CONNECT

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CRYSTALLOGRAPHY AT THE INSTITUTE: THE FIRST WAVE

Crystallography allows us to "see" the structure of a substance. Once we know its structure, we can do many remarkable things with it: understand its properties, make new materials, determine the purity of substances, and so on. In recognition of the importance of the subject, the United Nations has proclaimed 2014 as the International Year of Crystallography.

Crystallography is the science of investigating a crystal's chemical structure by studying how it scatters X-rays that fall on it. X-rays get scattered when they hit a molecule, just as light is reflected when it hits any object. If you repeat this from many different angles, you will get a series of scattered or diffracted rays, which can then be reassembled to predict the 3-dimensional structure of the object.

Beginning with Sir CV Raman's early studies on the optics of crystals, a number of researchers from India have contributed to the growth of crystallography; many of them have been, and continue to be, associated with the Indian Institute of Science (IISc).

The story of crystallography in India began in 1924 when 23-year old Kedareswar Banerjee joined CV Raman's research group at the Indian Association for the Cultivation of Science (IACS) in Calcutta, where Raman had been studying the physics of crystals. Banerjee, who came to be known as the first Indian crystallographer, proposed a new approach to solving structures of small molecules (those with less than 20 atoms) using X-ray scattering in place of the trial-and-error methods in use at the time.

After working at IACS, Banerjee moved to the Indian Meteorological Department and then to the Allahabad University. He eventually returned to IACS as its Director. Raman, on the other hand, became the Director of IISc. He also headed the Physics Department in 1933, which he founded.

Here, Raman continued working on crystal optics and X-ray scattering by crystals with his student GN Ramachandran. Ramachandran, who was studying Electrical Engineering at

Dorothy Hodgkin (third from left), Vijayan (fourth from left), Manohar (seventh from left, in jacket), Ramaseshan (eighth from left, partially hidden)

From the Editorial Team

Greetings! In this issue of CONNECT, Maneesh Kunte explores the history of crystallography at the Institute, S Vijaya tells us about the Centre for Infectious Disease Research (CIDR), K Suguna showcases the X-ray Diffraction Facility on campus, new faculty introduce themselves, Karthik Ramaswamy tells us about the early stages of planning and construction of the Main building and Manu Rajan profiles researchers who have recently won awards. We also feature an interview with the well-known astrophysicist T Padmanaban from the Inter-University Centre for Astronomy and Astrophysics (IUCAA) and much more.

In this issue

QUICK LINK apc.iisc.ernet.in/newsletter

Ramachandran (first from right), Vijayan (third from right), Venkatesan (fifth from right, in sweater) - ca.1974

the Institute, persuaded Raman to let him join the Physics Department and move back to the subject that he had studied as an undergraduate.

After obtaining a D.Sc. degree at IISc, Ramachandran went to Cambridge for a PhD. He returned to IISc in 1949 as an Assistant Professor in the Department of Physics. He, along with his student Gopinath Kartha, set up the first X-ray crystallography laboratory in the Institute.

The period following India's independence saw the expansion of many universities, including the University of Madras. The University of Madras invited Raman to head the newly-formed Department of Physics. Raman, who had just setup the Raman Research Institute, a stone's throw away from IISc, turned down the offer. He recommended Ramachandran's name instead. Ramachandran moved to the University of Madras along with Kartha. Here, they solved the structure of collagen — an important and abundant organic protein found in all animals.

Ramachandran's exit left IISc without a crystallographer. S Ramaseshan, another of Raman's students and coincidentally, his nephew, was already a faculty member at the Physics department. He was asked to take on the crystallographer's mantle by the then head of the Department and well-known physicist, RS Krishnan.

Ramaseshan's move into crystallography sowed the seeds for a robust and remarkable research lineage at IISc in this field, a lineage that still exists. Ramaseshan's students, over the years, went on to establish crystallography as a core discipline in other Departments in the Institute as well as in other Universities.

One of Ramaseshan's first students was K Venkatesan, who came to IISc from Annamalai University in 1953. After obtaining his PhD from IISc in 1959, Venkatesan moved to Zurich on a post-doctoral fellowship with Jack D Dunitz, a crystallographer of note. Dunitz had earlier worked with the famous Dorothy Hodgkin at Oxford University before settling into a faculty position at ETH, Zurich. Venkatesan, himself, then went to Oxford to continue his research with Hodgkin.

Central to any historical account of crystallography in India is the role of Hodgkin. Many of the early Indian crystallographers passed through her lab in Oxford. Hodgkin went on to win the Nobel prize for Chemistry in 1964 for the use of X-rays to detect biochemical structures. In her Nobel speech, she specifically mentioned Venkatesan's contribution to her research that led to the solving of the structure of Vitamin B_{12}.

Upon completing his post-doctoral stint with Hodgkin, Venkatesan eventually moved back to India to take up a position at the University of Madras in 1962.

In 1955, another physics postgraduate, MA Viswamitra, joined Ramaseshan's now growing group for his PhD. He graduated in 1960, and continued in the Physics Department as a lecturer.

Ramaseshan took over as Professor and Head of the Physics Department at the Indian Institute of Technology (IIT) Madras in 1962, leaving Viswamitra in charge of his research at IISc. A year later, Viswamitra, in collaboration with RS Krishnan, signed on M Vijayan, a new PhD student. In 1965, like Venkatesan before him, Viswamitra left for Oxford to work as a post-doctoral researcher with Dorothy Hodgkin. He returned to the Department of Physics in IISc in 1968.

Manohar (second from left) and colleagues at the Physics Department

Meanwhile, the Department had received a new researcher in Hattikudur Manohar, a graduate from Central College in Bangalore. He joined Ramaseshan's group in 1958. After completing his PhD in 1963, Manohar continued working as a Research Assistant in the Department of Physics until 1965.

Manohar recalls that there was already a demand for help with crystallography techniques from the Chemistry departments. Manohar distinctly remembers Vasudev Murthy, Professor at the

Viswamitra (third from left), Vijayan (second from right), Manohar (fourth from right), and colleagues at the Physics department

Department of Inorganic and Physical Chemistry (IPC), and others too, coming to the Department of Physics with samples for analysis. Given the growing realization of the importance of X-ray crystallography among chemists, IPC decided to create a faculty position in the field. Manohar was selected to take on this job and he joined IPC as a lecturer in 1965, thus kicking off crystallographic research in chemistry in the Institute.

This was followed by the Department of Organic Chemistry (OC) establishing a similar position. It was filled by Venkatesan who moved from University of Madras back to his alma mater. With this, the first wave of crystallography had formally spread to the Chemistry Departments.

After Vijayan had obtained his PhD in 1968, he too took the time-tested path of travelling to Oxford to work with Hodgkin, before returning to India in 1971. While at Oxford, Vijayan had helped to solve the structure of insulin, a problem which Hodgkin and others had been trying to crack for decades.

On his return, Vijayan first accepted a position at the Department of Physics in the Institute. He then moved to the Molecular Biophysics Unit (MBU) in 1974; MBU had been started by GN Ramachandran in 1971, after his return to IISc from University of Madras.

Vijayan (first from left), Ramachandran (third from left), Dorothy Hodgkin (far right) when Ramachandran was being made Fellow of the Royal Society

With his experience in studying the structure of insulin, a large protein molecule, Vijayan started macromolecular crystallography in India. The going was tough, with funding hard to come by. "You had to scrounge even for a few rupees," he says. However, in the eighties, the Department of Science and Technology (DST) stepped in and increased funding for research in crystallography significantly.

Ramachandran (fourth from left, first row), Dorothy Hodgkin (centre, seated in first row), Venkatesan (third from right, seated in first row), Vijayan (far right, seated in first row), Balaram (second row standing, second from right)

Inspite of the financial crunch in the early years, a rich legacy of crystallography had been created in the Institute, a legacy which began with Raman's experiments on crystal optics and diverged, first, into chemical and small-molecule crystallography and eventually, to macromolecular crystallography. With this legacy and increased funding, crystallography in the Institute now saw the birth of a new generation of promising researchers.

(This is the first in a two-part series about the history of crystallography at IISc. The author would like to thank Professors H Manohar (formerly with IPC), M Vijayan (MBU) and KV Abhinav (student, MBU))

Notes:

- Dorothy Crowfoot Hodgkin – Biographical: http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1964/hodgkin-bio.html
- The Nobel Prize in Chemistry 1964 : http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1964/
- Sivaraj Ramaseshan (1923-2003) : http://www.iucr.org/news/newsletter/volume-12/number-3/sivaraj-ramaseshan-1923-2003
- Sir Venkata Raman – Biographical: http://www.nobelprize.org/nobel_prizes/physics/laureates/1930/raman-bio.html
- Gopinath Kartha's obituary : http://journals.iucr.org/j/issues/1984/05/00/a24185/a24185.pdf
- Kedareswar Banerjee (India's first crystallographers) : http://www.iucr.org/news/newsletter/volume-8/number-4/kedareswar-banerjee
- Recent trends in Crystallography : http://www.iisc.ernet.in/currsci/feb102001/327.pdf
- Sir CV Raman and the story of the Nobel Prize : http://www.iisc.ernet.in/currsci/nov10/articles33.htm
- Memorial of Chandrashekhara Venkata Raman; American Mineralogist: http://www.minsocam.org/ammin/am57/am57_652.pdf : Vol. 57, pp. 652-656, 1972
- Prof. K Venkatesan (INSA profile) : http://insaindia.org/detail.php?id=N89-1041
- Prof. M. Vijayan (INSA profile) : http://insaindia.org/detail.php?id=N87-0982
- M A Viswamitra – Crystallographer and structural biologist by M Vijayan: http://www.iisc.ernet.in/currsci/may102001/1228.pdf
- An obituary for Dorothy Crowfoot Hodgkin by M Vijayan : http://ww1.iucr.org/cww-top/his.hodgkin.html
- Dorothy Hodgkin and the Indian connection by S. Ramaseshan : http://www.currentscience.ac.in/Downloads/article_id_072_07_0457_0463_0.pdf
- Gopalasamudram Narayana Ramachandran : Biographical Memoirs of Fellows of the Royal Society, Vijayan and Johnson – 51, 367–377 (2005)
- Review articles by Gautam Desiraju and M Vijayan, Journal of the Indian Institute of Science, Vol. 94, No. 1, Jan – Mar 2014

-- Maneesh Kunte

HELLO!

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

PURUSHARTH RAJYAGURU
(Department of Biochemistry)

I belong to Bhavnagar, a small city along the coast of Arabian Sea in Saurashtra (Kathiawar) in the state of Gujarat. Like many kids of my generation, I aspired to become a doctor, a medical doctor. The idea of doing my PhD was not on the cards until it became clear that I could not get into a medical school of my choice! So after doing my undergraduate and postgraduate degree, I got an opportunity to do my PhD at the Centre for Cellular and Molecular Biology (CCMB, Hyderabad). My time here changed my perspective about research. This was followed by six years of post-doctoral training and mentoring students in Roy Parker's lab at the University of Arizona. It was here that I finally realized that I wanted a career in research.

My scientific interests lie in understanding the process of gene expression at the post-transcriptional level, specifically during mRNA translation and decay. In our lab, we aim to understand the regulatory mechanisms that decide the 'fate' of mRNA in the cytoplasm. This is a fundamental biological problem with implications in variety of cellular processes and diseases. We use *Saccharomyces cerevisiae* (Baker's yeast), a simple eukaryote, to understand this biological problem.

When I am not doing research or teaching, I like to spend time with my family. I also love to play table tennis and watch Hindi cinema.

YOGESH SIMHAN
(Supercomputer Education and Research Centre)

I am thrilled to be here at IISc as an Assistant Professor at the Supercomputer Education and Research Centre (SERC). Prior to this transition last November. I was a Research Assistant Professor at the University of Southern California (USC), Los Angeles, and also served as Associate Director for its Center for Energy Informatics. I led several projects at USC on Cloud Computing, Big Data Systems and Smart Power Grids, supported by US National Science Foundation (NSF), Department of Energy (DoE), and DARPA. Previously, I was a post-doctoral researcher at Microsoft Research, San Francisco/Los Angeles in their eScience Group, and received my PhD from Indiana University, Bloomington.

My core area of research is on distributed data and computing systems. The Distributed Research on Emerging Applications and Machines Lab (DREAM:Lab) that I lead at IISc focuses on holistic distributed systems research that enables the effective and efficient use of emerging platforms such as Clouds, commodity hardware and even smart phones. To this end, we explore scalable software architectures, innovative programming and data abstractions, and algorithms to allow large-scale applications to leverage the underlying computing systems. Our lab currently focuses on software frameworks for stream and complex event processing, and graph analytics, which are of growing importance. But, as our name

suggests, we are always cognizant of, and DREAMing up, the next big thing in distributed systems research with a practitioner's perspective.

We focus on science that is inter-disciplinary and has social implications. And IISc, with its diverse departments and centres, offers a thriving environment for such collaboratory science.

I am an avid hiker and, when weekends allow for it, I enjoy a pleasant trek through the many hills and trails in Karnataka. I am also a strong proponent of social and environmental activism.

ABHISHEK BANERJEE
(Department of Mathematics)

I joined IISc as an Assistant Professor in the Department of Mathematics in December, 2013. I received my PhD in 2009 and continued my research for a few years before I finally came to the Institute.

My undergraduate major was in statistics, but after graduating I switched to mathematics. I do research in the field of Algebra. My interest in it was created early, through my excitement in Number Theory. Some day, I hope to go back and try to do something in Number Theory. I find it very hard to think about problems in geometric terms. I am more comfortable working with symbols. I really enjoy Math Olympiad problems, particularly those in Number Theory.

My hobbies are travelling, cooking, photography and painting. I also love watching cricket, facebooking and surfing the internet. I am fascinated by aeroplanes. I can watch planes landing and take off for hours. I love reading Chetan Bhagat's books and also watching movies based on his books. I am still discovering the lovely campus of IISc.

KUNAL CHAUDHURY
(Department of Electrical Engineering)

I vividly remember the chilly morning of 31 July 2003, when I turned up at the IISc Hostel Office to complete the formalities that were required for a naive ME aspirant. Little did I know how things would turn out in the next few years; I certainly did not know that I would be back in the same Institute as an Assistant Professor ten years later.

I joined the Department of Electrical Engineering in February 2014. Prior to that, I was a postdoctoral research associate at the Program in Applied and Computational Mathematics at Princeton University. I did my PhD from EPFL, Lausanne in Switzerland. Between my Masters and PhD, I spent a year at Siemens Corporate Technology as a Research Engineer.

I worked in the area of Image Processing for my PhD and this continues to be my main area of research. My particular focus is on developing fast and scalable algorithms for image acquisition and processing, and the analysis of these algorithms. During my post-doctoral research at Princeton, I developed a strong interest in convex optimization and its applications to imaging science. Since then, I have been working on algorithms for non-smooth convex optimization that frequently comes up in the area of robust convex optimization. In a related but different direction, I have also been working in the area of distributed convex optimization and semidefinite programming, and their application to NMR-based structure calculation and sensor network localization.

My hobbies include playing cricket and chess, and listening to music. I once used to play the violin but eventually lost touch. However, I do not miss the chance to watch a good movie.

CAMPUS VISITORS

THANU PADMANABHAN

The well-known theoretical physicist and cosmologist, Thanu Padmanabhan, visited the Indian Institute of Science (IISc) on 8 July, 2014 to give a talk titled 'Cosmic History and Mysteries". It was organized by the Infosys Science Foundation along with IISc.

Padmanabhan is a Distinguished Professor and the Dean of Core Academic Programmes at the Inter-University Centre for Astronomy and Astrophysics (IUCAA) in Pune. His research paradigm of studying gravity as an emergent phenomenon has implications for our understanding of quantum gravity and dark energy. He has won numerous awards, including the Infosys Science Foundation Prize, the Padma Shri, the Shanti Swarup Bhatnagar Award, the Third World Academy of Sciences Prize, and the Birla Science Prize among others. He is a Fellow of all the three National Science Academies in India. Besides his numerous research papers, he has written graduate-level textbooks and popular books on astrophysics and cosmology. Padmanabhan is also a passionate teacher and has a keen interest in pedagogy. He spoke to CONNECT *after his talk.*

Q Can you tell us about your research?

In recent years, I have been developing the idea that gravity is an emergent phenomenon like fluid mechanics, for example. Einstein's equations are like the Ideal Gas Law, PV= RT, which can be written down without knowing that the pressure is caused by the molecules knocking against the walls of the container. When Boltzmann came up with the idea that a gas is made of atoms, he had no idea what these were. But one could count them as PV/T, which is related to the Avagadro's number. Similarly, you can count how many `atoms of spacetime' exist per unit area, even though you do not know what they are! There are several features in Einstein's gravity which are mysterious if you think about them in the conventional manner, but makes sense if you think of gravity as an emergent thermodynamic phenomenon.

One recent result is what I talked about at IISc. Observations suggest that our universe is characterized by the values of three densities. Of these, two can possibly be determined by high energy physics and the third is related to the cosmological constant, which is driving the acceleration of the expansion of the universe. But nobody has a clue as to how to determine its value.

The emergent paradigm gives a new, unique relation between the three densities. When you put in the numbers, everything works out fine thereby solving the cosmological constant problem! I believe this is a breakthrough in the sense that it opens up new avenues of exploration.

"I have been developing the idea that gravity is an emergent phenomenon like fluid dynamics"

Q You have said somewhere that "progress has become difficult because the area has become very fashionable". Can you elaborate?

What happens is that everyone jumps onto the bandwagon, there are too many ideas milling around, mafias get formed; it is not possible for one to sit quietly and work. I prefer to work on things for a long period of time on my own. And that is difficult if you are in one of these hyperactive fashionable fields.

Q You like to popularize science through books and talks…

I believe that part of my salary is to popularize science. I feel strongly about that and I have even written about it. I think it is even more important in the Indian context, especially when one is doing pure science or mathematics. Our salaries are being paid by the tax payers. We have to tell the tax payer why what we are doing is important and exciting and why society should be supporting it. I feel that popularization of science is one way of paying a debt back to society.

"I believe that part of my salary is to popularize science"

Q What is the single biggest obstacle to science education and research in India? Is it the lack of money?

Money is not the issue. It is the channelization of money. There are two things that I would like to say here, both equally important. One is that we have no way of finding exceptionally talented students. We have no programme by which we can identify such students and tell them, "Look, you follow your dream. We will take care of the rest." I think in the future if we are going to have Nobel laureates, they are going to come from such a group. We do not have such a mentorship programme.

The second is that we are completely ignoring schools. School teachers and students are neglected. Without correcting this problem, we are never going to produce scientifically aware and scientifically well-equipped students. From the eighth to the twelfth standards, the kind of science education that is being given is poor. School teachers do not have a way where they can update their scientific knowledge. They cannot often provide feedback on the syllabus. People have not realized the importance of this huge problem. They used to think that you can train a student during his or her PhD. Then they said, "No, no, we need an MSc plus PhD integrated programme." Twenty years later, they said, "Oh, oh, we need good undergrad education." I have been saying that all this is futile unless you lay a good foundation. It might take another twenty years for people to realize that.

"We have no programme by which we can identify exceptionally talented students"

Q You won the Padma Shri in 2007 and the Infosys Science Foundation Prize in 2009. What did they mean to you?

Why did you pick these two among all my awards?

Q The Infosys award is the most glamorous science award in India and the Padma award is a prestigious award from the Government.

It is very perceptive of you. In another interview, I was asked which awards gave me the most satisfaction and I mentioned these two. The Padma Shri was a complete

surprise. One morning, when I was asleep, I was woken up by a call from a friend of mine who read about it in a Kerala newspaper. That was when I first heard about it. The official information came only a day later. In that sense, it was a very pleasant surprise. At the time I got it, not many scientists came under the radar of the Padma awards. It was usually awarded only to scientists involved in institution-building and heading scientific organizations and programmes, although that is changing now. So I felt very happy.

"The Padma Shri was a complete surprise"

The Infosys award, I felt happy for a different reason. There is a feeling in India that awards should be for recognition and fame and that there need not be any money. Infosys broke this tradition and brought in a new culture which I think is important. When I got it, the award was worth Rs. 50 lakhs, but now it is, I think, Rs. 55 lakhs (adjusted for inflation). I do not believe that just because you are a scientist, you have to live very frugally. And in that sense, I felt very happy that there is someone who believes that someone who is doing good work in academics should be rewarded handsomely. Also, the jury for the Infosys Prize, which is in the public domain, has many brilliant and accomplished people. So I was very pleased that it was an international jury choosing me for an award given in India.

"Infosys broke this tradition and brought in a new culture"

You will find more on Padmanabhan, his research, his teaching and his other interests here: http://www.iucaa.ernet.in/~paddy/

-- Karthik Ramaswamy

THE X-RAY DIFFRACTION FACILITY

The X-ray Diffraction Facility at the Indian Institute of Science (IISc), the first such national establishment, was set up at the Molecular Biophysics Unit (MBU) in 1983 to collect X-ray diffraction data from crystals of biological macromolecules. Its main objective is to carry out rigorous structural studies on a large number of proteins and other biological macromolecules. The Facility caters to the structural biology efforts of a number of researchers at the Institute with open access to investigators from other academic institutions in the country as well.

During its early years, the Facility played a major role in nucleating work in the area of macromolecular crystallography in the country. It has since become a catalyst in the growth of macromolecular crystallography, both in the Institute and in the rest of the country. The Facility has been financially supported by the Department of Science and Technology and the Department of Biotechnology, Government of India.

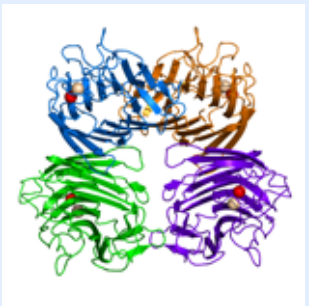
One of the X-ray generators

One of the central activities of structural biology is the elucidation of structures of biological macromolecules such as proteins with a view to relate the structures to their functions. X-ray crystallography has been the most powerful tool to determine the three-dimensional structures of proteins revealing the structural details at the atomic level. Proteins are key molecules in the regulation and catalysis of almost all functions of living cells. Protein function depends on the precise positioning of functional groups in its three-dimensional structure. Structural information is crucial for understanding cellular function. Much of the current understanding of the molecular basis

An X-ray generator with an imaging plate recording the intensity of diffracted rays

of cellular function has emerged from studies on protein structure and function. Many major areas of biochemistry and molecular biology have been influenced by structural information. The knowledge of many genomes including those of human and several pathogens at the sequence level has provided a new scientific challenge and opportunity to translate genome sequences to structures of proteins. Knowledge of structures is of strategic importance for public health in terms of reducing the cost of drug discovery as well as increasing the effectiveness of drug molecules. Detailed studies on the three-dimensional structure of key enzymes from pathogens are required in order to understand the life cycle of these organisms and for the design of pathogen-specific drugs. Towards this end, X-ray studies on a number of new proteins from mycobacteria, other pathogenic microbes and viruses are being carried out.

The state-of-the art Facility consists of several X-ray generators including a dual wavelength generator for *ab initio* phasing of new structures using anomalous dispersion, Imaging plates for diffraction data collection and measurement, computers for data processing and a crystallization robot to reduce (i) the time required to set up hundreds of crystallization screening conditions for each new protein and (ii) the amount of protein required

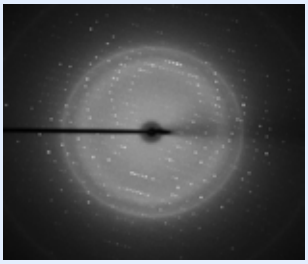


Crystal structure of peanut lectin- the first structure to be determined using X-ray diffraction data collected at the Facility

A crystallization plate under the microscope

for each experiment. Besides stereo microscopes to examine and manipulate crystals, the Facility also has a dynamic light scattering instrument to examine the homogeneity and crystallizability of the samples of molecules taken up for structural studies.

All the machines are available to users, both from within and outside the Institute. In addition, help is extended to the external users in all aspects of crystallography. The running of the Facility is overseen by four faculty members from the Institute: Professors M Vijayan, MRN Murthy, K Suguna and B Gopal. They are helped by three technicians as well as research students and post-doctoral associates. Diffraction data from hundreds of crystals that have been collected from the X-ray facility have resulted in more than 350 publications in reputed national and international journals.



X-ray diffraction pattern of a protein crystal

Many macromolecular crystallography centres in India have now acquired their own data collection and processing systems, but the Facility at MBU will continue to be used for macromolecular crystallography work in the major structural biology programmes. Some of these projects include: the structural biology of lectins; structure, assembly and stability of viruses; proteins from bacteria, viruses and parasites; drug or inhibitor design.

-- K Suguna

Campus Flora

A blooming magnolia next to the Tata Memorial. It flowers from July to September

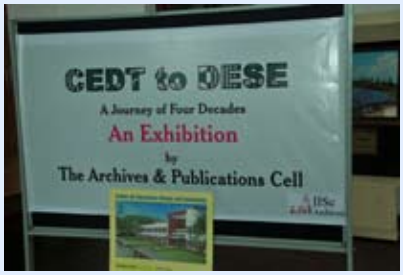
Photograph: K Sankara Rao *(Printed with permission from IIScPress)*

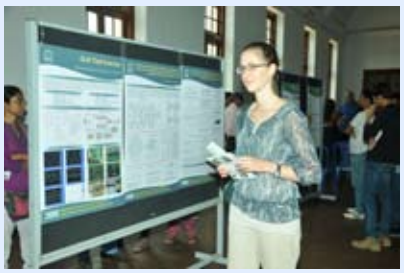
Events on Campus

An exhibition titled **'CEDT to DESE: A Journey of Four Decades'** was organized by the Archives and Publications Cell (APC) in association with the Centre for Electronics Design and Technology (CEDT), now called the Department of Electronics and Systems Engineering (DESE) at the Indian Institute of Science (IISc). It was inaugurated on 14 July, 2014 at the Reception Hall of the Main Building by Prof. BS Sonde, the former Chair of the Division of Electrical Sciences, and Prof. Anurag Kumar, the Director of IISc.

Prof. Sonde, who was instrumental in founding DESE, spoke about the history of the department, one that was born out of an agreement between the Governments of India and Switzerland in 1976. He shared the challenges the Institute faced in procuring equipment from Switzerland during its early years. He also commended the efforts made by APC to showcase the work of various Departments in the Institute as well as for its endeavor to preserve the history of IISc. Prof. Anurag Kumar, the Director of IISc, highlighted the dynamic role that DESE has played over the years in helping the electronics industry evolve. A short video on the growth of DESE, made by Sowmithri Ranganathan from APC, was screened during the inauguration. Ranganathan also curated the month-long exhibition.

The exhibition looked back at the eventful journey of DESE from when it was established. It showcased posters of prototypes of instruments developed by students of DESE, important visitors to the Department, the building that houses DESE, its past Chairpersons and related official documents. It also included actual prototypes of many instruments developed by the Department.




-- Megha Prakash

The 7th **ISSS International Conference on Smart Materials Structures and Systems** was held at the Indian Institute of Science (IISc) during July 08-11, 2014. The Conference was organized by the Institute of Smart Structures and Systems (ISSS), a professional society in IISc, MS Ramaiah Institute of Technology and Central Manufacturing Technology Institute (CMTI). It was inaugurated by Bharat Ratna Prof. CNR Rao who delivered the inaugural keynote address. The Conference included plenary sessions, invited talks, workshops and special sessions. An edited volume on Micro and Smart Devices and Systems published by Springer was released at a function during the conference. The Conference concluded with a plenary talk on Green Aviation by Prof. Roddam Narasimha.

-- Megha Prakash

The Infosys Foundation has endowed an **Infosys Chair Professorship** in the areas of Physics and Mathematics at the Indian Institute of Science (IISc), according to a press release. The Foundation has granted a corpus of Rs 20 crores towards this initiative. It has also provided an additional grant of Rs 1.20 crores to initiate the process of appointing Chair Professors immediately.

The press release added that the grant will enable IISc to appoint world-class physicists and mathematicians as Infosys Chair Professors. Speaking to CONNECT, Sudha Murthy, the Chairperson of Infosys Foundation, said, "If we want to enrich our students, we need to expose them to the best from around the world. We need to bring each of them for at least one year and that requires a huge amount of money."

On the choice of Physics and Mathematics Departments as recipients of the endowment, Murthy said, "Physics is one area where I felt we should do something. When I was a student at IISc, we used to hear a lot about physicists like CV Raman. And mathematics is the mother of all sciences and many mathematicians from ancient India, like Brahmagupta, made enormous contributions to the field. It is unfortunate that the country is not able to fund mathematics." She also added that IISc was an obvious place for this endowment because of its focus on pure sciences and its reputation.

"We are very excited about what this can do to the Department", said Gadadhar Misra, Professor and Chairperson, Department of Mathematics, one of the two Departments benefitting from this largesse. He was particularly excited for his younger colleagues, who, he said, would benefit greatly from this initiative. He added, "The terms are flexible and attractive. We have already set up a committee to work out the details and make recommendations." Misra hopes that, with efforts such as this one, the tradition of philanthropy will catch on in India.

Infosys Foundation

Sudha Murthy, Chairperson, Infosys Foundation

Established in 1996, the Infosys Foundation seeks to support the less privileged sections of society, create opportunities and strive towards a more equitable society. It selects its projects with infinite care and works in areas overlooked by the larger society. A dedicated team identifies programs in the areas of healthcare, education, culture, destitute care and rural development. More information about the Foundation can be found here: http://www.infosys.com/infosys-foundation/

-- Karthik Ramaswamy

Magical Mantids, a book written by Ananda Shikhara Bhat, was released by Raghavendra Gadagkar, Professor, Centre for Ecological Sciences (CES) and Chairperson, Center for Contemporary Studies (CCS) at the Indian Institute of Science (IISc) on 19 June 2014. It is published by Gubbi labs.

Bhat, a student of Class IX, is still thirteen. His fascination for these carnivorous insects began when he encountered a mantis in his garden and decided to keep it as his pet. Its behaviour fascinated him so much that he started studying them and now even has a book about these critters. Speaking to CONNECT about his book, Bhat says, "This book is meant for people who have absolutely no idea about praying mantises, and are interested in reading a beginner's guide."

Bhat is also interested in wildlife photography and sports. He plays football and badminton. Bhat aspires to become an entomologist specializing in mantids when he grows up.

-- Megha Prakash

The Centre for Infectious Disease Research

In a special function on 11 July, 2014, the Centre for Infectious Disease Research (CIDR) at the Indian Institute of Science (IISc) opened its doors to visitors to showcase its facilities and the progress it has made since it was established. Among those who attended the event was Prof. P Balaram, the then Director of the Institute. CIDR, besides providing intellectual and infrastructural support for infectious disease research, has a state-of-the-art biocontainment space — the Biosafety Level-3 (BSL-3) facility — to perform research with highly infectious pathogens. The running of the Centre is overseen by the CIDR committee. CONNECT *caught up with one of the members of the committee, S Vijaya (Professor, Department of Microbiology and Cell Biology). She told us about her involvement with CIDR as well as what makes this Centre unique.*

Prof. G Padmanaban and Prof. P Balaram, former Directors of IISc, visiting CIDR

Q What is your formal relationship with CIDR?

I am a member of the CIDR committee which has Dipankar Nandi (Professor, Department of Biochemistry) as the Convener. Other members include Sandhya Visweswariah (Professor, Department of Molecular Reproduction, Development and Genetics) and Saumitra Das (Professor, Department of Microbiology and Cell Biology). We facilitate the day-to-day running of the facility moving equipment, bringing in resources, trouble shooting, raising money, recruitment etc. I was responsible for setting up BSL-3.

Prof. S Vijaya, Department of Microbiology and Cell Biology and member of the CIDR committee

Q Why do we need a separate Centre to study infectious diseases?

We have many faculty members who work on infectious diseases, but that work is done in isolation in their labs. A Centre like this has a single large lab with people working on different infectious diseases together; it leads to cross-fertilization and a focused interest on infectious diseases like HIV and Tuberculosis (TB). Also, our Centre is not bound by rigid rules and can hire promising researchers who can focus on their research in an undiluted fashion. And for certain types of high-risk projects, you want someone who is already trained, knows the risks involved and the discipline required. This Centre allows us to recruit such people. CIDR is an experiment that we started out to do and so far, everybody is happy with the way things have gone. I hope it succeeds in a big way.

"A Centre like this has a single large lab with people working on different infectious diseases together; it leads to cross-fertilization"

Q Can you tell us more about BSL-3? Why is it called that and what makes it unique?

BSL stands for Biosafety Level, an internationally accepted terminology. We have BSL-1, BSL-2, BSL-3 and BSL-4 depending on the level of containment of pathogens. When we are working with bacteria like soil bacteria, which are not of too much danger to anybody, then it would come under the category BSL-1. But let us say that you have inserted a plasmid

into *E.coli* and made it recombinant. You may not know or be able to predict everything that it is potentially capable of causing. Then you will work in a BSL-2 facility with re-circulating air and follow certain rigid practices.

However, working with certain organisms like the aerosol transmitted *Mycobacterium tuberculosis* requires a BSL-3 lab, a facility with negative pressure to ensure that air does not seep out of the lab directly into the atmosphere.

There is also a BSL-4 lab to handle deadly viruses like the Ebola virus, or the virus which causes the Crimean-Congo hemorrhagic fever. The National Institute of Virology (NIV), Pune, has a vault in their BSL-4 facility where they store these viruses isolated from those patients who died. So it requires an even higher level of containment where one has to be in a special suit and the air you breathe comes from outside on an umbilical cord.

"Working with certain organisms like the aerosol transmitted *Mycobacterium tuberculosis* requires a BSL-3 lab"

Q How does this compare with other BSL-3 facilities in India?

We have about half a dozen or so BSL-3 facilities in India, but ours is the only one that has been subjected to third-party validation. We have taken pains to ensure that there are several design features that minimize the risk of inadvertent leaking out of pathogens being handled inside. So it is really well-planned with captive equipment in place for people to do the experiments with BSL-3 pathogens. For validation, we first took it to a Swiss company. They pointed out some defects and we fixed all of them; only then did we allow people to work with the pathogens inside it.

..."ours is the only one that has been subjected to third-party validation"

Q Can you tell us about the researchers at CIDR?

We have one regular faculty, Amit Singh, who has been hired through our Department (Microbiology and Cell Biology). He has students recruited through IISc and those that came with him from ICGEB (International Centre for Genetic Engineering and Biotechnology), Delhi. He works on *Mycobacterium tuberculosis* and does all of his work inside the BSL-3 facility. We have two Fellows, Arun Nagaraj, a Ramanujan Fellow, working on malaria and Annapurna Vyakarnam, a Ramalingaswami Fellow who has been seconded from King's College, London, studying HIV and TB co-infections.

The BSL-3 facility

Q How do you see this Centre grow?

Down the line, we would like to build on what we have and expand its activities and scope. We would like to bring in local hospitals as partners. We would also like to partner with industry. For instance, I am talking to *Beckman Coulter* which has bought a small start-up in Bangalore called *ReaMetrix*. Their flow cytometry technology would allow us to carry out clinical trials even in remote parts of India where we do not have good hospitals or cold chain facilities.

Many new pathogens, previously limited to certain latitudes, are spreading across the world due to climate change and globalization and discovering new hosts. Having a Centre like this will help foster research on such new and emerging diseases and in disseminating training to personnel dealing with outbreak investigations. So that is where I see it contributing.

"We would like to bring in local hospitals as partners. We would also like to partner with industry"

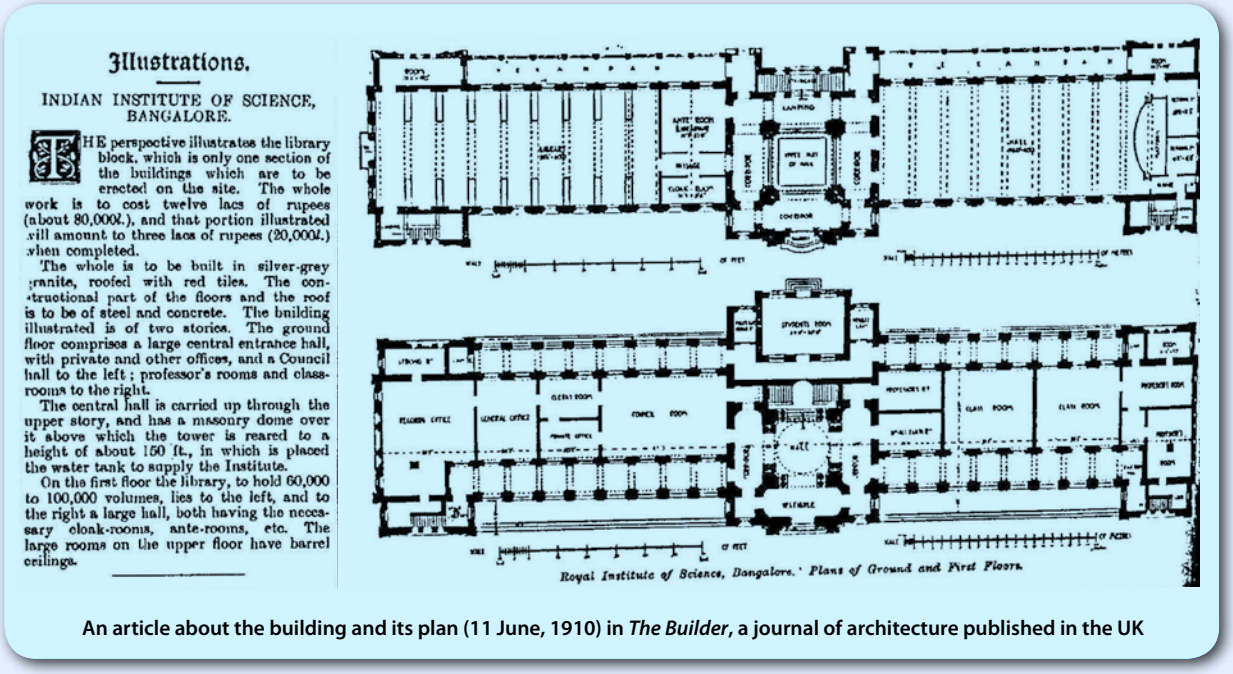
-- Karthik Ramaswamy

From the Archives: The Main Building – Part I

(This is the first in a multi-part series on the early history of the Main Building at the Indian Institute of Science)

The construction of the Main Building of the Indian Institute of Science (IISc) – also called the Library Building or the Central building – began in the summer of 1908 without an official ceremony. Its Foundation Stone was only laid on 1 February, 1910. The plan of the building was drawn up by the architects Messrs. Stevens and Co. and a tender for construction submitted by TCW Skipp was accepted. Its construction was initially estimated to cost between Rs. 12 to 13 lakhs.

Crowned by an imposing 150-foot tower, the Main Building was to be a silver-grey granite structure built in classical style using dressed stones (unlike cut stones, dressed stones are shaped and made to fit into the wall). The building was to house the library, secretarial offices and some departments. Most of the first floor was to be taken up by a library that could hold 60,000 or more books and journals. The chemistry labs were to be in the east wing and the electrical lab, along with the workshop, in the west.



Illustrations.

INDIAN INSTITUTE OF SCIENCE, BANGALORE.

THE perspective illustrates the library block, which is only one section of the buildings which are to be erected on the site. The whole work is to cost twelve lacs of rupees (about 80,000*l.*), and that portion illustrated will amount to three lacs of rupees (20,000*l.*) when completed.

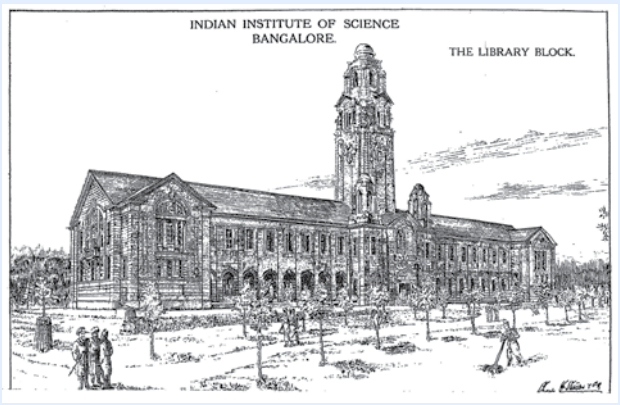
The whole is to be built in silver-grey granite, roofed with red tiles. The constructional part of the floors and the roof is to be of steel and concrete. The building illustrated is of two stories. The ground floor comprises a large central entrance hall, with private and other offices, and a Council hall to the left; professor's rooms and class-rooms to the right.

The central hall is carried up through the upper story, and has a masonry dome over it above which the tower is reared to a height of about 150 ft., in which is placed the water tank to supply the Institute.

On the first floor the library, to hold 60,000 to 100,000 volumes, lies to the left, and to the right a large hall, both having the necessary cloak-rooms, ante-rooms, etc. The large rooms on the upper floor have barrel ceilings.

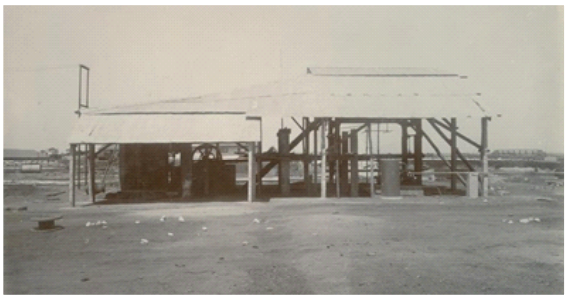
Royal Institute of Science, Bangalore.' Plans of Ground and First Floors.

An article about the building and its plan (11 June, 1910) in *The Builder*, a journal of architecture published in the UK



An artist's visualization of the building (1909)

The *maidan* in front of the building (1909)



The stone dressing plant (1909)

Construction of Main Building from the northwest corner (1909)

Construction of Chemistry lab from southwest corner (1909)

Pandal erected on building site for the Viceroy's visit (date unknown)

Construction of Electrical lab from northeast corner (1909)

Notes:

- 1st Annual Report of the Council of the Indian Institute of Science (1909)
- Subbarayappa, BV (1992) In Pursuit of Excellence: A History of the Indian Institute of Science. Tata McGraw-Hill Publishing Company.
- Harris, F (1958) Jamsetji Nusserwanji Tata: A Chronicle of His Life. Blackie and Son (India) Limited

-- Karthik Ramaswamy

AWARDS AND HONOURS

The following faculty from the Indian Institute of Science were recently honoured for their research contributions

DBT Innovative Young Biotechnologist Award

Sai Siva Gorthi *(Instrumentation and Applied Physics)* is involved in the development of novel instrumentation tools based on optics and microfluidics useful for carrying out basic and applied research in science and engineering. He has developed multiple imaging modalities for recording information of fast flowing biological cells in microfluidic devices. Two major application areas of his research are Non-destructive Testing and Evaluation (NDT&E) and Point-of-Care Diagnostics (POCD).

INSA Young Scientist Medal

Santanu Mukherjee *(Organic Chemistry)* works in the area of asymmetric synthesis, applying purely organic small molecules as catalysts (organocatalysts) for achieving enantioselective organic transformations. His research interests revolve around the creation and control of stereochemistry at quaternary stereogenic centres. He has developed a number of C–C bond forming transformations using (thio)urea-based bifunctional catalysts.

INSA Young Scientist Medal

Suryasarathi Bose *(Materials Engineering)* is interested in polymer blends, self-assembly of nano-materials, carbon nanotubes and graphene based polymer nanocomposites, phase separation in polymer blends, rheology and structure-property correlations in homopolymers and blends. His group has developed unique strategies like growing polymer brushs on the surface of nanoparticles to induce miscibility in polymer blends and manipulate the interactions between the constituent polymers. These contributions have considerable consequences in the areas of basic understanding of the miscibility gap in LCST (lower critical solution temperature) and UCST (upper critical solution temperature) polymeric blends.

Alexander von Humboldt Medal

PP Mujumdar *(Civil Engineering)* is currently serving as the KSIIDC Chair Professor in the Department of Civil Engineering. His recent research contributions include development of new methodologies for quantification and reduction of uncertainties in the assessment of climate change impact on regional precipitation, streamflow, urban and river floods, water demands and river water quality. He is a recipient of the Distinguished Visiting Fellowship of the Royal Academy of Engineering, UK and is a Fellow of the Indian Academy of Sciences.

DAE Young Scientist Research Award

Atanu Bhattacharya *(Inorganic and Physical Chemistry)* has been working towards building an ultrafast chemical dynamics laboratory. He studies photo-induced elementary chemical transformations and processes in the gas phase in pico-second, femto-second and atto-second time-scales. He is currently investigating the dynamics of photocatalysis and decomposition of energetic materials at the fundamental level. His team is involved in building tools and light sources that would be used to investigate interfacial charge transfer dynamics and electron dynamics in molecules.

Innovative Young Biotechologist Award

Ravi Sunderesan *(Microbiology and Cell Biology)* and his lab focus on aging-related diseases such as heart failure, diabetes, and muscle degeneration. Currently, they are trying to understand the mechanisms involved in the development of insulin resistance, cardiac fibrosis and muscle degeneration during diabetes. They are interested in Sirtuins, a family of histone deacetylases, involved in longevity and health span. Their goal is to disclose novel biological functions of Sirtuins that can be therapeutically targeted for promoting health-span of humans.

-- Manu Rajan

CAMPUS CRITTERS

The nocturnal jungle nightjar is well camouflaged on a rock during the day

Photograph: Natasha Mhatre *(Printed with permission from IIScPress)*

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