita Narain, Director-General of New Delhi-based Centre for Science and Environment (CSE) and Editor, *Down To Earth*, in her talk, urged conservationists to think of relocating the people living around the reserves only if it was necessary and focus on better forest management practices. M Ananda Kumar, a wildlife biologist with Nature Conservation Foundation (NCF) spoke about human-elephant conflict management in Valparai,



Tamil Nadu. Other plenary speakers included Goutam Narayan, Project Director of the Pygmy Hog Conservation Programme (PHCP); Gladys Kalema-Zikusoka, Founder & CEO, Conservation Through Public Health; Suprabha Seshan, Director, Gurukula Botanical Sanctuary; Lian Pin Koh, Associate Professor at the University of Adelaide and Daniel Brockington, Institute for Development Policy and Management, University of Manchester, UK.

The conference included oral and poster presentations by students, besides several day-long workshops that were held in parallel on topics ranging from remote sensing to experimental design.

-- Megha Prakash
(Photo: Prasenjeet Yadav)

CAREER FAIR

Samanway-2014, an annual academia-industry interaction event, was held at the JN Tata Auditorium, Indian Institute of Science (IISc) on 17 and 18 October, 2014 with the goal of creating a platform where students and the representatives of industry can exchange ideas and understand each other's perspectives and requirements. It featured keynote lectures, panel discussions, talks on careers in diverse industries and direct one-on-one interactions with representatives of more than 40 companies. This edition, the biggest held in Samanway's history, saw over 1500 students exposed to a wide range of career opportunities, covering fields as diverse as genomics, material science, electronics, software, e-learning, drug discovery, and even molecular gastronomy!



The keynote speakers, M Rangarajan, Director of Engineering, Akamai Technologies and A Nanda, GM - India Engineering Operations, GE Aviation, gave an overview of their companies' operations and discussed opportunities for IISc students in them. TK Alex, former Director, ISRO Satellite Centre (ISAC), described how both industry and academia contribute to ISRO's operations and how ISRO, in turn, contributes to their development. K Natarajan, co-founder, Mindtree, described its incubation centre, which is aimed at fostering industry-academia collaborations. The panel discussion on entrepreneurship highlighted the challenges in building startups and how they can be overcome. The second discussion on manpower trends in academia and industry featured eminent personalities from the government, educational institutions and industry. The panelists discussed the skills Indian industry expects students to possess when they are being hired, and what academia and the government can do to better prepare students as they enter the job market.

-- Nandini Mani
(Photo: Abhinav Jain)



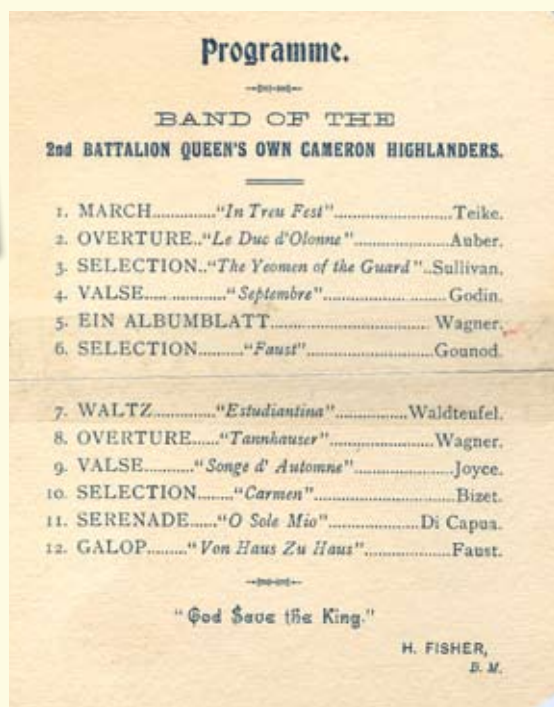
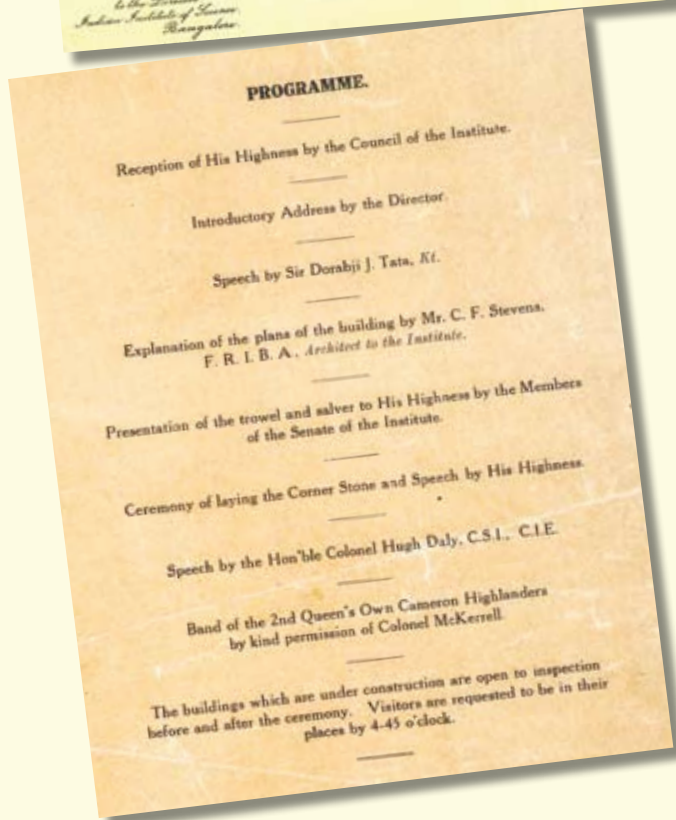
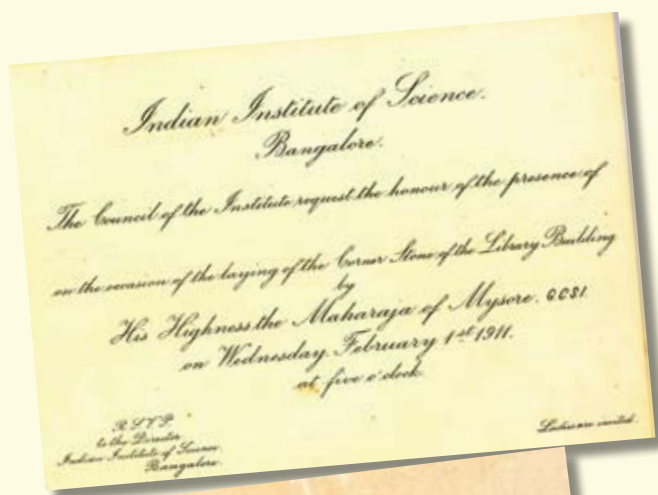
FROM THE ARCHIVES

THE MAIN BUILDING: Part II

The construction of the Main Building of the Indian Institute of Science (IISc), then called the Library Block, began in 1908 without an official ceremony. The Foundation Stone (Corner Stone) was finally laid by the Maharaja of Mysore, Krishnaraja Wadiyar, on 1 February, 1911. To celebrate the occasion, the approaches to the site were decorated and a huge *shamiyana* was erected under a giant crane that was helping with the construction. Morris Travers, the Director of the Institute, made the introductory remarks; this was followed by an address by Sir Dorabji Tata, son of JN Tata. The architect of the Building, CF Stevens walked the gathering through the details of his plans. After a brief ceremony, the Maharaja gave a speech. Those assembled at the ceremony that evening were also treated to music performed by the Band of the 2nd Battalion Queen's Own Cameron Highlanders.



The Corner Stone at the entrance of the Main Building as it exists today



Invitation from the Council of IISc for the laying of the Corner Stone on 1 February, 1911 (top left), the programme of events (left) and the music played on the occasion (above)

Report in *The Times of India* on the Corner Stone laying ceremony on 8 February, 1911

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THE TIMES OF INDIA ILLUSTRATED WEEKLY.

[FEBRUARY 8, 1911.]

INSTITUTE OF SCIENCE.
Foundation Stone Laying.

THE ceremony of laying the corner stone of the library building of the Indian Institute of Science at Bangalore was performed by the Maharajah of Mysore on Wednesday afternoon in the presence of a distinguished gathering from Mysore, Bombay and Madras. An introductory address was read by Dr. Morris Travers, the Director of the Institute, who welcomed Sir Lorasbi Tata as one of the founders. He left it to him to describe how the idea of founding the Institute first arose. The gift of his family, he said, of Rs. 30,00,000, which forms the endowment, was an act of almost unprecedented munificence. The late Mr. Tata and his sons have refused to allow the Institute to be called after them, but have nevertheless raised a lasting memorial and set an example to all India. He reminded all those who were interested in higher scientific and technical education that the Institute was for all India. In conclusion, he thanked His Highness for all that Mysore had done for the Institute through its great statesman, Dewan Sir Seshadri Iyer.

History of the Institute.

Sir D. J. Tata said:—Before asking Your Highness to lay the corner stone of the central building of the Indian Institute of Science, I think it will not be out of place to give a short history of the origin, development, and fruition of the scheme which has found visible embodiment in the well-planned buildings around us. It is all the more necessary to give this account in view of the impatience, not unmixt with a

dian University of Research" endowed with the properties which my father had offered. Government accepted the recommendations of the conference, and expressed its readiness to undertake the required special legislation as soon as all the details of the scheme should be settled. The provisional committee then invited Professor Ramsay, the eminent scientist, to guide and help them in maturing the scheme. Certain gentlemen then drew up a revised scheme and submitted their report in December, 1901, recommending that the Institute should be called "The Institute of Science" and be devoted to experimental science with three schools, one of chemistry, one of experimental physics and one of experimental biology, the initial cost amounting to Rs. 63 lakhs and recurring expenditure to Rs. 1,50,000 per annum. The provisional committee generally approved of this report, and recommended it to the favourable consideration of Government, at the same time intimating that your Highness's Government had generously offered a site of 371 acres of land at Bangalore, with a contribution of Rs. 5 lakhs for the buildings. Some time was necessarily taken up in settling the terms for the occupation of this land, and this settlement was effected in May, 1902. Your Highness's Government followed up this munificent contribution with the offer of an annual grant of Rs. 30,000 for ten years, and the Government of India offered a similar contribution, thus raising the annual income to Rs. 1,85,000.

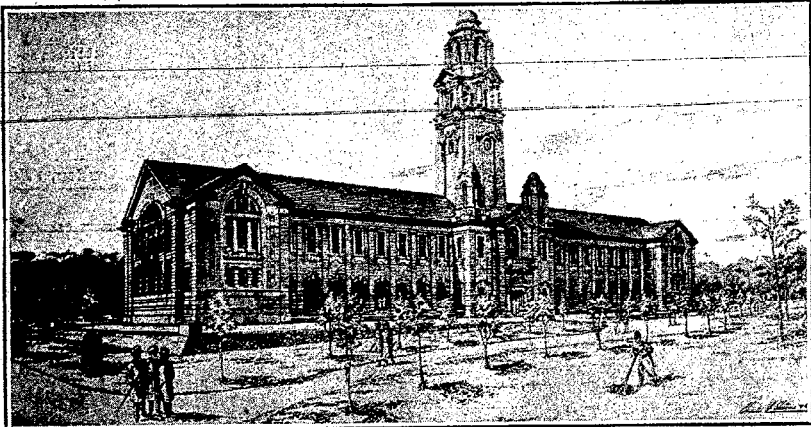
The Next Question.

The next question to be considered was the valuation of the endowment properties calculated to yield a net revenue of Rs. 1,25,000 per year, and the settlement of a scheme for their management and administration. In February, 1905, Government accepted Mr. Lowndes' valuation report and scheme of management, said your Highness's Government

same time that the two other contributors, the Government of India and the Mysore Durbar, might likewise commence the payment of their contributions. This having been agreed to, we paid for the intervening period of twenty-six months a sum of Rs. 2,71,000, which, with the other two contributions, formed a sum much larger than the expenses then to be provided, and left a considerable surplus. Dr. Travers arrived in India in November, 1906, and though the Institute was not legally constituted till some time later, its actual work may be said to have commenced with his arrival. All the academic and administrative arrangements have now been finished, the necessary buildings are nearing completion, and we are assembled here today to witness the laying of the corner stone of the central building, where the library will be accommodated, which ceremony your Highness has graciously consented to perform. Mr. C. F. Stevens, the architect of the buildings, then explained the plans of the Library and the senate of the Institute, headed by Professor Morris Travers, presented a silver trowel and silver to the Maharajah. Immediately afterwards his Highness formally laid the stone which was lowered in to the position by a crane 123 feet high with a 100-foot jib worked by an electric motor.

The Maharajah's Speech.

In the course of a lengthy speech the Maharajah said he realized very deeply the responsibility which fell on him of laying the corner stone of these magnificent buildings, the future home of an Institute which would be a unique one of its kind in India. The India of today he said is almost an entirely agricultural country and except in a few centres such as Calcutta and Bombay, large industries are practically non-existent. Laying under the conditions which surround him in India every thinking man cannot but



LIBRARY BLOCK OF THE INDIAN INSTITUTE OF SCIENCE, BANGALORE.

certain degree of irritation, provoked by the length of time that had elapsed since the initiation of the project, and of the misconceptions as to the attitude and action of Government towards this Institute to which the delay has given rise. In this account, I feel sure, will show you that an understanding of this magnitude, involving the careful consideration of numerous and complicated questions, not only of academic organization and legal procedure, but also of the practical and efficient management of the valuable properties with which the Institute has been endowed, could not be rushed through as quickly as impatient idealists might expect and require, and that the delay which has taken place in the final consummation of the scheme was, to a large extent, inevitable under the circumstances of the case. After dealing with a previous proposal by his father, the speaker passed on to speak of the scheme drafted by a provisional committee in 1898. He said:—This scheme was laid before Lord Curzon on 31st December, 1898, the day after he landed in Bombay. It involved an initial expenditure of 15 lakhs, and an annual cost of maintenance being estimated at 2 lakhs, my father's offer being calculated to yield 14 lakhs per annum and being accompanied by a condition with regard to a family settlement. On this scheme being brought officially before the Government of India in March, 1899, Government felt unable to consider the offer, unless the condition bearing upon the family settlement, which it was understood presented serious legal difficulties, was abandoned, and my father willingly gave it up. On this, Government suggested that a definite and less comprehensive scheme might be prepared, and with the view to expediting matters, proposed a discussion either at Simla or Calcutta. Accordingly, in October, 1899, my father met a small conference, educational experts at Simla. This conference laid down general principles, recommended Bangalore as the site for the Institute, the Government of Mysore having offered a valuable position, and drew up a Bill to incorporate the In-

having in the meanwhile increased your annual limit of time, the Government of India raised their contribution to Rs. 87,500 per annum (being one-half of one per cent of the local assets, consisting of Rs. 1,25,000, the income of the endowed properties, and Rs. 50,000, the grant of the Mysore Durbar, and the maximum admissible under the Bombay grant-in-aid code), also without limit of time, and agreed to raise it still further with the increase of local assets, but not exceeding 14 lakhs a year. These generous and timely contributions raised the annual income to Rs. 2,62,500, and assured the financial position of the Institute. The Government of India further gave Rs. 23 lakhs towards the initial cost, and later the Madras Government agreed to pay Rs. 14 lakhs spread over three years for the same object. Thus, Rs. 9 lakhs were available for the buildings and their equipment, though the actual cost is likely to be nearly double. It was always contemplated that special legislation would be necessary to constitute the Institute and provide for its administration. At a late stage of the negotiations, however, it was felt that the more flexible machinery provided by the Charitable Endowments Act would be better suited to the fulfilment of this object, and steps were accordingly taken for the promulgation of a vesting order under that Act. Meanwhile, at our request made in November, 1905 for the immediate appointment of the first director of the Institute, the Government of India moved the Secretary of State to secure the appointment of the director. A gentleman of eminent scientific attainments, Dr. Morris Travers, F.R.S., was selected by the Royal Society, and was accordingly appointed the first director. Pending the legal constitution of the Institute with the promulgation of the vesting order, he also guaranteed the salaries of two more Professors to be appointed, and with the object of strengthening the funds of the Institute, offered to devote to the project the whole income of the endowed properties, consisting of the

welcome a scheme like that of the Indian Institute of Research, which has as its object the development of arts and industries on scientific lines, and I feel that I am echoing the wishes of thousands of my fellow countrymen when I publicly acknowledge to day the deep obligation which we owe to that eminent philanthropist, Mr. J. N. Tata, in whose foresight and liberality is due the inception of this great scheme and to his sons and successors who have so readily and generously come forward to carry out their lamented father's wishes. (Applause.) It is not too much to say that the family of Tata will be remembered by the people of India for many generations to come as princely benefactors and as distinguished members of that enterprising and virile race who have been among the pioneers of commerce and industry in Western India. (Cheers.) Sir Donnell Tata pays a just tribute to the late Sir K. Seshadri Iyer, who was my mother's trusted adviser in this and all other matters. I cannot help feeling that the Council will be well advised to keep an open mind on the scholarship question until they are satisfied by actual experience that scholarships are not actually needed. (Applause.) The Hon. Colonel Ingham said a few closing words on behalf of the Council, assuring His Highness that his advice would be carefully considered and that they appreciated the Maharajah's assurance of his continuing sympathy. He recorded the absence of Mr. Bhatu Tata, but they were happy to have in their midst Sir Donnell Tata and his wife, representing their distinguished family. In conclusion, he was gratified to announce that he had been instructed by telegram to express the best wishes of the Viceroy for the future of the Institute, who also warmly appreciated the liberal support of the Mysore Durbar and the enthusiastic personal interest of the Maharajah.

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