CONNECT

GETTING AROUND ON *NAMMA CYCLE*

From the Editorial Team

This issue of **CONNECT** has some good reading. HS Sudhira, a former student of the Indian Institute of Science (IISc) and the brain behind the *Namma Cycle* initiative, discusses its history, successes and challenges. Find out about the next Director of IISc as he talks about himself, his research and his views on the Institute in an interview. Faculty who have joined us recently introduce themselves and their research. Maneesh Kunte and Megha Prakash catch up with interesting visitors to the campus. Karthik Ramaswamy rewinds the clock back to when Mahatma Gandhi visited the Institute. Parthasarathy Ramachandran tells us why the management programme in IISc is unique. And as always, Natasha Mhatre gives us a glimpse of the fauna on this beautiful campus.

On a serene, lush green campus like that of the Indian Institute of Science (IISc), moving around on bicycles — if one is not walking — is an ideal alternative to driving automobiles, which make our roads less safe and foul the air we breathe.

While some members of the campus community have their own bicycles, those who do not may still want to use them, even if it is not on a regular basis. The first bicycle-sharing community initiative in IISc was called the Common Usage Bicycles (CUBs) initiative. CUBs used bicycles abandoned on campus. Painted red-and-yellow, they were kept in designated stations around campus. But this initiative did not survive for long because of a lack of discipline on the part of users and also the absence of an effective mechanism for the maintenance of these bicycles.

As the CUBs experiment was coming to an end in IISc, a couple of bicycle enthusiasts[1] were trying to set up a public bicycle sharing system on the other side of the city — first at Electronics City and then at the Bangalore University campus. However, there were many challenges to overcome while implementing

Students with their bicycles

this project, particularly in getting administrative clearances. It was then that TG Sitharam, Professor and the then Chairperson of Centre for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP) at IISc, came forward and provided the needed support and anchor for this initiative. It was now to be carried out at IISc.

And so, *Namma Cycle* was conceived. It got the support of other enthusiastic players: Ride-A-Cycle Foundation (RAC-F), Gubbi Labs, Imagine Bangalore and EMBARQ India. Their coming together helped transform this idea into reality. *Namma Cycle* was launched on 6 August, 2012. The functioning of this

Renting bicycles at a station

initiative is overseen by a Board that includes Sitharam and the Registrar of IISc. RAC-F is in charge of the day-today operations, while Gubbi Labs is responsible for planning and design of the operations.

Namma Cycle will be celebrating its second birthday soon.'*Namma*', which means '*ours*' in Kannada, signifies the concept of shared ownership. The initiative is going strong with more than 20,000 unique trips completed; 40 % of the trips were made by visitors to the Institute. This is effectively the equivalent of about 4000 passenger car trips[2].
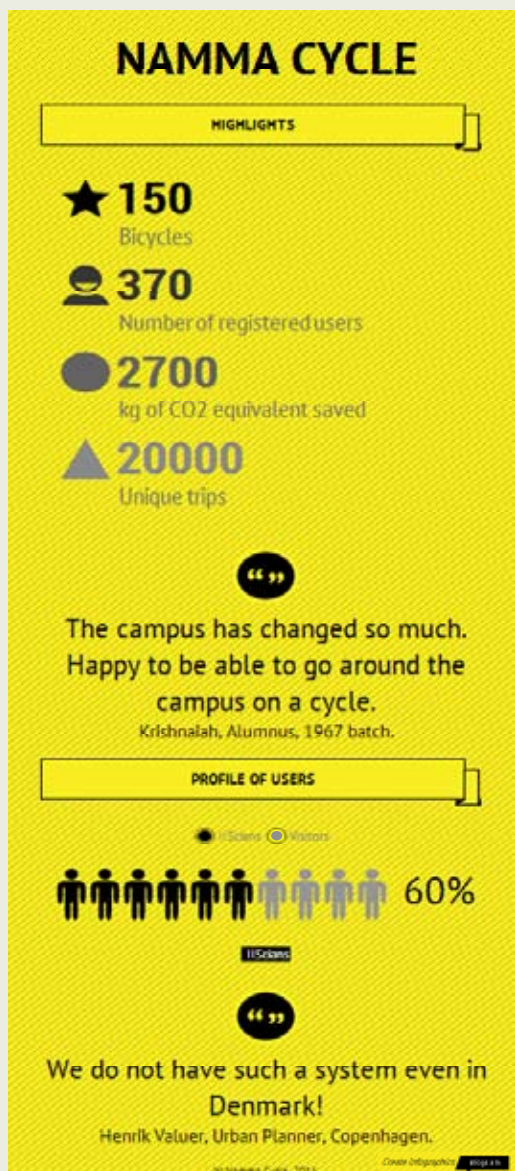
It began with 150 cycles sponsored by TI Cycles India, based in Chennai, and bicycle station racks sponsored by Biodiversity Conservation India Pvt. Ltd. (BCIL), a biodiversity company in Bangalore. It received the much needed seed money from Bruhat Bangalore Mahanagara Palike (BBMP) and Bangalore Electricity Supply Company Ltd. (BESCOM). Recently, Sigma-Aldrich has also come forward to support this initiative.

The system works on a simple "Sign-Up, Select, Ride and Return" system. Users can sign-up on the website and get a registration ID, select a cycle from any of the station racks, ride the cycle to their destination and return it to the nearest station. Six stations are located at strategic locations on campus. The cost of using this facility is nominal.

What makes this shared bicycle usage system unique is its flexibility; it can be operated both in manual and automated modes. An android-based mobile application to run and monitor the system has been successfully tested.

In the short existence of *Namma Cycle*, two valuable lessons have emerged. One, the success of this programme depends on the choices that bicycle users make. Also, for the long term financial sustainability of this endeavour, the players involved (both individuals and institutions) have to raise their own money and not depend on user charges alone. This money raised can be through advertising and through support from donors – alumni, friends and other well-wishers of the initiative.

Namma Cycle will soon be expanded to a 2 km radius around the campus. A wider network involving more local municipal authorities might also lead to an improvement in the road infrastructure for cyclists. In the future, shared public bicycle systems like *Namma Cycle* at IISc, will be integral to solutions to combat the increasing threat of carbon emissions and climate change.

More details about *Namma Cycle* can be found at: **http://www.nammacycle.in**

For those interested in donating money for this important initiative, please contact the Ride-A-Cycle Foundation[3]. Contact details can be found here: **http://www.rideacycle.org**

-- HS Sudhira

Notes:
[1] Disclosure: One of them is the author and an alumnus of IISc.
[2] In traffic studies, 1 bicycle trip = 0.2 passenger car equivalent or pcu (passenger car units).
[3] Donations in India are 50% deductible under Section 80G of the Income Tax Act, 1961.

MEET THE NEXT DIRECTOR

Anurag Kumar, *Professor at the Department of Electrical Communication Engineering (ECE) and Chair of the Division of Electrical Sciences, Indian Institute of Science (IISc), will become the next Director of IISc on 1 August, 2014.*

Prof. Kumar graduated in Electrical Engineering from the Indian Institute of Technology (IIT), Kanpur in 1977. He went to Cornell University for a PhD in Information and Decision Sciences, which he completed in 1981. After six years at the AT&T Bell Labs in New Jersey, he returned to India to become an Assistant Professor at ECE in IISc.

Prof. Kumar has had a rich and illustrious career as a researcher. He was the coordinator of ERNET (Education and Research Network) at IISc, a project that was instrumental in bringing together researchers and students from across India in the pre-Internet era. He has numerous publications to his credit and is a Fellow of the Indian National Science Academy (INSA), the Indian National Academy of Engineering (INAE), the Indian Academy of Sciences (IASc), the Institute of Electrical and Electronics Engineers (IEEE), USA, and The World Academy of Sciences (TWAS). Prof. Kumar sat down with CONNECT *to talk about himself, his research and his views on science and technology, as well as about the Institute he will soon be heading.*

Q Congratulations on being selected as the next Director! Did you know it was coming?

Not really. Among the Divisional Chairmen, there's always a possibility that one of them gets selected. But this was not something that I was anticipating or angling for. One day, all of a sudden, Prof. P Balaram called me to his office and said, "the Selection Committee has met and they would like to offer you this position." I said that I would like to think about it, that it is a major decision.

Q What was your first reaction on being offered the position?

My first reaction was one of surprise, and I was not positive about it initially. But then I gave it some thought, introspected, and spoke to my family about how it'll affect them. Finally, I think, after a day or so, I went back to Prof. Balaram, and conveyed my willingness to take up the responsibility.

Q Can you tell us about your research?

I am a communication engineer and work in the area of communication networks. You can think of communication systems as comprising two types of technical expertise. One is that of creating digital links from media, whether it is optical or electronic or RF wireless media. On the other hand, those who work in networks are concerned with how links are shared between different communication flows, and how networks of links are designed and managed. You can address this engineering problem in two ways. One is to build networks and experiment with them. My own approach is more towards understanding these systems by developing mathematical models. So my work is typically modeling, analysis, optimization, and control problems in wireless and wireline communication networks. That, in one sentence, is my area of research.

Q You've been closely associated with ERNET in the past. Can you tell us something about that?

ERNET was funded by the Government of India and UNDP starting in the mid-eighties. I joined IISc in 1988. ERNET had just been approved and was getting off the ground. It was a project to establish India's first packet network. India already had a telephone network. Packet networking technology is what is used in the Internet. You can say that it was India's first experiment with an Internet-like network. It was a project involving the IITs, IISc, DOE (later called DIT, and now called DeitY), and NCSI in Bombay. These 7-8 institutions built this network. There was a node in every institution. We began to exchange data, locally and internationally. We set up India's first email service for academics. The network remained important for about 5-6 years after that. It was a vehicle for a lot of learning and research for us in those formative days of the Internet. Around '94-95, India began to let in Internet Service Providers (ISPs) like VSNL. At that point, their commercial possibilities made them grow very fast. And then ERNET was used just for research, but now it just provides basic Internet access services to a small pool of Government users. So that's the history of ERNET.

"We set up India's first email service for academics".

Q What does Prof. Anurag Kumar do when he's not working? Any hobbies?

I'm working a lot of the time now. Actually, for the last 6-7 years since I took over as a Divisional Chair, I've hardly had

any spare time. But I enjoy, if I can find time, watching a good movie or reading. I used to regularly play tennis earlier, but all that has stopped now. It's pretty much my research or the administrative work that I have to take care of.

Q You're an engineer by training. You've worked with Bell Labs. Given your background, do you see a bigger push for collaboration between IISc and the industry in the next few years?

It's not something that I'll be seeking because I was in Bell Labs. I'll be seeking that because it is something that is required. An institution of higher learning cannot be aloof from society, or from the applications of the knowledge they are developing. So from that point of view, it is important that we do interact with the industry and society. It has already been happening. The present administration and the ones before that have been encouraging this viewpoint. I plan to take it forward. It must be remembered that the foundational science that we do is very important because today's foundational research could lead to engineering products 20-30 years down the line.

Q Recent Directors have pushed for interdisciplinary research. Do you think that we should make a conscious effort to set up Centres where people collaborate with each other or should that be an organic process?

Both. Already the interdisciplinary research agenda is in place by means of Centres that we have created. If you look at CiSTUP, it is supposed to bring together people in civil engineering, applied modeling, and computer science to do research in the areas of transportation and urban infrastructure. If you look at the new Robert Bosch Centre for Cyber-Physical Systems, its main agenda is to conduct translational research. It has to bring together research in sensing (which involves materials science), and in electronic devices and systems, computing, communication, control (which is the kind of work my Division does) with applications to various domains like the monitoring and management of drinking water, and urban pollution. These are domains that many scientists in IISc are involved in. If you look at the new Centre for Brain Research that has been funded by Kris Gopalakrishnan and the Tatas, they have also simultaneously established some Chairs in Computer Science. We have several PhD programmes that are interdisciplinary — mathematics, nanoscience, being examples. So the interdisciplinary approach in IISc is not new. I'll encourage it and take it forward.

> "... the interdisciplinary approach in IISc is not new. I'll encourage it and take it forward."

Q IISc has a great tradition and history. It is over a hundred years old. Are there challenges that are different for an institution with so much history? In other words, is change hard?

Probably. One is constantly reminded of our heritage when we do something. So that's a cautionary approach that might slow us down. But then, we cannot forget the heritage. It also builds pressure on us to take it forward and strive for higher things.

Q At the risk of generalizing, Indian institutions are not very good at selling themselves. Do you have any views on that?

I completely agree with people when they say that we are publicity-shy. Perhaps we even deliberately avoid publicity. I think we need to communicate more with society about what we are doing. It is something that Western systems are very good at, and I have seen it first hand during the 11 years that I lived in the US. Talking about our work, and specially our successes is important for several reasons. First of all, society funds us and they would like to see the fruits of their input into the institution. It will give them pride that one of the institutions that they have funded is doing very well. People also get to know about our research and come to us for applications. Perhaps science in India does not have impact on society because people don't know what we're doing. I would like to connect more with society, both in terms of exposing what we do, and finding linkages that will bring our research to practice.

> "I think we need to communicate more with society about what we are doing. It is something that Western systems are very good at, and I have seen it first hand during the 11 years that I lived in the US."

Q Would you like to talk about the challenges you are likely to face when you take over?

It's something that I would like to mull over. If you come back to me six months from now, I'll be able to give you a more elaborate answer to your question. There are challenges, but only when I am in the system will I get a feel for whether they are challenges or my perceptions. I would prefer to wait before I answer that question.

-- Karthik Ramaswamy

IISc Press

HELLO!

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

SOMA BISWAS
(Department of Electrical Engineering)

I joined IISc as an Assistant Professor in the Department of Electrical Engineering in October, 2013. I did my PhD from University of Maryland, College Park in the United States and then was a Research Faculty at the University of Notre Dame for two years before moving back to India. I worked for General Electric (GE) in Bangalore for a year before I was lured by IISc.

I work in the area of Image Processing, Computer Vision and Pattern Recognition. More specifically, I am interested in Image and Video Surveillance problems. For example, can we recognize a person from the face image captured by a surveillance camera? Poor resolution of the image in addition to difficult pose and illumination makes this problem extremely challenging. Often cameras capture pictures of crowded scenes like from outside a cricket stadium. It is both technically difficult and laborious for an operator to browse through hours of video to find behaviours that may be of interest to law enforcement authorities. One of the problems that I am working on is to find a way to automatically analyze these videos and send out alerts if there is anything unusual.

When I get the time, I like to travel to new places, read books and listen to music. The Institute is a great place to work, the campus is really beautiful and I thoroughly enjoy my time living and working here.

ABHIK CHOUDHURY
(Department of Materials Engineering)

My journey as a researcher began with a dual degree (Bachelors plus Masters) in Materials Engineering from IIT Madras. Thereafter, I did my PhD work with Britta Nestler at the University of Karlsruhe, Germany, in the field of Computational Materials Science. For my postdoctoral study, I worked with Mathis Plapp at Ècole Polytechnique (Paris). I then moved to Bangalore to join IISc as an Assistant Professor in the Department of Materials Engineering in November, 2013.

My research interests are in pattern-formation; I investigate how patterns are formed using a combination of theoretical, computational and experimental studies. Examples of such self-organizing systems are found not just in materials science, but also in biological and chemical systems; they include many ecological and environmental processes. Besides being of theoretical interest, the understanding of such dynamic systems will also lead to novel approaches in engineering optimal patterns in micro-structures of material. These materials could have a wide range of applications.

My hobbies include reading, designing algorithms, coding, cooking and watching movies. I also like to spend time with my parents and family.

DEEPAK NAIR
(Centre for Neuroscience)

I joined as an Assistant Professor at the Centre for Neuroscience in IISc in late 2013. Born in Kerala and having graduated in Physics, I took my first steps in fundamental research and optical instrumentation during my masters in Physics at IIT Chennai.

I then moved to the Leibniz Institute for Neurobiology (LIN) in Magdeburg, Germany for my PhD where I combined picosecond spectroscopy with Neuroscience. Magdeburg has a proud history of science; it is the birthplace of the vacuum pump. Here I investigated how proteins interact to form functional scaffolding complexes during the birth of a synapse in real time. After my PhD, I received the Marie Curie Fellowship from the European Union for my postdoctoral research and I moved to Bordeaux, a beautiful city in southern France, famous for wine. Bordeaux is also where the first single molecule fluorescence experiment was recorded. Here, at the Interdisciplinary Institute of Neuroscience (IINS), I learned about single molecule spectroscopy and studied the localization and movement of synaptic molecules at a nanoscale. These studies helped to understand the fine organization and regulation of some of the key synaptic molecules in real time.

My training and expertise is in the biophysics of synaptic communication and the role of mobility and localization of synaptic molecules in the flow of chemical information. I am particularly interested in the role of lateral diffusion, arising from thermally agitated Brownian movement in plasma membrane, in the fast exchange of molecules from a synapse to the external environment. This exchange has been identified to be critical in understanding how synapses respond to fast synaptic transmission and how fidelity is maintained between pre and postsynaptic compartments to tune the synaptic communication.
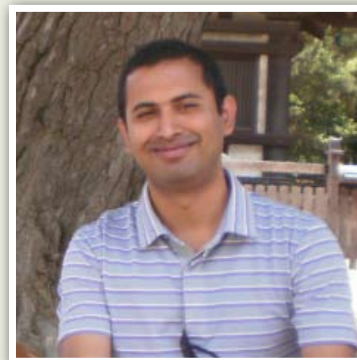
At IISc, my main goal in the next few years would be to understand the correlation between spatial heterogeneity and temporal behaviour of synaptic molecules at sub-diffraction levels. This information is vital — it will give fundamental insights on how neurons in the human brain share information and how the disorganization of these might lead to diseases.

Besides being in the lab and working with neurons and microscopes, I am also interested in travelling, reading, watching movies and listening to music. I am also a big fan of good food.

PRABEER BARPANDA
(Materials Research Centre)

I am originally from a place called Jagannath Dham in Odisha. My first degree (B. Engg.) was in Ceramic Engineering from NIT, Rourkela in 2002. When I was here I received a Young Engineering Fellowship in 2001 and 2002 to work as summer intern in the erstwhile Department of Metallurgy at IISc. This short spell at the Institute inspired me to take up a career in research. In 2004, I obtained an M.Phil degree in Materials Science from the University of Cambridge, following which I went across the Atlantic for my PhD at Rutgers University in New Jersey (2008). I moved back to Europe where I did my postdoctoral study in a CNRS-affiliated lab in France (2009-2010) before joining the University of Tokyo, Japan as a JSPS postdoctoral fellow (2011-2012).

After a ten-year stay overseas working in six countries and travelling to over 40 countries, I came back to India to join IISc as an Assistant Professor in Materials Research Center. Here I study Li- and Na-ion batteries. My research has been inspired by the work of many great scientists like JB Goodenough, MB Armand and JM Tarascon. In the next few years, I intend to build a laboratory to study the synthesis, structure and electrochemistry of novel battery materials.

Besides research, I enjoy travelling, reading books on philosophy and watching documentaries on animals and global issues.

CAMPUS VISITORS

NICHOLAS SPENCER

Nicholas Spencer, Professor of Surface Science and Technology at the ETH-Zurich and President of the ETH Research Commission, visited the Indian Institute of Science (IISc) on 2 June, 2014 to launch his book "Aqueous Lubrication : Natural and bio-mimetic approaches" co-published by IIScPress and the World Scientific Publishing Company. He also talked about the book during the launch. Spencer has worked in many parts of the world in both academia and industry. Spencer spoke to CONNECT *about his life and the book. The following is a excerpt from the interview.*

Q So did you have any defining moments where you said, "This was it… this was the work that you wanted to do"?

Yes, actually. So one was when, I can't remember which satellite it was, but when one of the first satellites went up in the late 50s probably, I decided I wanted to be a scientist. So I must have been 4 or something then. I wonder what it would have been. Not Sputnik, I was too young for that. Maybe Telstar, or one of the communication satellites. Yeah, that was one defining moment.

And then at some point I got into chemistry, I can't remember why. Oh, I think it was because a neighbour, a boy who was about three years older than me, got me interested in photography and then I got interested in developing my own films and that's the first chemistry I think I got in touch with.

But for a while I thought I wanted to be a physicist. When I got to University, I went back to chemistry once I discovered that physics is basically Math (laughs)!

Q How did the idea of this book come up?

Well, I'd been working in water-based lubrication for a long time and Sanjay (late Prof. Sanjay Biswas) said that I had no choice about the other book (his first book). I mean, I had to do a book which was basically a compilation of my papers plus introductory material.

And I did that, partially while I was here (as an IISc Centenary Visiting Professor in 2009). While I was doing that, he said that it would be nice to have a monograph as well. And then he asked, "what would

Prof. P Balaram, Director of IISc (left) releasing a book by Prof. N Spencer (right)

it be on?" He very much liked the idea of aqueous lubrication. And we'd been doing a lot in aqueous lubrication at that point, both on the polymer brushes and also the early work on the mucin. And we were thinking about getting into ceramics. And we'd looked at cartilage a little bit. So we'd sort of had an interest in many of those areas, which ended up in chapters written by other people.

Q So the decision to go with IIScPress was also related to…

Yeah, there was never any discussion! It was always intended to be something to come out of my Centenary Professorship.

Q How has the experience been?

Oh, it's been very good! I've really had no complaints at all. At every stage it was very pleasant. The only thing that slowed it down the most was the writing. And a lot of that was me!

Q What expectations do you have from the book?

Well, I hope it increases the awareness of aqueous lubrication a bit because a lot of people don't really think of it, even as a possibility. There are commercial applications of tribology in action that I talked about this morning like hair conditioners, food, construction, ceramics etc. There are already pumps and things that are water lubricated, and that's already quite established but it could be a bit better. And the whole mechanism of brush lubrication is pretty important, in that a lot of the initial experiments were done with water. A lot of things also apply to oil, but use simpler approaches to brushes in oil. I think it's a nice example of the bio-mimetic approach.

Q Where do you see the field going?

I guess I'm biased but I really like the stuff we're working on (laughs)! I really like the combination of gels and brushes so we have several people working on that. It actually makes it a bit more like cartilage; as you get towards the gel, it starts to be a bit more like cartilage in its behaviour. It becomes more bio-mimetic. I think it has very interesting properties.

So, I would say, in general, moving towards structures that resemble cartilage even more is what I find interesting. And also modelling — modelling these systems. I'm not a modeller, but we've had very nice collaborations with some of these brush systems and we're still doing that. I've had a former IISc student working on a project on molecular dynamics modelling of brush systems.

-- Maneesh Kunte

PALLAVA BAGLA

A science scribe for over a decade, Pallava Bagla is the Science Editor of New Delhi Television (NDTV). He has received many awards, including the American Geophysical Union's prestigious David Perlman Award for Excellence in Science Journalism for his piece on the impact of climate change on the Himalayan glaciers. Bagla, during his recent visit to Bangalore as a T V Raman Pai Chair Visiting Professor of Science Communication at the National Institute of Advanced Studies (NIAS), delivered a talk on "When Science Meets the Public: Bridging the Gap – Insights and Experiences of a News Reporter" at the Indian Institute of Science (IISc) on 12 May, 2014.

After the talk, Bagla in a tête-a-tête with CONNECT suggested ways in which science communicators and journalists could employ social media to disseminate information and the role science institutes could play in improving public understanding of science.

Q What is the difference between science journalism and communication?

There is a thin line of difference between science journalism and communication. Journalism is digging deep into the dirt and finding the facts while anybody can be a science communicator.

Q What steps should science institutes take to better engage people and the media?

Institutes like IISc should indulge in engaging both media and the public by organizing events such as exhibitions. It would be wonderful if each department at IISc holds periodical exhibits to showcase their work. For a better footfall, the Institute can collaborate with museums and planetariums in the city.

There is clearly a need for a dedicated public relations department which can make press releases available to science reporters on recent events and developments on campus. And unbolt the labs for journalists to visit and understand the nuances of the research being done in these labs.

Q Is there a role scientists can play in science communication?

Who better than scientists themselves to talk about their work? Scientists should make a conscious effort to bridge the gap between them and science journalists through press meets, lunches or may be explore the concept of Café Scientifique for discussions and debates.

Q What are the news tools and emerging trends in science communication?

This is the age of multimedia and television has emerged as a new medium to unravel the complexities of laboratory working. Social media such as Twitter, Facebook and Youtube have become handy tools to share video clips or footage and disseminate information.

-- Megha Prakash

Events on Campus

A three day Indo-Dutch International Conference on '**Design for Sustainable Well-being and Empowerment**' was organized to explore ways of extending research to address social problems like poverty, hunger, abuse, discrimination, pollution and neglect. It was held during 12-14 June, 2014 at the Indian Institute of Science (IISc).

The conference kicked off with a short abstract drama rendering of design principles called "Design Whispers", with *Design* representing engineering and *Whispers*, society. Prof. Anurag Kumar, Chair of the Division of Electrical Sciences, IISc, gave the inaugural address. He talked about IISc's thrust of taking fundamental research to the society. He also spoke of using information technology tools for modeling disease spread.

Dr. Devi Shetty, renowned cardiac surgeon and founder of Narayana Hrudalaya, a multi-specialty hospital in Bangalore, in his keynote lecture, raised concern over the number of medical error deaths that occur in hospitals. Dr. Shetty said that in order to tackle the problem, creating a patient management protocol was essential. He also argued that India was brimming with opportunities in providing protocol-based healthcare solutions.

The Conference saw lectures, papers and poster presentations on themes ranging from household organic waste recycling to the design of dry sanitation systems for rural India. Apart from keynote lectures, a panel discussion and a brain storming session were also organized.

-- Megha Prakash

A workshop on "**How to Promote Start-ups**" was organized in the Department of Management Studies at the Indian Institute of Science (IISc) on 13 June, 2014. It brought together eminent academicians, successful entrepreneurs and policy makers under one roof to discuss and derive pragmatic steps for cultivating a sustainable ecosystem that promotes start-ups.

Prof. HP Khincha, Chairman, Karnataka State Innovation Council was the guest of honour. Prof. Jayant Modak, CEO, Society for Innovation and Development (SID), IISc, presided over the inaugural function. The conveners of the workshop, Prof. MH Bala Subrahmanya, Chairperson, Department of Management Studies, IISc and Dr. Prahlada, Vice Chancellor, Defence Institute of Advanced Technology (DIAT), set the agenda for the workshop.

-- HS Krishna

As part of its series on Integrable systems, the National Mathematics Initiative (NMI) of Department of Mathematics, Indian Institute of Science (IISc) organized a workshop on **Discrete Integrable Systems**. It was held during 9-14 June, 2014 at IISc and was attended by prominent researchers from around the world.

-- Sai Prasanna

OUTREACH AT CeNSE

The Centre for Nano Science and Engineering (CeNSE) was born at the Indian Institute of Science (IISc) in July 2010. Covering an area of over one-hundred-thousand sq. ft, it was set up with the singular goal of *"a deep and thoughtful exploration of the nano-world for the common good of humanity"*, in the words of Rudra Pratap, Professor and Chairperson of CeNSE. The Centre has now established itself as a one-of-the-kind inter-disciplinary space for research and education in nanoscale materials, devices and systems.

The educational and research facilities at CeNSE are not restricted to faculty and students of the Centre alone. Outreach is an equally important focus of CeNSE. Its outreach activities can be divided into 4 broad categories: the Indian Nanoelectronics User's Programme (INUP), collaboration with industry and other institutes, nurturing inventors in nano-science and technology and its summer training programmes.

INUP: INUP aims to provide students and researchers from all over the country with the opportunity to not just use the facilities at the Centre, but also training in how to use them. INUP, run jointly by CeNSE and IIT Bombay, is funded by the Department of Information Technology (DIT) and the Ministry of Communications and Information Technology (MCIT), Govt. of India. It has three parts to it: the INUP Familiarization Workshop, INUP Hands–on Training and Project Execution.

"The Indian Nanoelectronics Users Programme is one of the most successful outreach programmes managed by CeNSE. The programme has contributed very significantly to developing and spreading expertise in nanotechnology in India", says Prof. Ambarish Ghosh,

Assistant Professor at the Centre. INUP's success rate is impressive. In its 5 years of existence, the programme has trained more than 1200 researchers from over 100 institutions spread across the country. So far, 39 long and 121 short term projects have been completed, 364 researchers have been trained, 61 peer-reviewed papers have been published and 3 patents filed. Jitendra Kumar, a graduate student from IIT-Kanpur is delighted with what he got out of INUP. He says, *"INUP is a very nice programme. It gives us access to some of the most sophisticated equipment under one roof. The facilities available at INUP are the best in India and are of international standards. The technical insight and knowledge of the people conducting the training in handling the instruments is appreciable."*

More details about this programme can be found at **http://www.nano.iisc.ernet.in/inup**

COLLABORATIONS: CeNSE has active collaborations with other academic institutions and industry. It has partnered with many universities in India and abroad, including IIT Bombay, NITK Surathkal, IIT Hyderabad, Stanford University, Cornell University, Ècole Polytechnique (Lausanne), University of California at Berkeley, University of Western Australia and Tokyo University. The industry collaboration comes under the aegis of the Industry Affiliate Program (IAP). IAP has two goals: to take research from the laboratory to the industry and to jointly solve complex problems in nano science and technology. Some of the industry partners of CeNSE are Analog Devices, IBM, Samsung, Centum Electronics, Lam Research and Unilever.

INCUBATION: CeNSE is also committed to being an incubation centre, where young inventors, planning to start high-tech ventures in the area of nano-science

and technology, are nurtured. The aim is to provide a research-oriented environment for young innovators, an environment, in which both technical expertise and high-tech facilities are found under a single umbrella.

SUMMER INTERNSHIP PROGRAMMES: CeNSE conducts summer internship programmes for undergraduate and master students from universities in India and abroad. As part of this programme, students carry out short term projects under the guidance of faculty from CeNSE. The duration of these projects ranges from 8 to 10 weeks. All students receive a scholarship of Rs. 5000 per month.

Integral to the success of the outreach programmes at CeNSe are the dedicated research facilities that are available for visiting researchers and students. The equipment is spread across two laboratories — the National NanoFabrication Centre (NNFC) and the Micro and Nano Characterization Facility (MNCF). As Prof. Ambarish Ghosh says, *"this program is designed to make the fabrication and characterization facilities available to researchers from around India, and to help them execute sophisticated R&D projects."*

NATIONAL NANOFABRICATION CENTRE (NNFC)

NNFC, covering an area of 14,000 sq. ft. is equipped with state-of-the-art device fabrication instruments. The clean room facility is comparable to any in the world.

Lithography: Laser writer, Coater and Developer Stations, Double-side Mask Aligners, E-beam Lithography.
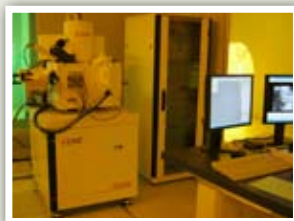
Growth and Deposition: High temperature processing furnaces, LPCVD, Plasma CVD, ALD, E-beam Evaporation, RF Sputtering, Dual Ion Beam Sputtering, Pulsed Laser Deposition, MOCVD of compound semiconductors.

Etching: Wet etching, RIE, DRIE.

More details are available at **http://sindhu.ece.iisc.ernet.in/nanofab/twikii/bin/view/Main/WebHome**

MICRO AND NANO CHARACTERIZATION FACILITY (MNCF)

MNCF has four labs in all.

Electrical Characterization:

Wafer probe stations, Semiconductor Device Analyzers, Vector Network Analyzers, RF Signal Sources, Storage Oscilloscopes.

Mechanical Characterization:

Micro System Analyzer, 3D Optical Profilometer, Rate Table, Pressure Calibrator, Acoustic Microscope, UTM.

Optical Characterization:

Micro-Raman, PL and EL Measurement, FTIR, Solar Simulator, Variable Angle Spectroscopic Ellipsometer

Material Characterization:

Dual Beam FIB, FESEM, Particle Analyzer, AFM

More details are available at **http://www.cense.iisc.ernet.in/mncf/home.htm**

-- Debadrita Paria

FROM THE ARCHIVES:
When The Mahatma came calling

Mahatma Gandhi did not reject modern science; he did, however, have his reservations about many aspects of how it was being done[1]. He believed that the problems of the poor and those at the margins of society should be the focus of scientific research[2]. He viewed technology with suspicion because, in his view, it would lead to unemployment on a large scale[2], a view that was in conflict with those in the scientific establishment, including Sir CV Raman, an ardent admirer of the Mahatma himself[3]. In spite of his apprehensions about science and technology, Gandhi visited the Indian Institute of Science (IISc) on two occasions, once in 1927[4,5] and again in 1936[3,6].

During his first visit to the Institute on 12 July, 1927, he outlined his vision for Indian science. The speech was published the following day in The *Hindu* and reproduced on 21 July, 1927 in *Young India* [7], a weekly paper published by Gandhi.

201. SPEECH AT INDIAN INSTITUTE OF SCIENCE, BANGALORE

[*July 12, 1927*][1]

I was wondering where do I come in? There is no place here for a rustic like me who has to stand speechless in awe and wonderment. I am not in a mood to say much. All I can say is that all these huge laboratories and electrical apparatus you see here are due to the labour—unwilling and forced—of millions. For Tata's thirty lakhs did not come from outside, nor does the Mysore contribution come from anywhere else but this *begar*[2] world. If we were to meet the villagers and to explain to them how we are utilizing their money on buildings and plants which will never benefit them, but might perhaps benefit their posterity, they will not understand it. They will turn a cold shoulder. But we never take them into our confidence, we take it as a matter of right, and forge that the rule of "no taxation without representation" applies to them too. If you will really apply it to them, and realize your responsibility to render them an account, you will see that there is another side to all these appointments. You will then find not a little but a big corner in your hearts for them, and if you will keep it in a good, nice condition, you will utilize your knowledge for the benefit of the millions on whose labour your education depends. I shall utilize the purse you have given me for *Daridranarayana*. The real *Daridranarayana* even I have not seen, but know only through my imagiation. Even the spinners who will get this money are not the real *Daridranarayana* who live in remote corners of distant villages which have yet to be explored. I was told by your professor that the properties of some of the chemicals will take years of experiments to explore. But who will try to explore these villages? Just as some of the experiments in your laboratories go on

[1] From *The Hindu*, 13-7-1927
[2] Forced labour

for all the twenty four hours, let the big corner in your heart remain
perpetually warm for the benefit of the poor millions.

I expect far more from you than from the ordinary man in the
street. Don't be satisfied with having given the little you have done,
and say, 'We have done what we could, let us now play tennis and
billiards.' I tell you, in the billiard room and on the tennis court think
of the big debt that is being piled against you from day to day. But
beggars cannot be choosers. I thank you for what you have given me.
Think of the prayer I have made and translate it into action. Don't be
afraid of wearing the cloth the poor women make for you, don't be
afraid of your employers showing you the door if you wear khadi. I
would like you to be men, and stand up before the world firm in your
convictions. Let your zeal for the dumb millions be not stifled in the
search for wealth. I tell you, you can devise a far greater wireless
instrument, which does not require external research, but internal—
and all research will be useless if it is not allied to internal research—
which can link your hearts with those of the millions. Unless all the
discoveries that you make have the welfare of the poor as the end in
view, all your workshops will be really no better than Satan's
workshops, as Rajagopalachari said in a joke. Well I have given you
enough food for thought, if you are in a reflective mood, as all
research students ought to be.

In concluding, he [said that] they must keep the lamp of their love for the
motherland and her children always bright, trim, and steady. And as they did that, so
they deserved the knowledge and the advantage they were deriving from the Institute.[1]

Young India, 21-7-1927

[1] This paragraph is from *The Hindu*, 13-7-1927.

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Report on Gandhi's visit to IISc in *The Hindu* on 13 July, 1927

MAHATMAJI AT TATA INSTITUTE

Bangalore, July 12.—This evening Mahatmaji and party motored to the Indian Institute of Science and he was received by the staff and students of the Institution. Dr. C. Smith took him round the several departments and Mahatmanji was particularly impressed with the electric section. In the wireless, Mahatmaji himself had a "listening in" and was very much pleased with the arrangement. Finishing further inspection Gandhiji arrived at the meeting quadrangle where the staff and students had gathered in all their numbers.

With a short speech from one of the students and purse presented to him, Mahatmaji spoke in English for a few minutes thanking them for the purse and for their exhibition of patriotic spirit and self-sacrifice. He suggested that inasmuch as they were enabled to acquire so much knowledge and have the advantage of such elaborate organisations and institutions all because of the labour, unwilling or almost forced labour of the millions who were the real "Dharidhranarayan" of the land, the students must realise that all the knowledge they gained and the advantages they derived should be utilised to better the condition of their country-ment. Otherwise, he remarked, the huge apparatus which they worked and the immense knowledge they were acquiring from day to day would be no more than Satan's Workshop as Rajagopalachari once stated. They must install and develop a wireless machinery in their heart which would respond to and communicate with the hearts of the millions for whose service it was worth while sacrificing anything. That would be an achievement more glorious and more enduring than the wireless machine which they just then showed him.

In concluding, he put in a touching plea for searching into one's heart and developing its capacity for love and sacrifice side by side with the scientific resources they made in the Institute. He exhorted them to wear khaddar as a practical demonstration of their love and sympathy for their country's poor, and not be afraid of appearing in Khadi. Let them not conclude that by presenting a purse they had finished their duty; rather their duty had just begun! Whether in the Tennis Court or in the billiard room the problem of the heart, the problem of helping the poor of their country know no time or place and every moment of their life should be given to this one thought. They must keep the lamp of their love for the motherland and her children always bright, trim, and steady. And if they did that so they deserved the knowledge and the advantage they were deriving from the Institute."

After the function, Mahatmaji and party returned to Kumara Park.

Gandhi's second visit to IISc was in the summer of 1936. An ailing and frail Gandhi was advised complete rest by his doctors. He chose to recuperate at Nandi Hills near Bangalore[6]. During his stay, he was paid a visit by Sir CV Raman, the then Director of the Institute, and his wife, Lokasundari. Lokam, as Raman called his wife, became part of the Swadeshi movement early in life. Raman, inspired by Lokam, eventually became a supporter of Gandhi's struggle. Raman was to later endow the Gandhi Memorial Lectures, given annually at the Raman Research Institute in Bangalore. During this visit to Nandi Hills, Raman invited Gandhi to IISc. Gandhi readily accepted the invitation, provided Raman showed him some "magic". Gandhi also wanted to use the visit to raise money for his Kamala Nehru Memorial Fund[3]. He came to IISc on 12 June, 1936 and left Bangalore the same day[6].

Gandhi at the Department of Electrical Technology. Also seen are CV Raman (third from left), Kasturba Gandhi (fourth from left), Kenneth Aston (fifth from left) and Mahadev Desai (sixth from left)

Gandhi with CV Raman (first from left) and Mahadev Desai (third from left)

Gandhi with CV Raman (first from left)

Notes:

1. *Hands and Heads - Gandhi, Nandy and Bhatt: three critiques of modern science*, an article by Ramachandra Guha in *The Telegraph* on 4 February, 2006.

2. Letter from Mahatma Gandhi to Sir M Visvesvaraya dated 23 November, 1934 reproduced in *Dr. Mokshagundam Visvesvaraya* by Shakuntala Krishnamurthy (1980; The Bangalore Press).

3. *CV Raman: A Biography* by Uma Parameswaran (2011; Penguin Books India).

4. 19th Annual Report of the Council of the Indian Institute of Science, 1928.

5. *Mahatmaji at Tata Institute*, a report published in *The Hindu* on 13 July, 1927.

6. www.gandhiserve.org

7. *Speech at the Indian Institute of Science, Bangalore*, reproduced in *Young India* (June - September), 1927.

-- Karthik Ramaswamy

Education Focus: Master of Management

Small and medium business enterprises (SME) have many constraints when they compete with large businesses, especially in the manufacturing process. In order to help them succeed in the marketplace, are there optimization models that they could follow in this process? Ekamdeep Singh is trying to answer this question for his capstone project. This is a rigorous six-month project that is an integral part of the Master of Management (M. Mgt.) programme, which was launched by the Department of Management Studies at the Indian Institute of Science (IISc) in 2011.

The capstone project is one of the aspects of M. Mgt. at IISc that makes it a unique programme when compared to the average MBA being offered by countless institutions across the country. As part of the project, students have to formulate a problem, define a methodology and analyze it. *"The students learn the art of analytics",* says MH Bala Subrahmanya, Professor and Chairperson of the Department of Management Studies. During the course of their project, they present a viva in two stages and then make an open presentation at the end of six months.

The Institute launched the programme after consulting alumni of the Department, Engineering faculty from IISc and a host of people from industry. It was decided that this programme should tap into the core strengths of the Institute — technology and analytics.

Each year fifteen students, all first class engineering graduates, are chosen for the programme based on their performance in GATE/CAT/GMAT exams and personal interviews. *"We are batch producers, not mass producers"* says Subrahmanya, referring to the small

batch size. However, he is not averse to increasing the size of each batch to thirty if they get high quality faculty to teach in the programme. *"If we increase the batch size, I see no concern in terms of project and placement opportunities. The programme has good prospects",* he says.

In their first semester students study the fundamentals of management in courses like Finance & Accounting, Economics, Behavioural Science, Human Resource Management and Marketing. They then have to specialize in either **Technology Management** or **Business Analytics**.

The rapid expansion of the high technology sector with a significant focus on research and development requires personnel who understand and appreciate the technology landscape with a good training in management disciplines. The **Technology Management** specialization aims to provide graduates with such a background through courses like Technology Management, Management of Innovation and Intellectual Property, Management of Technology for Sustainability, Knowledge Management and Entrepreneurship. The Entrepreneurship course is of particular importance to those students who may want to initiate a start-up.

On the other hand, the **Business Analytics** stream seeks to give students the skill sets required to explore the available data to gain insights about the business environment. The goal is to help them take management decisions that are backed by empirical evidence and also to develop business plans for an organization based on the data. Courses in this specialization cover topics like Operations Research,

Time series analysis, Data Mining, and Decision models that are being offered to develop this expertise.

Manohar Nagula, a product of the first batch, is now working as an Engineering Officer at the Information and Publicity Division of the Central Power Research Institute (CPRI). Nagula elaborates on why this programme is special. *"A regular MBA does not understand technology. We integrate technology with management. Technology managers can help researchers in moulding their product and also in taking it to the market."*

The first batch of students from this programme graduated in the summer of 2013. This first batch received complete placement with reputed companies like Target, CPRI, Fidelity, Goldman Sachs, HP Global Analytics, ICICI Analytics, TCS and Wipro. In its short existence, the reputation of the programme has grown. *"This time the companies have come on their own",* says Subrahmanya.

Ekamdeep Singh will graduate from this programme in the next few days and take up a job with GenPact as an Assistant Operations Manager. In the long run, he would like to help his mother with her business back home in Punjab.

More details about admission into the programme and course structure can be found here: **http://mgmt.iisc.ernet.in/newwordpress/master-of-management**

-- Parthasarathy Ramachandran

CAMPUS CRITTERS

An ant tending a treehopper. In return for honeydew, ants protect treehoppers from predators
Photograph: Natasha Mhatre (Reprinted with permission from IIScPress)