Connect

WITH THE INDIAN INSTITUTE OF SCIENCE

Volume 13 Issue 3 Sep 2025

AI and Art
Coding creativity

Urban Diseases
Persisting problems

Science of Coffee
From soil to cup

ISSN 2454-6232

IN THIS ISSUE

EDITORIAL

Dear readers,

The monsoon has arrived cold and early, bringing with it a rise in dengue cases. At the same time, public debate is swirling around the Supreme Court's recent order to capture and shelter all stray dogs, aimed at curbing rabies. Why is it still a struggle to control these age-old diseases? In our cover story, we delve into the viruses, the vectors, and the wily ways in which these diseases persist in our cities.

We also explore other lines of enquiry in this issue. Why do some animals cross species boundaries to form unlikely friendships? How can science help us make a better cup of coffee? Why do some of us feel averse to AI-generated art, even as it becomes mainstream? These led us to some intriguing insights we think you'd love to read.

In other stories, we chronicle the amusing history of campus hostels, investigate the business of academic publishing, and profile Amulya KN Reddy, whose work championed science for social good. We also hear from faculty members on what drew them into academia. This issue features two in-depth conversations: one with former Associate Director N Balakrishnan on his life and contributions to national projects, and another with former staff member MA Decroos, who worked with five IISc directors over four decades.

And finally, head to our fun page for a student's humorous take on the trials of PhD life and a crossword to solve on your break.

Team Connect

Abinaya Kalyanasundaram (Coordinator), Ashmita Gupta, Bitasta Das, Kavi Bharathi, Ranjini Raghunath, Rohini Subrahmanyam, Sandeep Menon

Contributing Writers

Aarav Ghate, Kavitha Harish, Mohit Nikalje, Sheetal Potdar, Shrivallabh Deshpande

Contact

Email: connect.ooc@iisc.ac.in
Phone: 91-80-2293 2066
Address: Office of Communications,
Indian Institute of Science,
Bangalore 560 012
Website: http://connect.iisc.ac.in

Design: Magnetyz
Cover illustration: Sumana Sainath
Printer: Sri Sudhindra Offset Process

Doors wide open

A brief history of IISc hostels

- Aarav Ghate

Photo: Aarav Ghate

The entrance to E-Block hostel

To the south-west of the IISc Main Building, a stone's throw away stands a rather squat piece of architecture. The ground floor construction is of grey-brown rock, cut and piled in rectangles of various sizes. The first floor is painted with what must have been a shade of cream, but is now lined with grey streaks of dust.

The building is fortified by an armada of bicycles. Whether they are new and shiny or old and battered (and likely punctured) depends on how much time has passed since a new batch of students came in. To the left of the entrance door – so creaky that it can awaken most of the 200-odd occupants if opened at night – is a white and red sign prohibiting smoking.

To the right, block letters scratched out with white chalk pop out against the background of dark stone. They spell out "E. Block".

Students who reside within a hostel's walls build friendships that last a lifetime and rivalries that last a bit longer

Housing students for three quarters of a century, E-Block has a hundred rooms and is the oldest hostel still standing. While the main entrance is duly closed at 11 pm every night, there is a back entrance which, as a consequence of recent developments (explained later), is kept open for 24 hours.

The two entrances stand as an allegory to the hostel's dual nature. The students who reside within a hostel's walls build friendships that last a lifetime and rivalries that last a bit longer. Some experiences leave imprints so deep that they evoke nostalgia even when too little time has passed to warrant such indulgence.

Meanwhile, the hostel building itself has stories to tell. Rebellious graffiti that now hides under many layers of paint, or a window with gratings which were never installed – a secret entrance for generations of students evading early curfews. Or the tale of how an extra floor was built in haste to accommodate an intake of students that provided much-needed breathing room – today, it leaks tendrils of water with every one of Bangalore's erratic showers.

* * * *

The story of IISc's hostels begins with two quarters, built approximately where the New Girls Hostel (NGH) and New Boys Hostel (NBH) stand today. Each quarter contained 36 rooms arranged in two rows, with mess rooms at the ends of each row. These rows were built parallel to each other, with latrines and baths located in the space between. Two sets of rooms in each row would be connected to function as a seating room and a bedroom, reserved for four "demonstrators (instructors)" to reside. A total of 64 students and eight demonstrators could stay here. In 1911, the first batch of 21 students began their scientific endeavours at IISc, and the student quarters were occupied for the first time.

As time passed, the student body grew exponentially, but there was a gender disparity in the available facilities. Although male hostels kept expanding, it was only in 1942 that the first permanent women's hostel was constructed. Before this, only temporary accommodation was provided to female students and the resulting issues, such as the arduous task of constantly changing rooms, were highlighted in a 1936 letter from three women students. It was addressed to the then director, CV Raman, and delivered to him through his wife, Lokasundari Ammal, who was the Warden of the Women's Hostel. In the same letter, the students also suggested that the Institute make the availability of accommodation for lady students known to the public. This would encourage and attract parents who were looking to send their daughters to IISc to pursue research.

Around the time of India's independence, the need arose for another men's hostel. And so, a building with 46 rooms on the ground floor was constructed in 1947-48. While students occupied these rooms, the construction of a first floor was said to have been "progressing rapidly," according to the 1947-48 Annual Report. This was none other than E-Block, now a two-storied building with a long corridor, and rooms on either side. "It looks like a ruler on a map" is a common description that its occupants use.

By the time the Institute completed its Golden Jubilee in 1959, it could house 368 male students in seven hostel blocks – named A through G – along with nine women students in a separate block. This expansion in housing capacity was funded by an interest-free government loan that the Institute received at the time. The numbers grew, and by 1981, the hostels could accommodate over 1,000 male students and 100 female students. In later years, special accommodation facilities for married scientists, postdocs, and visitors also came up.

The increasing influx of students over the years has brought in some rather unusual problems – an outflux of showerheads, for instance. In 2005, a letter from the Deputy Registrar to the Security Office lays out the tale of chromium-plated showerheads being mysteriously stolen from the Rohini hostel bathrooms, and brass float-valves from overhead tanks in the F, G, and H hostels. While the staff and workers were suspected in this particular case, as noted in the letter, students have also been known to partake in mischievous theft in recent years. An anonymous student source

Photo courtesy: IISc Archives

One of the two students' hostel blocks west of the Main Building (c. 1912), built to accommodate 72 students

claimed that locks belonging to the Hostel Office were stolen from a hostel during the summer break in 2025, collected in a bag and placed, surreptitiously, on the roof of the Hostel Office (whose staff, apparently, are still unaware that the hiding place is right above their noses).

* * * *

S-Block overlooks the slope of the bank road and is located opposite the Faculty Club. With a spread out, almost circular layout, it is nestled in a corner and practically hidden by a compound wall, which is not much shorter than the building itself.

The construction of S-Block began around 1995-96, and part of the funds – Rs 20 lakh – was provided by ISRO, mainly to support 15-20 ISRO-sponsored students. In response to the kind gesture, faculty member KP Rao, Convener of the ISRO-IISc Space Technology Cell, made a request to the then Director, G Padmanaban, that accommodation be provided to sponsored students prematurely, starting August 1995, even though the actual hostel wouldn't be ready until 1998-99.

"Nowadays, UG students are provided hostels like NBH and A-Block in their third year, but we were not so lucky," says Pabitra Sharma, a former undergraduate student at IISc, who lived in S-Block for over a year, starting March 2021.

The increasing influx of students over the years has brought in unusual problems, like the outflux of showerheads

Since he also stayed on campus for a part of the lockdown, Pabitra feels that it influenced his outlook on hostel life. A major part of his first two years overlapped with the pandemic, and his batch had a rather atypical experience of hostel life. As they were entering the third year, the restrictions began to fall away, and new hostel room allotments were on the horizon. Of course, there were strong opinions on the kind of rooms that they would prefer.

"We were looking forward to a housing facility where we could get some sunlight," says Pabitra. "More than anything else, we wanted to see other people's faces. Another thing was the desire for balconies, so we requested A, B Block or NBH."

Those specific hostels boast a large number of students, comfortably sized rooms with a balcony, and more than anything else, a sense of community – something these students were pining for after being cooped up for so long. Their earnest requests, however, were denied, and Pabitra and his batchmates were relegated to S-Block, which had only two floors. Current students, on the other hand, are allotted those airy hostels by default, and are sometimes even allowed to decide which rooms they want. "I think it's unfair!" laments Pabitra.

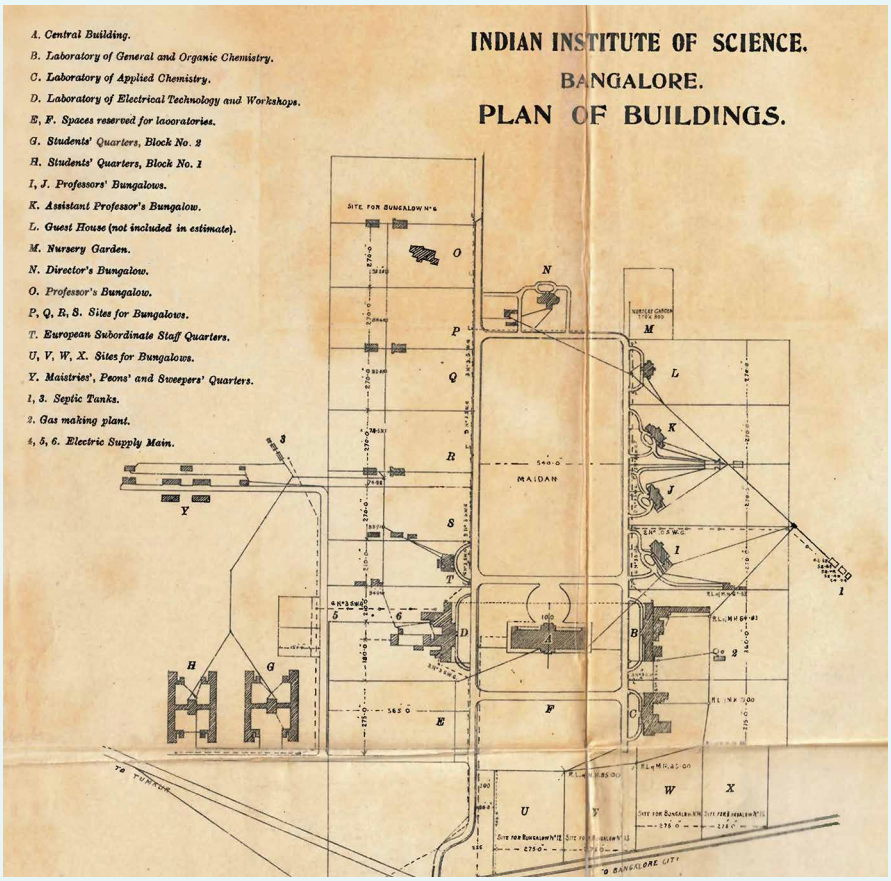
* * * *

Over the years, the Hostel Office also had to adapt to the growing number of students. "I remember the old days when everything was manual. We had around 14 people working in the Hostel Office," says BS Sheshachala, former superintendent of the hostels. "Today everything is computerised, so only 6-8 people are needed."

Sheshachala worked at the Hostel Office for 40 years from 1979 to 2019. He has overseen many changes and transitions in hostel allocation and management. He feels that the older system of handling hostel bills and documents manually was better, because it encouraged camaraderie between students and the administration. Since everything was in writing, students had to visit the Hostel Office every month to pay their mess bills, and got to interact with the staff more frequently. Sheshachala recollects knowing most of the students on a first-name basis.

"Whenever I see an old student, they always ask me: 'Where are you these days, sir? Still in the Hostel Office?'" says Sheshachala. "Once, I met an old student. I went over and asked him whether he was from the Physics department. He was confused and asked me how I knew. I then recounted his guitar-playing skills and the hostel he lived in, and he was totally shocked! He was very happy to speak to me."

Photo courtesy: IISc Archives



Early plan drawing of the IISc campus, showing the students' quarters on the left (marked G, H)

According to Sheshachala, another benefit was the possibility of ensuring compatibility between roommates. Students from the same place were often given accommodation together in case of shared rooms. This offered solace and familiarity in a new city surrounded by so many new faces. However, such considerations drastically reduced after 1995, when a lottery system was introduced to allocate rooms. New students picked out chits, and rooms and roommates were allotted randomly. Single rooms were always sought after, and seniority was the deciding factor to get them when they became available.

Agrim Arsh, a second-year BSc (Research) student, says that he was incredibly frustrated with the lot system and struggled for two days to get a room allocated. On the first day, he was allotted room E28, but it was a storage room and was full of luggage. He was told to come the next day at 11 am. "When I arrived, the luggage had been cleared out. However, E28 had now been declared a 'Medical Room' and couldn't be allotted. I went back to the box of chits and picked out E5. On going there, I saw that the room was locked. I called my assigned roommate, his mother, and then his father. None of them picked up."

Students from the same place were often given accommodation together … offering solace and familiarity in a new city

This is when Agrim took matters into his own hands. After roaming around for a while, he came across E100. "This is the most spacious room in the hostel, and can comfortably fit three people, even though only two actually live there. A senior was living there at the time, all alone. I basically demanded that I be allotted the room, after all the running around I had done. It worked, and that's how I landed the biggest room in the hostel!"

* * * *

"All the students who have moved to the New Hostel Complex are hereby requested to hand over the keys of their old rooms to the Hostel Office immediately."

Photo: Aarav Ghate

Students in the common room of E-block hostel

This notice from 2004 signalled the opening of the New Hostel Complex – including the new A and B Blocks with 900 new rooms, along with attached messes having the same names – as the new home for a majority of the student population. This was followed by the decommissioning of the A-H hostels, excluding E-Block. All of these had been constructed in the 1950s and had seen multiple generations of students pass through their halls.

While F and G Blocks were recommissioned in January 2005 due to a housing crisis, almost all the old buildings were eventually demolished and gave way to the New Boys Hostel (NBH) and the New Girls Hostel (NGH). E-Block, however, was refurbished for the use of UG students, the last remnant of the older generation of hostels.

"E-Block was special because I lived there during the lockdown. We were working on a project and had permission to stay on campus while following social distancing protocols," says a former BSc (Research) student, who preferred to stay anonymous. "We were severely undersupervised and got into a lot of mischief during those days. E-Block, having two doors, is great for accessibility, but causes security issues. When we were living there, the back gate was locked. So, we broke the lock. In response, a bigger lock was installed by the authorities. This time, we unscrewed the hinge and managed to remove the lock. Our next challenge was the door being locked from the outside, so we removed the entire door! After that, a security guard was placed at the back gate, but no more locks were installed."

Until a few weeks ago, the back door of the E-block building was still closed with loops of jute rope, and all traffic came through the front entrance. Late one night in July 2025, the rope was cut, and the back door was open once again, making it much easier to get to the messes and the Sarvam Complex.

But that wasn't the end of it. A few days later, a rather sturdy lock showed up in place of the rope. While no one had the stroke of inspiration to remove the entire door, a neater solution was devised by an unknown group of E-Block residents. The very handles to which the lock was attached were removed, leaving the back entrance open for use.

Since then, the entry arrangements have seen a radical shift. E-Block now has its front door duly locked at 11 pm. The back door remains unlocked for 24 hours, albeit with a security guard present. Only we residents know that the reason is not because of a policy decision, but because its handles have been surgically extracted making it impossible to lock. Until the next time someone tries a different tactic to make our hostel life more interesting.

Aarav Ghate is a second year BSc (Research) student at IISc, and a science writing intern at the Office of Communications

(Edited by Ranjini Raghunath)

City Slickers

- Ranjini Raghunath

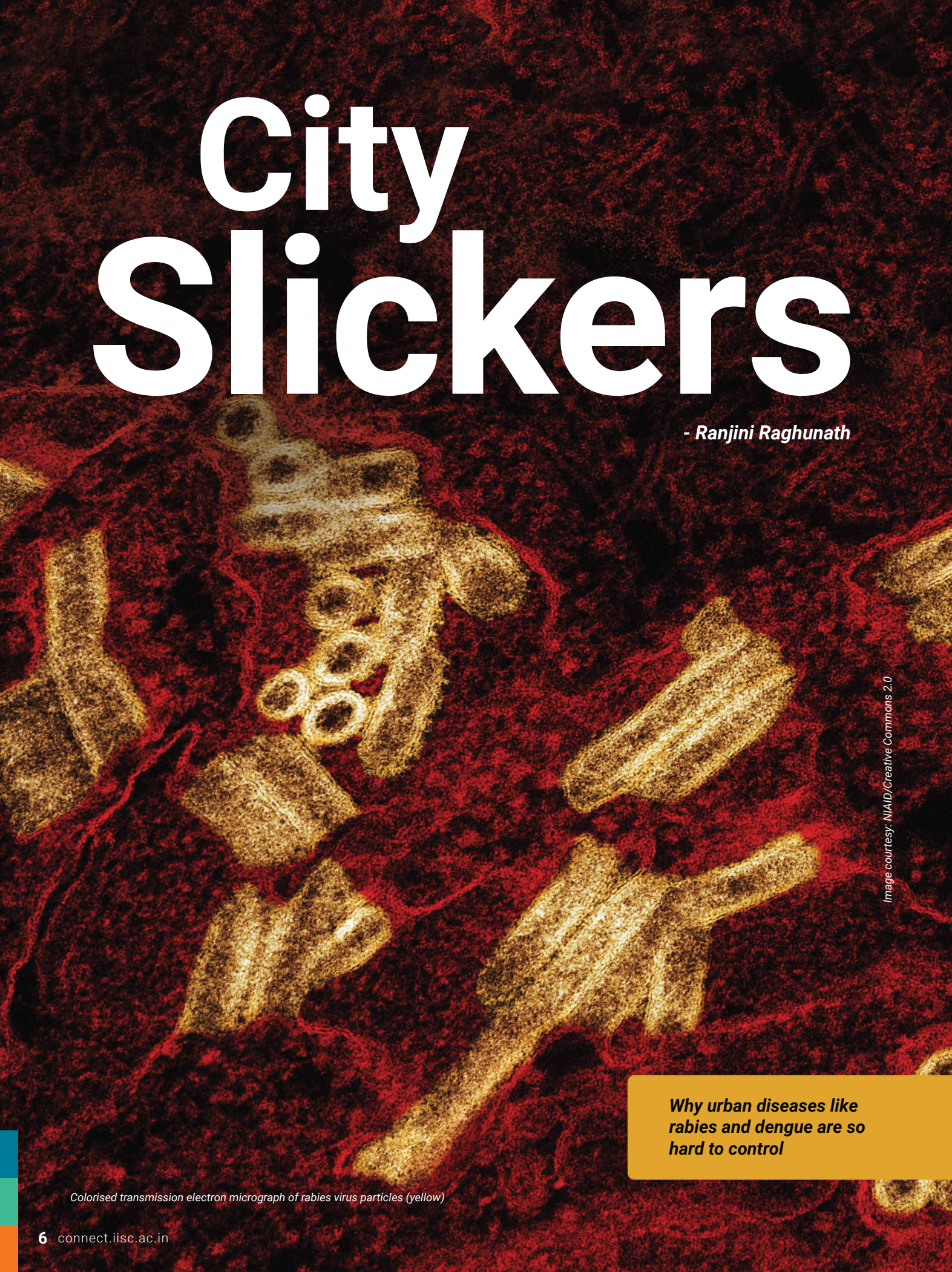


Image courtesy: NIAID/Creative Commons 2.0

Why urban diseases like rabies and dengue are so hard to control

Colorised transmission electron micrograph of rabies virus particles (yellow)

Less than a kilometre from Bengaluru's Lalbagh botanical garden lies the Bisilu Maramma Devi temple. The goddess also has another name: Plague Maramma. Devotees believe that the deity harnesses the sun's power to kill bacteria and viruses and ward off illnesses.

The temple is one of several that people flocked to when a devastating plague struck the city in 1898. Driven by congestion and poor sanitation, the disease went on a rampage, killing hundreds and prompting a mass exodus. Riots broke out over the stringent measures that the ruling British government took to screen and isolate patients. Distrust of "foreign" medicine prevented many Indians from taking life-saving plague inoculations.

The outbreak also led to a revamp of Bengaluru's civic infrastructure. A citywide telephone network was set up to coordinate plague control measures. New healthcare centres, including the Victoria Hospital, were built. Old buildings were demolished en masse in congested areas, and better-lit and ventilated houses were constructed. Citizens were encouraged to move to newer layouts like Malleswaram and Basavanagudi, which had wide roads, modern drainage networks, and plenty of greenery.

Today, however, that modernised city is reeling from repeated outbreaks of vector-borne and zoonotic diseases. It is a major hotspot for dengue fever in Karnataka, accounting for nearly half of the state's reported cases. Rabies deaths in cities like Bengaluru and Delhi have ratcheted up each year – India alone accounts for 36% of the world's total rabies deaths, according to the WHO.

"Cities are a more saturated interface between animals and people," says Abi Vanak, Senior Fellow and Director, Centre for Policy Design, Ashoka Trust for Research in Ecology and the Environment (ATREE). This proximity to potential disease vectors, in addition to rapid urbanisation, overcrowding, and improper waste management, has made city dwellers more vulnerable to infectious diseases.

Disease spread in urban areas depends on several ecological, environmental, and socio-economic factors. Viruses that cause diseases like dengue and rabies constantly evolve to evade human interventions. Vaccine development and distribution are stymied by scientific and logistical challenges. Vector surveillance and control measures are generally ill-planned and post-hoc. All of these have created a complex cocktail of conditions that allow largely preventable diseases to not just persist but also thrive in urban areas.

"Many of these diseases are not just healthcare problems but also socio-economic problems," says Utpal Tatu, Professor in the Department of Biochemistry, IISc. "They most commonly affect people from lower economic strata."

"The way people live, the way we are reshaping the environment around us so fast … does have an effect on diseases and their vectors," says Farah Ishtiaq, Principal Scientist at the Tata Institute for Genetics and Society (TIGS). Dengue fever, for example, was once a forest disease that spilled over to humans due to increased deforestation. "The mosquito and virus have become so acclimated to the urban environment that we think that they have always been around us," she adds.

The origins of the dengue virus are murky. Scientists think that it was circulating in primates in the jungles of either Africa or Southeast Asia about 1,000 years ago, and jumped to humans a few hundred years ago. Hitching a ride on *Aedes aegypti* – a tiny black-and-white striped mosquito – the virus zoomed across the globe, before making inroads into Asia after World War II.

The lifecycle of the dengue virus alternates between the mosquito and the human. When a female mosquito bites a human already carrying the dengue virus, the latter enters and multiplies inside the mosquito's salivary glands. The next person that this virus-laden mosquito bites then gets injected with the virus, continuing the chain of transmission.

Once the virus enters our bloodstream, it hijacks our cells and multiplies, setting off alarms in our immune system. Our body responds by attacking the virus and turning up the heat ("dengue fever"). Sometimes the immune system may overreact, unleashing a storm of inflammatory signals leading to plasma leakage from blood vessels, organ failure, and even death.

"The problem with dengue is that the causative agent is not just one virus," says Rahul Roy, Associate Professor in the Department of Chemical Engineering, IISc. "It's a large group of related viruses that infect in roughly the same way."

'The problem with dengue is that the causative agent is not just one virus, but a large group of related viruses that infect in roughly the same way'

There are currently four serotypes (variants) of dengue circulating in India. Based on genomic analysis, Rahul's team has shown that Dengue 1 and 3 serotypes were dominant until 2012, but Dengue 2 is currently the most common serotype across the country. Dengue 4, once thought of as the least infectious, has become the predominant south Indian strain.

The virus also mutates remarkably fast. "It can mutate even within an individual host. Sometimes, the virus that infects you is not the same virus that later grows in your body. It is even capable of adapting to different tissues in our body," Rahul says.

Rahul points out how the same virus that thrives inside a mosquito is able to survive inside a human with such vastly different physiology. "You have such a pliable organism, a chimera that can change itself so quickly," he explains. "It is challenging to develop a drug or vaccine because the pathogen does not remain the same. A new variant of the pathogen will come – maybe even out of the intervention that you did."

When did zoonotic diseases first emerge?

Analysis of ancient human DNA suggests that they started hopping from animals to humans at least 6,500 years ago, and that farming and livestock domestication sped up their spread. The plague caused by *Yersinia pestis*, for instance, seems to have emerged about 5,000 years ago when farming communities in the Eurasian Steppe started domesticating livestock. When these pastoralists later migrated rapidly across Europe and Asia, along with their languages and genes, they may have also unleashed the plague among local populations, much like how colonial diseases wreaked havoc on Native American populations in North America.

The rabies virus has an unusual modus operandi. When it enters the human body – usually through a bite from an infected animal – it attacks muscle cells, sneaks into neurons via neuromuscular junctions, and then travels along the nerves up to the brain. One of its key targets is the limbic system – a part of the brain that regulates emotions and behaviour.

The stealth invasion of the central nervous system is one of several tricks that the virus uses to evade elimination. In the initial stages, it multiplies slowly while silently suppressing chemical signals that could alert immune cells. Once it reaches the brain, it gets shielded from circulating immune cells by the blood-brain barrier.

The stealth invasion of the central nervous system is one of several tricks that the rabies virus uses to evade elimination

Infected victims first experience mild flu-like symptoms – fever, discomfort, headaches. As the disease progresses, they start to feel intense pain, excess salivation, anxiety, aggression, and a fear of water. In the final stages, their neurological functions rapidly deteriorate, leading almost certainly to death. By the time it reaches the brain, it is "100%" fatal, says Utpal.

"Rabies is a very complex disease," he adds. For several years, Utpal's team has been working on understanding the different clades (lineages) of the rabies virus. They have been able to identify at least four different clades and pinpoint specific mutations present in each. This can help track or develop interventions against each clade independently. His team has also developed a PCR-based assay to identify the presence of two of the main clades.

"It is one of the oldest known diseases," Utpal adds. "But there is a lack of information on the different variants, their pathogenesis, and outcomes."

Scientists believe that the rabies virus first spread in bats thousands of years ago, and later evolved to infect larger mammals like dogs. Its ability to inhabit a wide variety of mammalian hosts has allowed it to persist for centuries. As dogs' proximity to humans – either as pets or strays – grew, so did opportunities for the virus to spread in urban areas.

One of the quirks about rabies, says Abi, is its unpredictability. The incubation period – the time between infection and appearance of symptoms – can vary widely, from a week to a year. "A dog that's infected today may not show symptoms for months," he says. Some animals, like the African yellow mongoose, have been known to survive with rabies, without visible symptoms, for years.

Symptoms may also vary from animal to animal, and may be mistaken for other diseases. "Most people only recognise the classic 'furious' form of rabies – dogs attacking and biting people," Abi adds. "But there are lots of rabies cases in which the dog doesn't do anything. It might look like it has a distemper virus or a head injury, or it might just appear lethargic. That is equally dangerous."

In 2016, the Philippines launched a large vaccination campaign to give Dengvaxia, a dengue vaccine developed by the pharma company Sanofi Pasteur, to 1 million schoolchildren. It was a disaster. Children without a prior dengue infection faced an increased risk of hospitalisation or severe symptoms if they caught dengue after vaccination. After 19 children died, the campaign was suspended.

Dengue poses an unusual problem. When a person gets infected by a specific dengue serotype, our immune system creates antibodies that latch onto the virus and neutralise it. These antibodies offer protection for a few years. But if the same person catches a new infection from a different serotype later, the older antibodies are unable to fully eliminate the newcomer, but they can still bind to the virus and inadvertently smuggle it into our immune cells. Inside the immune cells, the new serotype goes on a rampage, multiplying rapidly, resulting in a more severe infection.

In the Dengvaxia case, the jab acted like the first infection, triggering a more severe second infection. Following the fallout, the WHO recommended that the vaccine should only be given to people who either live in places with an extremely high number of dengue cases – where benefits outweigh risks – or to those who already have a diagnosed past infection.

But it's hard to screen for past infections because most people don't show symptoms. Some estimates put the level of dengue antibodies in urban populations at 70-80%, according to Rahul, meaning that most people have already had a dengue infection at least once in their lifetime.

The fact that all four serotypes circulate contemporaneously in India also boosts the chance that one can get infected by any one of them at any time.

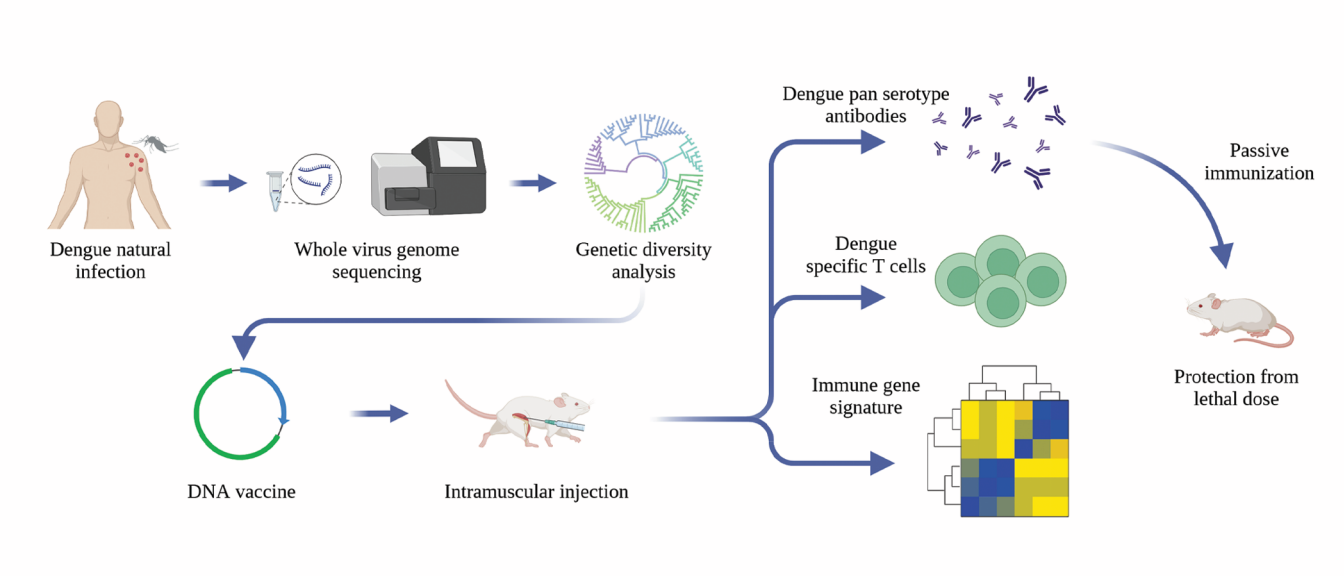


Image: Suraj Jagtap

Schematic depicting a study that helped identify Indian dengue virus strains and how this has aided in developing and testing a new DNA vaccine against the dengue virus

"You might see a spike in dengue one year and then the next two years you might not see dengue cases as much in your locality," says Rahul. After a few years, when antibody levels against the first infection start dropping, a new serotype moves in, changing itself to mimic the older virus just enough to evade immune detection, and slowly establishing itself as the new dominant strain.

"This complicates the development of a vaccine, because you need one that generates antibodies against all dengue serotypes and possibly other new variants that might arise," says Rahul. "People have been working on such dengue vaccines for 20-30 years now." So far, most dengue vaccines have only helped stave off serious symptoms, not prevent infection entirely. Rahul speculates that vaccines currently approved for use abroad also might not work well in India because the local serotypes are different from the strains used to develop those vaccines.

It's hard to screen for past dengue infections because most people don't show symptoms

Rahul is currently part of a multi-institutional effort to develop a DNA-based vaccine for dengue that can protect against all four serotypes. "Studies in mice are promising," he says. "Human trials have to be carried out."

What makes bats the most efficient viral vectors?

During the COVID-19 pandemic, conspiracy theorists falsely blamed its emergence on people eating bat soup. Bats have also been painted as villains because of their link to frequent Nipah virus outbreaks. But bats are indeed pretty good at hosting some of the deadliest viruses without dying or showing symptoms. One theory is that as they evolved to fly, their metabolic rates and body temperatures shot up, which can damage DNA, forcing the animals to develop robust DNA repair mechanisms that also help them fight off viral infections. The fact that they roost together in close-knit communities also encourages viral exchange and adaptation. But most viruses remain within these bat communities and only spill over to humans when there is habitat destruction or rare instances of close contact.

On 6 July 1885, a nine-year-old boy who had been bitten by a rabid dog 14 times was rushed to the lab of French scientist Louis Pasteur. Pasteur had been experimenting with a crude vaccine that he had developed from sun-dried spinal cord sections of rabbits killed by rabies. He administered the vaccine continuously for 13 days and the boy survived. Pasteur's vaccine formulation continued to be used, with some modifications, until the early 20th century.

Modern rabies vaccines for humans contain the inactivated virus grown in animal cell lines, and can help prevent as well as treat the disease. Post-exposure doses need to be given immediately after an animal bite, along with a shot of rabies immunoglobulin – a medication containing anti-rabies antibodies. "The extent of disease depends on how much the virus has multiplied in the dog, the degree of bite, the depth of the wound, and the bite location – close to the hand or neck or elsewhere," explains PN Rangarajan, Professor in the Department of Biochemistry, IISc. "As soon as a dog bites, if you immediately wash it with soap water and take the vaccine shot, the disease can be prevented. You have to basically catch the virus before it enters the nervous system."

But rabies vaccines may not always be available immediately, especially at underserved public health centres.

Photo courtesy: Abi Vanak

A dog being vaccinated in Shirsuphal, Maharashtra

"The current human rabies vaccine has to be lyophilised [freeze-dried for storage and transportation]. It is very expensive to make," says Rangarajan. "There are probably only three or four companies that are making it in the country." Several years ago, Rangarajan and his team tried to develop a DNA rabies vaccine that would not require cold storage and significantly cut down costs. "We got a patent and published studies, and even tied up with a pharma company to manufacture it. Toxicology studies were carried out in mice and monkeys. The Department of Biotechnology came forward and agreed to fund regulatory trials under the Jai Vigyan Vaccine Mission," he says. "But it did not move further."

Post-exposure rabies vaccine doses need to be given immediately after an animal bite, along with a shot of rabies immunoglobulin

Pet and stray dogs also need to be regularly given doses of veterinary rabies vaccines. "You have to conduct vaccinations at very high levels to maintain herd immunity in dogs," says Abi. "But Bengaluru has about 4-5 lakh stray dogs; you can't vaccinate all of them in one go."

Vaccination is also only one component of rabies control, points out Rangarajan. "We need to have a multi-factorial approach."

A factor that's often overlooked in dealing with zoonotic diseases is understanding the life cycle and behaviour of vectors. In India, surveillance of disease vectors is almost non-existent, says Farah. "We are not looking at the ecology of vectors like mosquitoes at all."

Farah's team has been tracking *A. aegypti*, the primary dengue vector. "*Aedes* mosquitoes don't need a water-filled habitat to lay eggs. They just need shallow water or even a damp surface. When it rains, their eggs hatch and you have lots of mosquitoes." There is also a misconception that dengue mosquitoes only breed in dirty water, she adds.

Tracking mosquito numbers can help map dengue hotspots. Farah's team has been placing ovitraps – mesh-covered containers with water that attract female mosquitoes to lay eggs – which can help measure egg densities across the city. This can serve as a proxy for mosquito numbers.

"We've also been trying to design sticky traps – they mimic an ovitrap but the lining is kind of gluey, so when the female lays eggs, it also gets stuck to the side wall," she explains. Counting these adult female mosquitoes – which are the main carriers – can also give an idea of potential dengue incidence. "You can also screen the [trapped] adult mosquitoes for other viruses like the one that causes chikungunya." This data can be matched with past clinical data from fever clinics or hospitals to pinpoint hotspots.

Identifying these hotspots early can help municipal authorities plan ahead, says Bhaskar Rajakumar, Programme Director of Healthcare Initiatives at ARTPARK, IISc. For the last few years, he and collaborators at IISc and other institutes have been working with the Bruhat Bengaluru Mahanagara Palike (BBMP) to develop a digital dashboard that can predict which areas might face a dengue surge. "They asked us to come up with predictions so that they can make policy decisions," he explains. "How many paracetamol tablets should they stock? How many beds should they keep reserved? Do they need to send more healthcare staff to certain areas?"

To create the dashboard, the ARTPARK team first obtained line list data – how many patients reported fever and in which areas – from government records over 8-9 years. Then they pooled in climate data – temperature, humidity, rainfall – as well as mosquito breeding spot surveys and photos taken by ASHA workers. They fed all of this to machine learning models and created a digital dashboard showing which regions in the city are likely to face increased dengue cases. "In disease or climate modeling, people usually use a single model. We tried an ensemble approach using seven different models," Bhaskar explains. "As of now, we can provide a two-week advance prediction at the sub-district level, with about 70% accuracy."

Photos courtesy: Farah Ishtiaq

(Left and middle) An ovitrap with water which attracts female mosquitoes to lay eggs. (Right) Aedes *mosquito eggs on a germination sheet*

Last year, when dengue cases hit a new high, some of these predictions helped BBMP take necessary measures, Bhaskar adds. “They set up temporary fever clinics. They could also mobilise ASHA workers and field health workers to look for and clear out breeding spots.”

“India appears to be the world capital of rabies,” Utpal says. “It has the highest number of human deaths due to dog bites and rabies transmission. The numbers on government websites are probably underestimates, as many cases go unreported.”

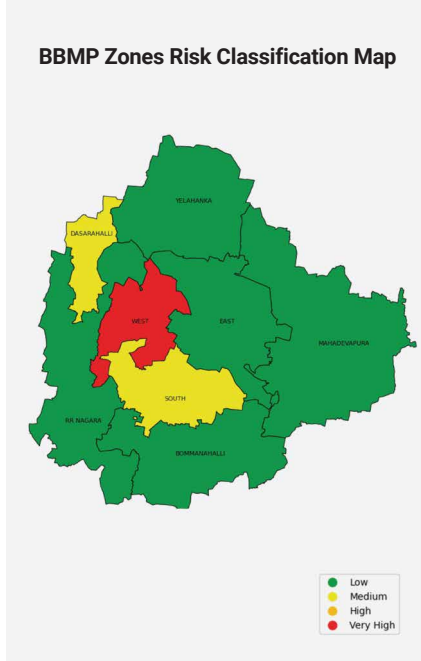
In August 2025, after a six-year-old child died from rabies following a stray dog bite, the Supreme Court passed a sweeping decision to round up thousands of stray dogs from the streets of Delhi and lock them up in shelters, a move that re-ignited an age-old debate about animal versus human safety on city streets. It also shows how responses to spikes in disease numbers are often knee-jerk reactions. Animal activists, for example, have long advocated for large-scale vaccination and sterilisation as more humane and proactive solutions.

“Most cities in India don’t have rabies control, technically speaking,” Abi says.

Could a zoonotic disease ever lead to a zombie apocalypse?

If yes, rabies might be the best contender. Some manifestations of the disease, like aggressive behaviour and transmission via bites, already match pop culture depictions of a zombie outbreak – think *Resident Evil* or *28 Days Later*. The chances of the rabies virus being maliciously modified into a bioweapon are extremely remote, but what if the virus naturally adapts to reduce its incubation period inside a host in order to spread faster? Or what if at some point it becomes aerosolised like the flu virus? Fortunately, these possibilities lie firmly in the realm of science fiction. For now.

Image courtesy: Bhaskar Rajakumar



Dengue outbreak prediction dashboard for Karnataka – BBMP areas at zone level

“They will carry out sterilisation and vaccinations at a small level, but the numbers [of dogs vaccinated] are so small compared to the actual population that it’s virtually useless.”

A few years ago, Abi and collaborators worked with a non-profit animal hospital in Pune called ResQ to carry out rabies surveillance. They set up a helpline for people to call in and report suspected rabies cases. Animals were brought into ResQ and tested for rabies using lateral flow assays. “Out of 1,200 dogs, at least 750 were positive for rabies. 40 of them were pet dogs,” he says. “A lot of these animals did not show any classical symptoms of rabies.” Based on the data, the Pune Municipal Corporation vaccinated about 23,000 dogs. The team also distributed educational material about rabies prevention to people across the city.

Abi and others have also carried out studies to analyse dog feeding patterns in cities. “Most people who feed street dogs don’t take any responsibility for them – they don’t take them for vaccination or sterilisation,” he says.

Beyond vector control, a bigger issue is seeing these animals as isolated factors rather than part of an interconnected system that encompasses human, animal, and environmental health, a concept referred to as the ‘One Health’ framework. “Any dialogue related to zoonotic diseases usually only involves veterinarians and doctors,” Abi says. “It doesn’t involve environmental scientists, hydrologists, ecologists or even social scientists – human behaviour [too] is an important determinant of disease emergence.”

In 2024, when dengue cases in the state hit a new high, the Karnataka government declared the disease an epidemic and imposed fines ranging from Rs 400 on households to Rs 1,400 on construction sites if there was any water stagnation.

Simple steps like clearing away stagnant water or preventing garbage from piling up on streets can go a long way towards keeping disease vectors at bay. But many people don’t follow such simple rules, point out Farah and Rangarajan.

“Rabies has been eradicated in Western countries. In the USA, you will never see a stray dog. If you have a pet dog, you need to have it on a leash, and scoop up its poop,” points out Rangarajan. “We want to follow these countries in designing metros and missiles. We should also follow them in enforcing such simple rules, no?”

Even if awareness is not a major issue, attitudes can be, Farah adds. “BBMP does a good job of communicating guidelines about dengue in both English and Kannada,” she says. “If you go to the heart of the city, you will find ASHA workers doing a brilliant job of educating people about vaccination, clearing breeding spots, and so on. If you go to an affluent apartment complex, people won’t even let you inside or listen to you – but they’ll have 10 plant pots with stagnant water that may be breeding mosquitoes.”

Reducing the burden of urban diseases is not impossible. Bengaluru once used to be a city of wells and lakes that offered prime locations for the malaria mosquito to breed. But when people switched to groundwater and piped water supply, malaria cases dropped drastically, Farah explains.

“If we can eradicate a disease like polio, why can’t we eradicate a disease like rabies?” Rangarajan asks. “It all depends on the government’s resolve, and the cooperation of NGOs, public health agencies, and the public.”

(Edited by Abinaya Kalyanasundaram)

Currency of Science

- Sandeep Menon

Illustration: Ashmita Gupta

The promise and perils of scientific publishing

Midway through 2025, a young researcher was wrought in thought. He knew that he had a paper that was good, worthy and ready to be shared with the world, but he hesitated. It was not a lack of confidence nor a matter of insecurity. It was a question of money. Publishing in a reputed journal would help his career, but it required a hefty payment of multiple lakhs. He could publish elsewhere, maybe in a society journal, but with a long career in academia ahead, he was unsure of how the paper would be received by his peers, or what impact it might have.

The scientific publishing industry's main job is to put forward advancements and discoveries made by scientists. But some publishing companies have been gatekeeping research advances, running a lucrative business aimed at maximising profits. High costs for submitting articles to reputed journals, as well as the subscription cost, mean that not all scientists can equally access the benefits of the publishing world.

For years, the scientific community has argued, pontificated, and grown increasingly concerned by this sombre reality hiding behind the veneer of the knowledge-sharing industry. However, the prestige that comes with publishing in top journals is so intimately intertwined with academic success that it ensures that the current system – however expensive – remains in place.

Writing at a price

Scientific publishing started in the mid-17th century to share new learnings, an advancement from the informal correspondence and science salons that predated it. It evolved over time, but it was in the mid-20th century when it transformed into a commercial business.

Over time, the scientific publishing business became highly profitable, with global revenues exceeding £19 billion

A young former army man, Robert Maxwell, was tasked to manage a struggling and inefficient British science publishers' partnership with the German company Springer. Maxwell took control of the project and, with the aid of his editor Paul Rosbaud, created a capitalist's dream. They acquired companies, introduced new journals, streamlined the process of editing and publishing scientific advancements, struck exclusivity deals with scientists and built an empire. Over time, the scientific publishing business became highly profitable, with global revenues exceeding £19 billion according to a 2017 *Guardian* article.

These remarkable revenues are the result of an interesting business model. Scientists produce materials for publishing; their expenses are covered by their institute, the government, or private grants. Most of the editorial process, including verifying accuracy and originality, is done by peer review, undertaken by scientists largely voluntarily; many consider, or are expected to consider, this as part of their responsibility to ensure correct science. Though the publishers have staff and editors across the globe, the overheads remain relatively low. They then sell the published products back to the institutions, universities, and libraries for a premium, labelled as subscriptions.

Some publishers earn profit margins comparable to Google because in addition to a subscription fee, they also charge a publishing fee from the scientists. While paywalled articles that need subscriptions usually avoid this fee, those that are free require the scientists to pay an Article Processing Charge (APC) that can go up to thousands of dollars. What was once a fee to offset the publishing cost during the era of print journals has morphed into something inexplicably large, especially as many articles, over time, have become online-only. This is particularly challenging for the Global South, where the exchange rate equals a terrifying expenditure. This financial

burden not only eats into the government and institutional budgets but also creates a knowledge imbalance, with cash-strapped institutions struggling to keep up with the latest advancements.

Some journals, however, remain free to publish, and the publishers do offer discretionary waivers of APC on a case-by-case basis. Several scientists from India have received this benefit over the years.

It was using this waiver that the researcher mentioned in the introduction published his work in a top journal. But that is a small victory in the costly world of publishing.

Accessibility conundrum

In 2011, Kazakhstani computer programmer Alexandra Elbakyan created Sci-Hub, a website that provides access to millions of research papers by circumventing paywalls and copyright restrictions set by the publishers. Elbakyan is considered a modern-day Robin Hood, wielding her programming skills to steal from the rich and give to the poor. For her efforts, which garnered widespread goodwill, she has been fighting lawsuits against copyright infringements for years.

Sci-Hub has been a major voice in the open access movement, a global push for free and open online access to academic information. The chorus became louder following the tragic suicide of programmer Aaron Swartz, an internet hall of fame hacker and open access activist; he took his own life in 2013 while awaiting trial after his arrest for mass-downloading articles from JSTOR (an online journal storage site). Swartz's death opened conversations about the democratisation of information and open access.

The publishing houses, on their part, have started several methods to balance profits with open access to their repositories

These radical steps taken to make scientific articles accessible to all have been a counter-push against the publishing industry. Even the APC charges came into existence to alleviate the call for open access.

The publishing houses, on their part, have started several methods to balance profits with open access to their repositories. There are Gold Open Access journals where authors have to pay a substantial cost to publish, but the articles are free to read. There are also articles are free to read. There are also Read and Publish agreements (where the institute makes a deal with the publishers to gain access and waive the APC) and Subscribe to Open models (existing customers maintain their subscriptions to keep the content open for the wider world), among others. But they all tackle only a part of the problem. Merits of models such as pay-to-publish (where the author pays to ensure free access to readers) and pay-to-read (subscription) are still widely debated.

Initially, only publishers using the Gold Open Access model, where the entire journal is open access, charged APCs. But soon, several became hybrid open access, where the journal is subscription-based with a paywall, and the author will have to pay extra to make their work open access. “That is double-dipping. Some publishers say that the money raised will go to subsidising the general subscription price for journals, but it does not make much of a difference. Also, libraries generally do not receive a refund for the subscription fees paid to access a scientific paper if in case it gets retracted,” explains Umeshareddy Kacherki, librarian at the JRD Tata Memorial Library, IISc.

The Indian government's introduction of the One Nation One Subscription (ONOS) plan is a step in the direction of open access. A sizable number of participating universities and institutions, even from tier two and three cities, can access papers from about 30 major international publishers under a national license. The government also plans to provide financial support to authors to publish in open-access journals.

Publish or perish

The publishers’ high costs are often attributed to the multiple services they provide. Beyond editing, streamlining processes, ensuring image and research quality, and other publishing responsibilities, they also provide user-friendly software that suggests optimal peer-reviewers, stringent plagiarism tests and similarity reports, among others. Such is the level of vigilance that they even alert scientists about potential editors with dubious reputations. These companies further provide language editing for non-English speaking scientists, formatting, guidance, and publishing masterclasses to young researchers. Once published, the work is sent to all the libraries and hyperlinked and processed thoroughly such that all citations and references are easily accessible. The publishers also provide shareable links to the author sometimes, through which their published work can be read and shared, though not downloaded or screen-grabbed.

Nevertheless, some scientists believe that the APC costs are, at times, a bit too high. In 2023, more than 40 editors resigned from two leading neuroscience journals, citing an ethical dilemma over the high APCs being charged.

A major reason why scientists continue to pay prohibitively high APCs to publish in reputed open access journals is because of their high impact factors, i.e. the frequency with which the average article in a journal is cited in a year.

Poignantly, scientists themselves have a fair share of the blame to shoulder for allowing impact factors to decide much of their fate. Having their research published in high-impact or Q1 journals (the top 25% of the reputed journals) is seen as a matter of prestige.

"Earlier, you sent papers based on their relevance to a particular journal. Now impact factor is driving everyone," points out Elangannan Arunan, Professor at the Department of Inorganic and Physical Chemistry, IISc, and listed in the 2024 PCCP (Physical Chemistry Chemical Physics) outstanding peer reviewers.

A lot of the issues are also systemic and run deep within the core of how academia is set up. At every step of their academic career, scientists are encouraged to publish work in high-impact journals; in some institutes, this could play a role in the jobs they get, the grants they receive, and whether they get promotions or tenure. This has led to an explosion of scientific journals catering to the demand for publishing. *Scopus.com* lists over 48,833 journals, with Springer-Nature publishing over 3,000, Taylor & Francis 4,233, and Elsevier 2,232.

This 'publish or perish' mentality has also given rise to several predatory journals, which publish research without peer review to cater to the numbers game. While IISc and other top institutions are fairly insulated from these practices, the same cannot be said of others.

The desperation also opens doors to scientific misconduct, fraud, and an overinterpretation of results, leading to paper retractions. It was reported that over 10,000 research articles were retracted in 2023, a record. Over 8,000 of them came from journals run by an Egyptian company, which is a subsidiary of Wiley. In 2023-24, almost 7,000 cases of cheating using AI tools were found during a survey by the academic integrity violations in London. As per the Retraction Watch Database, India ranks third with 2,737 retractions in 2023.

This has led towards a research culture that sometimes incentivises quantity over quality, where publications become the currency of success

Ultimately, this has led towards a research culture that sometimes incentivises quantity over quality, where publications become the currency of success. Several institutions use the impact factor of journals as a metric to drive up their standings in the pecking order, such as NIRF (National Institutional Ranking Framework) and QS World University rankings, among others.

"It's a consequence of institutions wanting numbers and trying to give incentives to people who publish for the sake of it. Fortunately, IISc does not do it," says GK Ananthasuresh, Professor at the Department of Mechanical Engineering, IISc. "There are so many institutional rankings, and many of them are based on publications and citations. Researchers are also human; it's tempting."

Open science

Problems like these led Brian Nosek, professor of psychology at the University of Virginia, to establish the Center for Open Science (COS) in 2013. "We look at the problem in two ways," Nosek says. "As a system, what are the rewards and incentives that drive a researcher's behaviour? From an individual perspective, how does the system create biases in a researcher's decision-making and reporting of the research?"

According to Nosek, what ends up in the research is biased as the rewards are for positive results and not for information that does not align with the dominant narrative, false stars and failures. There is also the chance that researchers could rationalise data in a way that looks best for the purpose of publishing.

"People are picking problems that can be published and not problems that need to be solved. Publication should be a result and not a goal. It should be about the significance of publication," Elangannan agrees.

To that end, COS promotes a model called registered reports where the scientists submit their research plan for peer review before doing the work, and the journal commits to publishing the outcomes before they are known to anyone. This way, the decision to publish the research remains result agnostic. "Negative results are still results," Nosek says. "But we can agree that the question and the method involved were good."

Another solution could be having journals run by institutions, though that is easier said than done. The *Journal of the Indian Institute of Science* has a history dating back to 1914 and has published several important papers over the course of the century. However, the journal almost folded in 2006-07 before continuing as a multi-disciplinary review journal. Even then, it requires expert support in marketing, editing, formatting, and other administrative processes that go into publishing, which Springer provides.

"The agreement we came to was that we [IISc faculty and a guest editor] take care of the technical matters and they [Springer] take care of the marketing and everything else," says Ananthasuresh, who is the Editor-in-Chief of the journal. "The main objective of the journal is to curate review articles in selected themes in emerging, contemporary topics, so that they will be available for free to researchers in India."

The articles published have a six-month moratorium period after which they are freely accessible on the IISc Journal's website. "Springer's worldwide distribution helps, and since these are review articles, researchers value them ... we get a reasonable impact factor," he adds. The journal is especially a big help for developing countries that have limited money available for bulk subscription towards general scientific journals.

A more democratic approach that is gaining traction is uploading the pre-prints of research papers to the ArXiv, a free service and open-access archive. Papers are accessible and free to be commented on, albeit not peer-reviewed. IISc alone submits more than 600 papers a year to various ArXiv.

There are talks of alternative models, one among them being diamond open access, which is free to publish and read. This model has found success in Latin America, where the Scientific Electronic Library Online is funded by various agencies including the government. But it is yet to find solid ground in the rest of the world.

There is also a movement within the scientific community that is calling for publishing in journals under professional societies (like the American Chemical Society) and other open journals (think Indian Academy of Sciences). Although, in many of these alternative publishing options, the matter of prestige remains unanswered.

Thus, it becomes the proverbial question of who will bell the cat? To force a change, who would stand for a set of values that would likely be detrimental to a successful academic career? It is a tough ask and even tougher decision.

One would think identifying the problem and finding solutions are right up the alley of scientists, but they, too, are bound by the same problems of money, job security, and career advancement that haunt the rest of the world. And the wheel keeps turning.

A hamster wheel.

(Edited by Rohini Subrahmanyam)

‘My work on national projects became the driving force of my life’

- Interview by Ranjini Raghunath

Photo courtesy: SERC

Narayanaswamy Balakrishnan (“Balki”) has spent over five decades at IISc. Upon completing his BE (Hons) from the Coimbatore Institute of Technology, he pursued his PhD from the Department of Aerospace Engineering, IISc, where he continued as a faculty member. He contributed to diverse areas, including aerospace electronics, computational electromagnetics, and information security. He also played a key role in setting up the National Centre for Science Information (NCSI) and Supercomputer Education Research Centre (SERC) at IISc and served as the Associate Director from 2005 to 2014. In this interview with CONNECT, Balki reminisces about his research, work on national programmes, and time in the Institute administration.

Can you tell us a bit about your background? How did you come to join IISc?

I was born in the small town of Villupuram, Tamil Nadu. I joined the new branch of Electronics and Communication at the Coimbatore Institute of Technology for my BE. But my brother, who was then doing his PhD at IISc, advised me that a BE was not a terminal degree.

Srinivasa Sampath, the Director of IIT Kanpur, once visited our college for a lecture on electronics. I was dropping him off at the railway station after his talk when he asked me about my future plans. I told him that I was thinking of joining either IISc or Bharat Electronics Limited. He said to me, "Don't be mad. Join the Indian Institute of Science." I later learned that he was an IISc alumnus and held the Institute in high esteem.

Coming from a small town, I knew little about engineering research. But I weighed all my options and decided to join IISc, while keeping an eye out for openings abroad. A few years before 1972, the Department of Aerospace Engineering at IISc started a group called Guidance and Control. I finished my BE in the year 1972 and joined IISc for an MSc (Engg). I have been here for 53 years.

How did you end up doing a PhD here?

When I joined IISc, my future supervisor, S Ramakrishna, told me that he was working on building a guidance system for a surface-to-air missile and was looking for someone to work on electronics hardware.

Ramakrishna was a visionary; he was extremely generous and gave us plenty of freedom. One evening, he visited the lab at 8.30 pm – I used to work very late – and asked me to explain what I was doing. Then, he said: "You are doing good work." And he suggested that he will request for conversion of my registration to PhD. The whole process of conversion was a breeze.

One of the nice attributes of this Institute is the extreme amount of freedom that one has to do research

What made you stay on as a faculty member at IISc?

One of the nice attributes of this Institute is the extreme amount of freedom that one has to do research. For my PhD, I worked on the constrained optimisation of antenna arrays. I was doing purely electronics work in the aerospace department, and still being appreciated. Simultaneously, I worked on my supervisor's project on re-engineering the guidance package for a Russian missile that India was manufacturing at that time.

After completing my PhD, I was offered a postdoctoral fellowship at Ohio State University, USA. By then, I had met my wife, who was also a PhD student at IISc. Her parents insisted that we get married before I left.

My supervisor was not happy that I was leaving. He asked the Director, Prof Satish Dhawan, to dissuade me from going. Prof Dhawan said, "Balki, if you go abroad, you will be a screwdriver. Somebody else will turn the screws. If you stay back, you can turn the screws." Prof Dhawan requested me to stay at the Institute, which I did. I have no regrets.

What did you like most about IISc?

As a student, it was the mess, the hostel, the computer centre, the Gymkhana, and its night coffee. The Gymkhana cafe was open only till 1 am, but I usually worked until 1.30-2 am. So, we would go to the Yeshwantpur railway station to have hot coffee or tea and return by which time our computer program run would have completed.

After I became a faculty member, my students became part of my family, and many are still in touch with me.

Thirdly, my work on national projects, which became the driving force of my life.

What projects did you work on for the defence sector?

Tons of them! At that time, the entire aerospace department was working on defence projects. There was a saying that not a single object would have gone up in the air without a nut or bolt designed by the department.

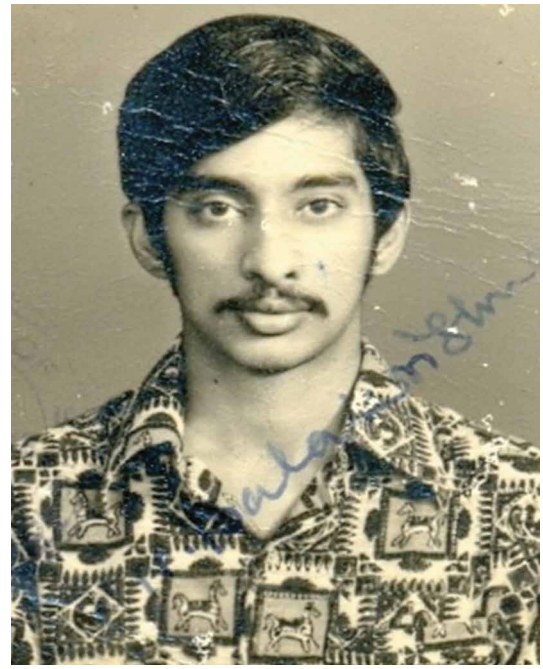


Photo courtesy: N Balakrishnan

N Balakrishnan when he joined the Institute

When my supervisor left IISc, I was asked to work on the second phase of his missile project, on the guidance, coding scheme, and control. Dhawan also asked me to work for ISRO on the theoretical analysis of antennas mounted on satellites.

There was a saying that not a single object would have gone up in the air without a nut or bolt designed by the aerospace department

I also got involved with India's AWACS [airborne early warning and control system] programme. The first challenge was power generation using travelling wave tubes, the second was designing low side lobe arrays, and the third was clutter analysis to distinguish an enemy aircraft from the sea, forest, and so on. This was my foray into large defence projects.

We also worked on sensor fusion, and on Radar Cross Section (RCS) analysis of one of the Aeronautical Development Agency (ADA)'s new aircraft.

Once, I went on a sabbatical to the National Severe Storms Laboratory

(NSSL), USA. It was a turning point in my life. We used electromagnetic analysis to separate individual radar echoes from hail, snow, and rain collected using their NEXRAD weather radar. When I came back to India, I told my defence contacts that this approach can also be applied to detect stealth aircraft.

A Russian scientist once made a passing remark that if the aircraft is completely stealth, it does not reflect the radar signal, but you could track its wake. One of my students worked on it and published a study on detecting low-visibility aircraft from its wake pattern.

Photo courtesy: N Balakrishnan

N Balakrishnan (bottom, third from left) with members of his first research lab at SERC

How did you become involved with the Supercomputer Education and Research Centre (SERC)?

I was already doing a lot of programming in the aerospace department. During IISc's platinum jubilee celebrations in 1979, the Director, S Ramaseshan, sent several proposals to the government seeking funding for emerging centres. He also said that we should ask the Prime Minister for a single, large entity. The Institute decided to ask for a supercomputer.

The person put in charge was Roddam Narasimha. As his former student, I was pulled in as the "ball picker boy" in the team – tasked with finding out what systems were available across the world.

We proposed a computing system called the CRAY Y-MP. It had an onion-layered configuration, with 90% of the users on peripheral smaller computers while the rest had deeper access. The proposal was sent to the government. Prof V Rajaraman [from IIT Kanpur] was invited to head the new centre [SERC].

Photo courtesy: K Nagarathna

N Balakrishnan (right) with Roddam Narasimha (left)

Due to an enormous delay in getting the CRAY supercomputer, we submitted a revised proposal to the government.

Luckily, at that time, single monolithic supercomputers were being replaced by distributed systems with powerful processors. We decided to purchase a distributed system, and Prof CNR Rao helped us get cabinet clearance. We had an IBM machine for computation, another machine for graphics, and one for databases – all connected through a powerful network so that they shared resources. It was a unique concept.

For both the target identification and information security research, we needed a tremendous amount of computational power. If I hadn't moved to SERC, it wouldn't have been possible.

Can you talk about your work on information security?

By the time Abdul Kalam became the Scientific Advisor to the Defence Minister, I was working continuously with him. I was his "1 am friend" – he frequently called me at that time.

I had also been visiting Carnegie Mellon University (CMU) every summer and learning a lot about information security. I worked on the Million Books to the Web project. My mentor at CMU, Raj Reddy, said to me: "Balki, the whole world is working on information security. You must convince the Indian government to look into it." I came back and informed Kalam. He agreed, and that's how the country's information security research programme started.

After 2000, my entire life revolved around information security. I was involved with CERT-in [a national nodal agency for responding to computer security incidents]. We trained 120 people from DRDO and the government sector. Monitoring and traffic control of the internet was another big problem. For this work, my students got the AGNI award, and I got the DRDO Academy Excellence Award. Subsequently, most of our work was on intrusion detection systems and improving the accuracy of intrusion detection.

What was it like working with government and strategic organisations?

I realised that the way to succeed with government projects is not to say, "You lay off your hands and give me the money, I will do the work," but to involve them closely.

For example, India has been importing a lot of equipment from China and non-friendly countries. How do we know that they are secure? The Department of Telecommunications (DoT) put six of their senior engineers here on campus, and I worked closely with them, guiding them on developing standard procedures for testing the equipment.

As a member of the National Security Advisory Board, I got a bigger picture of national security. The people I worked

with in DRDO were very understanding, particularly Kalam, VS Arunachalam, and VK Aatre – they were all of the opinion that university research cannot be constrained.

The important thing is that these organisations have to share data with us. When telecom companies had to share call records, they were anonymised before sharing.

For my work at SERC and on information security, I received several awards, including the Padma Shri. I don't think I would have gotten these awards if I hadn't worked on national programmes.

Can you talk about your role in the National Supercomputing Mission (NSM)?

In 2010, K Kasturirangan, who was a member of the Planning Commission, asked me to work on a proposal for establishing supercomputing facilities in India. There were two issues: getting access to supercomputers and making them. We decided to focus on access.

We gathered people from around the country to write status papers across fields – bioinformatics, drug design, aerodynamics, and more – outlining national needs. The NSM proposal was approved, with IISc and the Centre for Design of Advanced Computing (C-DAC) as implementing agencies. A Technical Advisory Committee was formed, and I became a member. VK Saraswat, another IISc alumnus, was the head. He felt that we should do more within India. We have finished phase I. Phase II is now ongoing.

Do you think more scientists should contribute to national projects?

Absolutely. Where else will [organisations like] DRDO go? But that does not mean everyone should. IISc, for example, evaluates faculty members on five pillars: teaching, research, students, consultancy, and technology development. There are people who want to do science – we can't ask them what product they have developed. You can't ask a person who develops products how many publications they have. Some are original thinkers, and some are excellent teachers. Everyone should have the freedom to choose between the five pillars, but they must contribute substantially enough in that area.

Photo courtesy: Ragini Mukherjee

N Balakrishnan (left) with former President of India APJ Abdul Kalam at the inauguration of the Centre of Excellence for Hypersonics in 2011

How did you get involved in administration? You were the Associate Director when P Balaram was the Director.

I'd been in the Institute administration since the age of 32. I was the convenor of the National Centre for Science Information (NCSI), the Centre for Microprocessor Applications, and Associate Chair of the Centre for Scientific and Industrial Consultancy (CSIC). I was brought in to head SERC and later the Division of Interdisciplinary Science.

I don't think I would have gotten these awards if I hadn't worked on national programmes

When I became the Associate Director, I got the additional responsibility of bringing in money to the Institute, while Balaram handled faculty and students.

When Balaram was trying to start the undergraduate programme, several people opposed it, including me. I told him: "Don't start this programme. But God forbid you start this, please appoint a Dean of Undergraduate Affairs." I had handled student affairs for 10 years as an advisor to two directors. PhD students were already mature. Bringing 16-18 year-olds on campus – I didn't know whether we had the experience. I opposed it only for this reason. Balaram listened to me, and in the Senate, he said: "The first person who opposed this programme is Balki, my Associate Director. He said that if I am going ahead with this, I should appoint a UG Dean. I never disagree with Balki, so I am appointing one." The programme, of course, turned out to be tremendously successful.

What do you like most about the campus?

I love everything about this campus.

The jubilee garden used to be an undeveloped area with a pond; you would find snakes, fish, and numerous birds. I lived in DQ19, in the faculty quarters on campus. My children would listen to the chirping of birds early in the morning and try to identify them.

At one point, the number of birds on the road leading from the old biochemistry building to the library was so high that you couldn't walk by without getting hit by bird poop.

When I was a student, in the mess, if I took one *poori* less, the server would ask me: "Did your guide scold you? Please eat more." I feel that personal touch is gone now.

What advice do you have for students and young researchers?

Be the best in whatever you are doing. Don't plan too much. Life will be nice to you.

(Edited by Ashmita Gupta)

Birds of Different Feathers

- Mohit Nikalje

Photo courtesy: Pexels/Vik Joshi

Secret lives of mixed species groups

A mixed species herd of zebras, gazelles and wildebeests in the savannah

Some years ago, while driving through the scenic Masai Mara, a savannah wilderness in Kenya, Kartik Shanker made an interesting observation.

"Various species of ungulates (hoofed mammals) like gazelles, zebras, and wildebeests were foraging together, but what was interesting was that smaller individuals grouped with similarly sized individuals of other species," recalls Kartik, now a professor at the Centre for Ecological Sciences (CES), IISc.

Many of us have grown up with images of these iconic savannahs: tall grass rippling in the wind, lions crouched low and watchful, and herds of animals grazing under the open sky. Yet these gatherings of animals are far from random. They are strategic alliances, forged in the wild, where survival often depends on the company one keeps. Such mixed-species groups (MSGs) have long fascinated ecologists, including Kartik.

These gatherings of animals are strategic alliances, forged in the wild, where survival depends on the company one keeps

One of the central questions they seek to answer is this: while it is well known that some animals often form groups within their own species, what drives individuals of entirely different species, each with its own behaviour and ecological role, to bridge these interspecies barriers and move as one?

There are complex trade-offs, shared benefits, and evolutionary pressures that make such unlikely partnerships not just possible but advantageous for survival.

Teaming up for food

Several animals, from elephants to ants, are known to live in social groups of varying sizes. "Living in groups provides a lot of shared benefits, like finding food, hunting together, or just staying protected from predators," explains Kartik.

For example, an individual lion may not be an efficient hunter, but catching prey, especially larger ones, can be more successful when done as a team.

However, single-species groups can't expand beyond a certain limit; competition increases as all group members seek the same resources. To reduce competition while still benefiting from group living, animals form mixed-species groups, since each species will typically target different resources.

Scientists have been observing such group formations for several decades. The English naturalist Henry Walter Bates observed this in the Amazon rainforests. In his 1864 book *The Naturalist on the River Amazons*, the preface of which was written by Charles Darwin, he writes: "It would not be supposed that the insectivorous birds are also gregarious; but they are so; numbers of distinct species, belonging to many different families, joining together in the chase or search of food."

Another example of such coordinated feeding comes from the forests of the Anamalais in the Western Ghats, where two langur species form a mixed-species group. Such associations – shaped by factors such as the scarcity of food resources or human activities – often influence the Nilgiri langur (*Semnopithecus johnii*) and the tufted grey langur (*Semnopithecus priam*) to come together in overlapping zones.

Both species feed on leaves, shoots, and fruits from many of the same tree species, so when these resources are patchily distributed, foraging side by side becomes advantageous. "These mixed-species groups are very efficient at foraging in dry deciduous forests ..." explains Santanu Mahato, a PhD student at the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore.

"Unlike typical uni-male/multi-female groups, they are generally larger in group size and made up mostly of a multi-male/multi-female structure," he adds.

Ocean ecosystems harbour such species associations, too. Coral reef fishes, like the striped parrotfish (*Scarus iseri*) and the ocean surgeonfish (*Acanthurus tractus*), are known to form groups in the Indian Ocean and forage together. Both feed on algae but, interestingly, feed in different ways which complement each other.

The parrotfish, with its strong "beak", scrapes algae off the corals, exposing the smoother inner layers and the small organisms residing within, which then become accessible to the surgeonfish to feed on.

Outsmarting predators

It isn't just similar food habits that prompt the formation of mixed-species groups. The striped parrotfish and ocean surgeonfish also happen to be somewhat similar in appearance. Such similarity makes it harder for predators to single out a specific target, creating confusion during an attack. The outcome is what scientists call the dilution effect: the probability of any one individual being caught decreases simply because there are more equally vulnerable targets in the group.

A study from Kartik's lab, led by PhD student Hari Sridhar, analysed 55 datasets from 24 sites across India and found that similar-sized birds, often also similar in appearance, tend to form

Photo courtesy: Santanu Mahato

Mixed morphotypes of Nilgiri langurs and tufted grey langurs form groups to forage together in the Anamalais

groups. This mirrors what is observed in fish and ungulates, where similar-sized individuals group together.

Size similarity isn't always a rule. Sometimes, individuals of smaller species group together with larger ones to avoid aggression or predation. For example, smaller parrotbills (*Paradoxornis aemodius*) have been observed associating with the much larger greater necklaced laughingthrush (*Pterorhinus pectoralis*). Such associations may offer protection through intimidation, although research is still underway to confirm this explicitly.

Groups reduce predation risk by increasing vigilance – more eyes to spot danger

Another way mixed-species groups reduce predation risk is by increasing vigilance – more eyes to spot danger. For example, in the Masai Mara grasslands, the space is so open that grazing ungulates are vulnerable to predator attacks, making group formation an intelligent strategy. These are supplementary benefits, as ecologists like to call them, where each member contributes to the safety and welfare of the group, allowing individuals to feel safer to forage.

Priti Bangal, a programme coordinator at the Nature Conservation Foundation (NCF), observed an interesting example of this. "When I was in the Western Ghats studying mixed-species flocks, I often observed dark-fronted babblers (*Rhopocichla atriceps*). They are very shy and sulky birds that mostly live in the understory, so you don't see them very easily. But what I observed on a few occasions was that when these birds were with the racket-tailed drongo and other flocking birds, these shy birds were seen high in the canopy," shares Priti. "Hanging out with other birds probably expands their foraging niche and opens up untapped territory for them, although this needs to be established through more systematic studies."

Transient or lifetime bonds

A common theme researchers have noted is that mixed-species groups often seem to emerge in times of scarcity. During seasons of abundance, animals may not form such groups.

"In places like India and Africa, mixed-species flocks of birds are observed during the dry seasons," points out Umesh Srinivasan, Associate Professor at CES, who studies mixed-species groups in the Eastern Himalayas.

This points to a key distinction – individuals in mixed-species groups can join or leave these associations depending on resource availability, unlike single-species groups, where members often remain committed, especially when young ones needing parental care are involved.

Photos courtesy: Wikimedia Commons

On Nicobar Island, a unique foraging alliance was observed between treeshrews (bottom left), racket-tailed drongos (top left) and the predatory sparrowhawks

This is in stark contrast to the pattern seen in the Amazon forests, where mixed species groups of birds stick together year-round – not because resources are scarce, but because the environment, though resource-rich, is also highly competitive and teeming with predators.

Research has shown that the strategies behind group formation are far more complex and highly context-dependent. Remarkably, there have also been observations of groups formed between a bird and its potential prey. During fieldwork in the Great Nicobar Islands in 2000, Kartik and fellow researcher Meera Oommen, who together co-founded the Dakshin Foundation, witnessed interactions between tree shrews (small insect-eating mammals), sparrowhawks (small predatory birds), and racket-tailed drongos.

Meera's study showed that tree shrews would flush out insects and other small vertebrates while foraging through the undergrowth, providing prey for the drongo and sparrowhawk. However, it was noted that tree shrews preferred to keep a greater distance from sparrowhawks, and were more likely to form such associations when a drongo was present, possibly to reduce predation risk from the sparrowhawks.

Though the study had to be discontinued after the 2004 tsunami hit the islands, it exemplified how species can change their typical behaviours to form such associations.

Field challenges

Studying mixed-species groups is uniquely challenging, as it involves tracking not one but various species across difficult terrains. In reefs, for example, researchers had to learn scuba diving, follow fish groups underwater with a camera and then spend weeks analysing the data in the lab to identify the species and their interactions.

The same challenges arise in terrestrial landscapes too – especially when tracking birds. Priti had to learn various bird calls to identify them; in dense forests, where sightings are rare, bird calls may be the only clue. In the early days in the field, this could be confusing, although, she admits, she did find a new thrill in learning unfamiliar calls. "I used to get excited while watching a mixed-species group. I would eagerly listen and wonder, 'Is that a

Photo courtesy: Bharat Ahuja

A mixed species shoaling group

racket-tailed drongo mimicking something? Or did I just hear a paradise flycatcher?'" Priti recalls.

For Santanu, it was a completely different struggle in the dry scrub and deciduous forest of the Anamalai Hills: "For nearly six months, it has been extremely dry at my field site, and every day began with the weight of 4-5 litres of water and food for the whole day strapped to my back during the field season, from dawn to dusk. In that desolate dryness, every observation was both a fear and a privilege."

Additionally, as most of this research is in pristine, protected areas, it requires extensive forest permits and skilled field assistants familiar with the landscape and logistics.

Besides field challenges, fleeting animal sightings restrict the scope of the research. Researchers often get only brief glimpses of groups, limiting detailed behavioural observations. "Getting measurements of anything beyond species composition is nearly impossible in the field, especially for tropical bird flocks," points out Kartik.

Umesh's lab is trying to partially solve this challenge by tagging individual birds. This has allowed them to show that an individual from one species was consistently pairing with the same individual of another species.

Advanced technologies like drones and stereo cameras can help explore other aspects of mixed-species group interactions – for instance, the role of bird calls in communication and group formation, a current research focus in Kartik's lab. His lab is also expanding research into other ecosystems, such as wetland bird communities.

Shifting climate, shifting alliances

Despite the challenges, researchers are still uncovering new nuances and subtleties behind diverse mixed-species interactions. Unfortunately, these important ecological interactions are being increasingly disrupted by climate change and human activity.

A study from Umesh's lab found that logging – the selective harvesting of trees – impacts mixed-species associations. It showed that logging led to fewer species interacting in the understorey, likely because the loss of dense vegetation reduced the availability of food and microhabitats, leaving fewer opportunities for such associations to form.

In contrast, both the number and strength of species associations in the midstorey actually increased with heavier logging. As thinning of the forest canopy makes birds more visible to predators, they tend to flock together more often, likely as a strategy for shared vigilance and safety.

Umesh's lab also found that global warming is pushing birds uphill, alongside the effects of logging in the forests of the Eastern Himalayas. Umesh hypothesises that this may cause many mixed-species groups to break apart and reassemble. Such shifts could be harmful for species that rely heavily on the stability of their groups for survival, although more data is needed to confirm this.

Reef fishes, too, are being impacted by climate change. Corals – home to symbiotic algae – are degrading due to rising global temperatures. As these algae die off, the availability of food for coral reef fishes like surgeonfish and parrotfish declines, reducing the frequency of their group formations. However, new associations are emerging. For instance, goatfish (*Parupeneus indicus*), which feed by disturbing the sand to uncover small animals, are now often followed by wrasse fishes that take advantage of the stirred-up prey.

Clearly, animals form mixed-species groups as a smart strategy to cope with the growing challenges of climate change and human-induced habitat degradation. Just as importantly, these interactions serve as indicators of ecosystem health. Studying them is therefore crucial – not only to understand their benefits, but also to assess how disruptions might harm the species involved.

The public, too, can play a role in studying these fascinating ecological relationships. "We are trying to introduce some citizen science initiatives through which recreational divers can collect information about reef fish, including potentially MSGs," says Kartik. "While such data may be fairly coarse, these practices can raise awareness about mixed-species groups and their importance."

Mohit Nikalje completed his MSc in Life Sciences at IISc and was a science writing intern at the Office of Communications. He is currently working as a science communicator at the Atal Incubation Centre (AIC) – CCMB, Hyderabad.

(Edited by Abinaya Kalyanasundaram)

Photo courtesy: Aman Biswakarma

A rusty-fronted barwing tagged (colour-ringed) by Umesh's team at Eaglenest Wildlife Sanctuary, Arunachal Pradesh, to track its interactions with other species

CONNECT ASKS

How do you use AI tools in your work?

During my undergrad days, I tried using ChatGPT for my assignments. It didn't give me very accurate responses, particularly for complex [math] problems. But I've found it useful for finding references.

It would be great if AI could assist mathematicians in more ways. Computers have already been used for a long time to verify lengthy and complex proofs. Sometimes a proof is so long that it's just not feasible for a human to manually check every step, and that's where computers – and now AI – can be really useful. Even mathematicians like Terence Tao think so!

Sagnik Saha
Integrated PhD student, Department of Mathematics

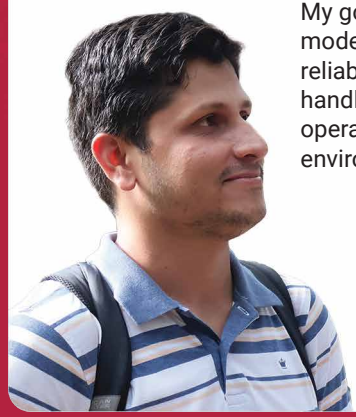
When I was applying to colleges, I used AI tools to find information about the hostel and courses. I also use it to understand some concepts while studying: there's a website that turns lecture PDFs into videos. But AI doesn't always give the right answers, so I don't rely on it blindly.

Elizabeth Soreng
Bachelor of Science (Research) student

My area of research involves AI. We develop algorithms to tackle specific problems, which may be computational or language-related. One issue I've noticed is that whatever we experiment with in the lab doesn't always translate well into the real world.

You've probably heard of robots being used in medical fields. In robotic control, for example, if you train a model and deploy it in a surgical setting without testing it in varied or uncertain environments, it might make critical errors. So when we develop models, we try not to rely solely on benchmark datasets.

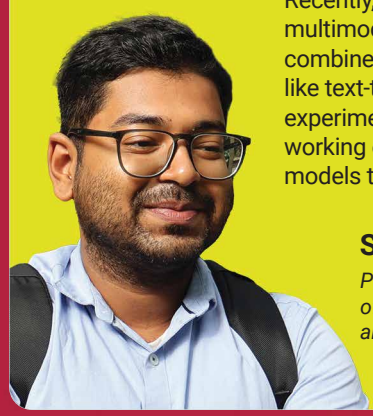
My research focuses on how well models trained in controlled environments can generalise to untested, real-life situations. We introduce uncertainties in testing to evaluate how the model performs under stress – particularly in high-stakes fields like medicine. My goal is to make AI models more robust and reliable, especially when handling sensitive data or operating in unpredictable environments.



Abhishek Kumar Sinha
PhD student, Department of Electrical Engineering

I use AI to research AI! I work on developing AI-based algorithms to tackle certain problems, computational or NLP (Natural Language Processing).

Recently, there's been a rise in multimodal models that combine vision and language, like text-to-video generation or experiment simulation. We're working on those kinds of models too.



Subhajit Paul
PhD student, Department of Computer Science and Automation

I use AI for image analysis – specifically to measure the forces exerted by cells on a substrate. In our micro-studies, we place cells on a substrate embedded with fluorescent particles. When the cells apply force, these particles move. We capture that movement through imaging, and then process the images using AI to calculate the force field. It's quite useful.

We mostly use MATLAB codes and incorporate AI techniques within that framework. From there, we analyse the displacement and calculate the stress field, which tells us how much force is being exerted. This helps us study pathological cells, how the forces they exert differ from normal cells. This also helps us observe the dynamics or kinetics of cell behaviour.

I use AI to write the MATLAB code for image analysis which saves us a lot of time. That means we can do more troubleshooting or fine-tuning. Otherwise, doing everything manually – looking at images, tracking movements by hand – would be extremely time-consuming.

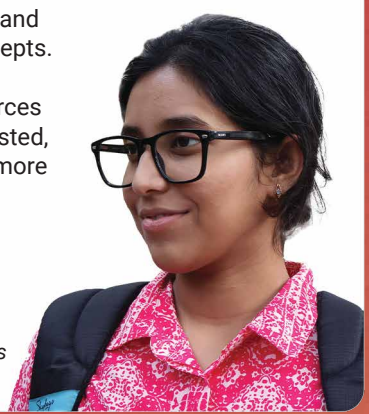
Sanjay Sain

PhD student, Department of Mechanical Engineering

I find AI especially helpful for assignments. If I'm trying to understand a problem, I can create a dialogue with it – ask questions and go step by step. For example, in my final semester during undergrad, I had a biostatistics course. I used ChatGPT to discuss and understand different concepts. It's useful for biological sciences as well. The sources seem to be more clearly listed, and the explanations are more accessible. But I always cross-verify!

Gayatri Das

MSc student, Division of Biological Sciences



I find it useful! It can explain some concepts well. Like I used it to learn more about algorithms. It helped when I was preparing for competitive exams, too. You can ask it to suggest YouTube videos to understand a topic better. It can also recommend websites that convert lectures into podcasts or generate practice questions.

Sri Varshinee

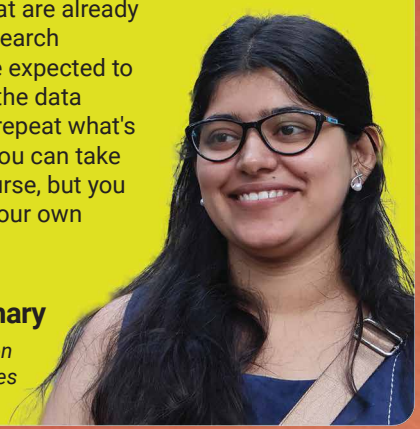
Bachelor of Science (Research) student

In grad school, for one of my projects, I used it to help interpret some data. We were studying the effects of thermal stress on a species of fish – specifically, looking at the therapeutic benefits of a phytochemical called rutin. I used ChatGPT to help make sense of some of that data. But my professor caught me (*laughs*).

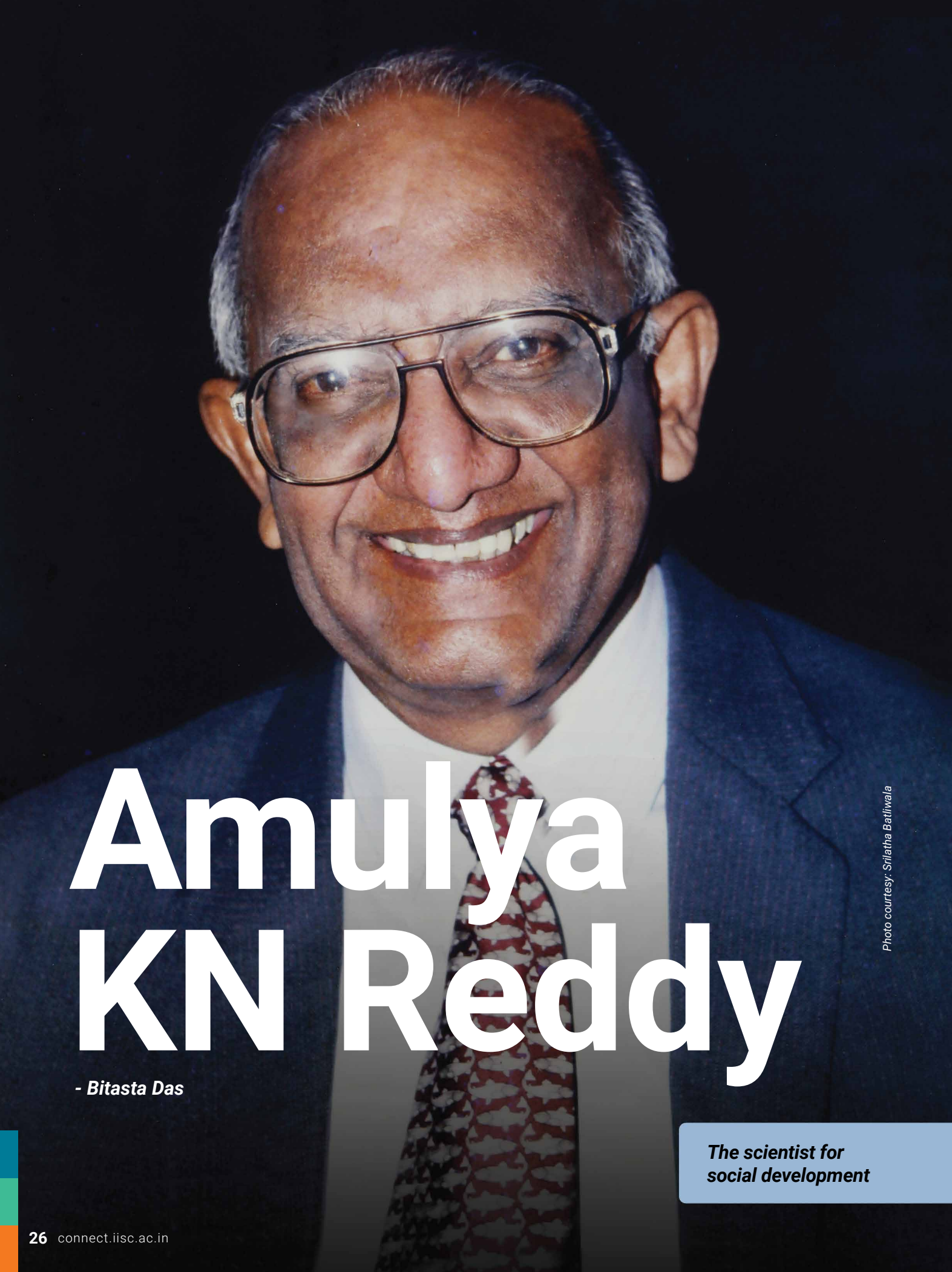
Using AI for interpretation is not usually encouraged. It's not that the model is completely wrong – it is just that it often suggests interpretations that are already found in other research papers. But you're expected to critically analyse the data yourself, not just repeat what's in the literature. You can take references, of course, but you have to develop your own interpretation.

Himani Choudhary

MSc student, Division of Biological Sciences



(Edited by Ashmita Gupta)



Amulya KN Reddy

- Bitasta Das

Photo courtesy: Srilatha Batliwala

The scientist for social development

One morning in the early 1940s, 12-year-old Amulya Reddy received a letter from his uncle and hero, CGK Reddy, a marine engineer and political activist. The letter, written on a rough piece of paper, had arrived from the Madras jail where CGK was imprisoned for his anti-British activities. In the letter, he cautioned young Amulya against choosing a career based on hero-worship and urged him to pursue his passion. Amulya, who had been flirting with the idea of becoming a sailor like his uncle, began to introspect on his life's true calling.

Being and becoming

Amulya Kumar N Reddy was born in Bengaluru in 1930. His early life was influenced by the Gandhian philosophy endorsed by his father, Narayana Reddy. Amulya's interactions with towering figures like Jayaprakash Narayan, Achyut Patwardhan, and Rammanohar Lohia left a deep and lasting imprint on his personality. During his college years, Amulya found himself torn between his love for cricket and science. On one such occasion, he writes in his autobiographical piece (*Citizen Scientist: The Amulya Reddy Reader*): "I remember worrying about the electronic structure of the transition elements when I was fielding at square leg in an inter-collegiate cricket match. Not surprisingly, I dropped a catch." Amulya believed that his interest in science was strengthened during his late teens through his close friendship with his schoolmate, V Radhakrishnan, and his cousin S Ramaseshan, the son and nephew, respectively, of Nobel Laureate CV Raman.

Hardship to horizon

Amulya completed his schooling at St Joseph's School, and his BSc (Chemistry) and MSc (Physical Chemistry) at Central College, Bengaluru. It was around this time that he and Vimala Pawar, his collegemate and friend, decided to get married. He took up teaching and became a lecturer in chemistry at Central College in 1951. Their first daughter, Srilatha, was born soon after. In 1955, Amulya set off for Imperial College London to pursue a PhD in electron-diffraction studies of the structure and growth of electrodeposits. Vimala and his daughter joined him a few months later. Solely dependent on his meagre scholarship, Vimala took up a job to support their household, but she had to give it up soon after as their second child was born. To sustain his family, Amulya took a high-paying part-time porter's job in the British Railways at London's Waterloo station for two months. During this time of physical labour, he faced everything from humiliation to gratitude from the passengers whose luggage he carried. This experience opened a new perspective for him, one seen through the eyes of a labourer.

Amulya Reddy's early life was influenced by the Gandhian philosophy endorsed by his father

Amulya earned his PhD under the supervision of John Bockris, with whom he later co-authored the landmark two-volume series *Modern Electrochemistry*. He returned from England in early 1958 and secured a job as a Senior Scientific Officer at the Central Electrochemical Research Institute (CECRI) in Karaikudi, where he spent three years working mainly on the structure and growth of electrodeposits. While at CECRI, he received an offer for a postdoctoral position at the University of Pennsylvania in 1961, and he jumped at the opportunity to return to the academic track.

He found deep satisfaction in his research. Here, he worked on ellipsometry, the study of surfaces through analysis of the changes in reflected polarised light. His discovery of a new technique, chrono-ellipsometry, drew significant attention from the scientific community. This gave him much fulfilment and confidence as a scientist. This recognition ushered in many lucrative opportunities to work in the industry. But attractive salaries did not guarantee the freedom to choose what he wanted to work on. And the post-World War II gloom made him sceptical of science's involvement in warfare. During one particularly disheartening occasion, he confessed to his wife that the work felt soul-destroying and that he was increasingly becoming mercenary. His wife, knowing exactly what he needed to hear, said, "Let's go home."

Charting a new chapter

By the time Amulya returned to India in 1966, he had already earned a strong reputation as a research supervisor, thanks to his significant contributions to science, particularly in the field of ellipsometry. His co-authored two-volume textbook on electrochemistry was by now hailed by reviewers as the "bible of electrochemistry."

These accomplishments helped him secure an assistant professorship at IISc. He joined the Department of Inorganic and Physical Chemistry in

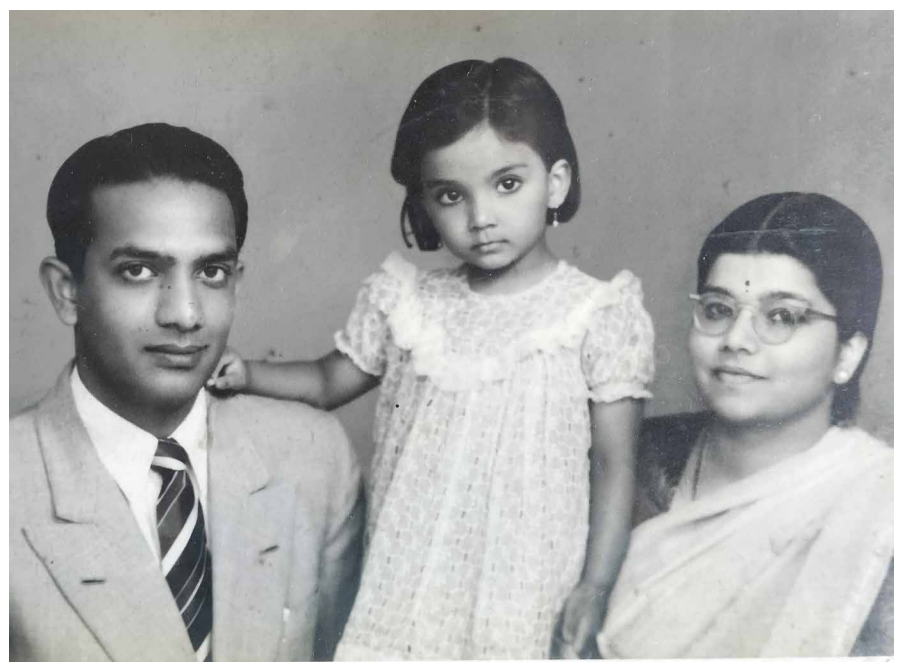


Photo courtesy: Srilatha Batliwala

AKN Reddy with his wife Vimala Reddy and their eldest daughter Srilatha in the 1950s

1967 and began his research with a team of students. In the beginning, progress was slow due to limited funds, and experimental facilities had to be built from scratch. Gradually, things improved, and the work picked up pace. He quickly realised that a majority of the fundamental discoveries in the field of electrochemistry were already made and began to steer his research towards an applied direction.

The shift within

It was during his time at IISc when an event altered his way of thinking. In a lecture, economist CT Kurien, who was then working at the Madras Christian College, argued that poverty had increased with industrialisation. His persuasive argument shattered Amulya's faith in the Nehruvian dictum: "science and technology -> more industrialisation -> less poverty". A period of intense introspection followed.

He took a step towards unpacking this problem and presented a paper titled: "An Asia Science to Combat Asian Poverty", at the One Asia Conference in Delhi, organised by the Press Foundation of Asia. He argued that the industrialisation-poverty nexus arises from the capital-intensive, labour-saving pattern of industrialisation based on imported Western technology and that an attack on poverty (in India) required a different science and technology, an "Asian Science".

The paper attracted favourable attention. Subsequently, he was invited as a discussant for the National Committee of Science and Technology's document on "An Approach to Science and Technology Plan". In the discussion, he insisted that India was a dual society with islands of elite affluence amidst an ocean of poverty, the inequality driven primarily by inadequate income-generating employment in the rural countryside, and that such employment would not come from capital-intensive industrialisation.

As a consequence of this presentation, a large number of faculty members from IISc agreed with his argument and expressed their desire to contribute to alternative science and technology. It was at this point that Amulya resolved to focus on developing technologies for rural India. He quit electrochemistry, walking away from his life's work without a backward glance. He did not want to have a fallback option when things got difficult in his new venture. Such was his conviction and belief in his path.

Amulya resolved to focus on developing technologies for rural India

Reframing scientific focus

In 1974, Amulya Reddy established the Centre for Application of Science and Technology in Rural Areas at IISc. The centre became better known by its acronym ASTRA, which means 'weapon' in Sanskrit. The name was a deliberate effort to underline the focus of the Centre's multidisciplinary efforts, which drew on the expertise from various science and engineering-oriented departments. However, ASTRA was not without their detractors, attracting scorn from several prominent figures within the Indian scientific establishment. Despite these obstacles, ASTRA's work began to receive national and international recognition and appreciation. While awarding the Ravindra Puraskar to Amulya in 1978, Prime Minister Indira Gandhi is said to have exclaimed, "It must have required rare courage!"

Early projects of ASTRA focused on rural India-specific critical areas such as bioenergy, fuel-efficient stoves, low-cost housing, and clean water. The Ungra village in Karnataka became a living laboratory for ASTRA's early innovations, where rural communities benefited from biogas energy solutions derived from agricultural waste and biomass. This programme not only provided energy for domestic use but also supported street lighting, irrigation, and small-scale industries.

"Amulya Reddy did not want technological innovations to be handed down to the villagers as products, but he wanted them to participate in the process," recalls HN Chanakya, who joined ASTRA in the early 1980s and started his work in Ungra. He recollects the challenges and failures in setting up new technologies before they achieved success. Even gaining the trust of the locals took significant time and effort. But once the people understood the value, they wholeheartedly cooperated.

In 1975, Amulya became involved in establishing the Karnataka State Council for Science and Technology (KSCST), working alongside MY Ghorpade, the then Finance Minister of Karnataka, and Satish Dhawan, the then Director of IISc. The primary aim of KSCST was to bring government and scientific institutions together to address the problems of poverty in Karnataka. The idea was that ASTRA would concentrate on the generation of technology and KSCST would focus on the dissemination of the solutions. KSCST, in the later years, became a model for other state councils.

Photo courtesy: Srilatha Batliwala

A light moment at Ungra village. AKN Reddy (left), KS Jagadish (second from left) and other colleagues

In the same year, Amulya took a sabbatical and went to Nairobi, Kenya, to work with the United Nations Environment Programme (UNEP). There, he involved himself in the development of the conceptual framework for environmentally sound and appropriate technologies. It was during this stint that he formed his views on concepts such as development as a process of economic growth that is directed towards equity and the satisfaction of basic needs, starting with the needs of the neediest; empowerment as the strengthening of self-reliance; and environmental soundness as living in harmony with the environment.

He held on to these learnings for almost two and a half decades. However, when the controversy surrounding the Narmada valley projects came out (which centred around the Sardar Sarovar Dam and other large dam projects on the Narmada river, primarily due to the displacement of communities and environmental concerns), he accepted that the benefits of development projects must start with the people at the project sites and radiate outward. Otherwise, the very people at the epicentre of the projects become the victims of development. He also believed that women are crucial agents in development activities. Engenderisation became an important element of his idea on development from thereon.

At the turn of the century, Amulya Reddy was conferred with the prestigious Volvo Environment Prize. The prize recognised his outstanding collaborative work since the early 1980s in developing a new policy-driven approach to analysing global energy needs and identifying ways to meet them in the early decades of this century.

Passion and purpose

"There was little distinction between his professional and personal self," says Srilatha Batliwala, Amulya Reddy's eldest daughter, an accomplished advocate and women's rights scholar. Srilatha remembers him as gutsy, steadfast in his beliefs, and with an unwavering commitment towards equality, be it gender, social or economic. He was also blessed with a sense of humour and could bring levity to serious situations. At home, he nurtured lively discussions on social issues, and their dinner table conversations featured nationalism, advancing social justice, and contribution to nation-building. Srilatha remembers how she once sniggered about a romantic relationship between two girls during her time at school in the late 1960s. Amulya disapproved of her contempt, saying each person has the right to love whomever they want. This continues to serve as a guiding reference in her work as a gender activist.

Srilatha remembers him as gutsy, steadfast in his beliefs, and with an unwavering commitment towards equality

Amulya always cautioned his three daughters that "if you accept discrimination against anyone because of who they are, you have to be ready to accept discrimination against yourself too." He was agnostic, troubled by the divisive role caste and religion played among citizens. Cricket was the only religion that he partook in.

Photo courtesy: Srilatha Batliwala

AKN Reddy with the other Volvo Environment Prize awardees, 2000

Photo courtesy: IISc Archives

A woman in Sirsi village, next to a smokeless three-pan ASTRA OLE stove

A lasting legacy

ASTRA was renamed the Centre for Sustainable Technologies (CST) in 2003 in recognition of its growing focus. Since Amulya's initial efforts, CST has emerged as a leading force in India's sustainability landscape, developing a range of technologies that tackle both local and global challenges. Its research spans critical areas including climate change mitigation, green buildings, solid waste management, and ecotoxicology. As CST marks its 50th anniversary in 2025, it remains dedicated to advancing science and technology to empower communities and meet the evolving environmental and societal challenges of the future. Today, the centre's focus is on water purification, waste-to-energy technologies, and energy-efficient construction, highlighting its integrated and holistic approach to sustainability.

Amulya Reddy passed away on 7 May 2006. Through his steadfast dedication to sustainability, equity, and technological innovation, he redefined a key purpose of scientific inquiry – placing people, especially those who are marginalised, at its core.

"Even till his last days, my father refused a kidney transplant, saying that he would not take a poor man's organ to extend his life," says Srilatha.

(Edited by Sandeep Menon)

In the 'AI' of the Beholder

- Sheetal Potdar

Beauty and bias in perceiving art

Images: Canva, ChatGPT 4.0, DeepAI, Adobe Firefly, FotoAI, Imagen, LucidOrigin, Midjourney 7, Nightcafe, OpenArt, PicLumen, Picsart, Reve., and Van Gogh

Art produced using various generative AI platforms. Prompt: "Night landscape painting in the style of Van Gogh"

"I feel like we are nearing the end of times. We humans are losing faith in ourselves."

Hayao Miyazaki, the Japanese animator and co-founder of the renowned production house Studio Ghibli, uttered these words in 2016 after seeing an AI-generated animation film for the first time. Nine years later, this quote has resurfaced and gone viral.

It started with a single tweet. Someone posted their family photo recreated by OpenAI's ChatGPT in Studio Ghibli's distinct style, calling it an "alpha move." Millions followed, and soon the internet became populated with images of bright, wide-eyed, and innocent-looking people that are so characteristic of Studio Ghibli movies.

The "Ghiblification" trend brought a lot of attention to the rise of AI-generated art, which has existed for over a decade in some primitive form or another. What started in 1973 – with the computer program AARON that could create abstract art – has today devolved into generative adversarial networks, diffusion models, and transformer architectures generating art based on the visual data that they are trained on. In fact, in 2018, a portrait "created" by an algorithm based on 15,000 14th-20th century paintings of people, sold for nearly half a million dollars – the first AI-generated art piece auctioned at such a high sum. Today, several AI platforms, such as OpenAI's DALL-E, Google DeepMind's Imagen, and Midjourney, can churn out art mimicking famous artists in a matter of minutes.

While AI art is becoming more mainstream, a growing section of people shares Miyazaki's antipathy towards it. In an essay in *The New Yorker*, author Ted Chiang argues that art is about making a series of choices which AI can never replicate, while others like award-winning artist and writer Molly Crabapple are calling upon "team human" to "value the work of real people". In online forums, too, debates rage about how AI art appears "soulless", with campaigns such as #SayNoToAIArt.

Debates rage about how AI art appears "soulless", with campaigns such as #SayNoToAIArt

"My problem with AI art is that it automates something that never needed any automation," says Komal Shendge, a Bangalore-based digital artist who goes by Kay. "It is made to replace something that was never a burden on humans."

Anisha Kotibhaskar, a Pune-based artist, for whom art represents a spiritual outlet, says, "When I create a piece, I am telling a story – of my turmoil, emotions, good or bad experiences. Where is the story in pooling a few ideas from here and there and generating 'art' as AI does?"

Whether AI-generated art can ever replicate human-made art is a rising debate, sparking deeper questions about the definition of art and what makes it beautiful.

Drawn to beauty

How do we perceive beauty in art?

For some, it is about vibrant colours or striking compositions; for others, it is the hidden symbolism, emotional undertones, or the story behind the brushstrokes.

"The painting *Landscape with the Fall of Icarus* really speaks to me. I even have it as my wallpaper," shares Niranjan Rajesh, a research assistant at the Vision Lab, Centre for Neuroscience, IISc. The 16th-century piece – based on the famous Greek myth of Icarus, who flew too close to the Sun and fell into the sea – shows Icarus's flailing legs above the waters in a corner of the painting, while the focal point is a village scene with a farmer and a shepherd, seemingly oblivious to Icarus's plight. "What resonated with me is not the colours or the myth, but the message that life goes on for others, even when we are deep in pain, as Icarus was; humans are rarely in the spotlight as we imagine ourselves to be in," says Niranjan.

To understand how our brains perceive art, let us turn to neuroaesthetics, a field of cognitive neuroscience investigating

Photo: Wikimedia Commons

Landscape with the Fall of Icarus *by Pieter Bruegel the Elder (c. 1560), oil on canvas*

the neural basis of aesthetic experiences. “One of the frameworks to understand aesthetic encounters is called the aesthetic triad,” explains Anjan Chatterjee, Professor and Director of the Penn Centre for Neuroaesthetics, University of Pennsylvania. “The first component has to do with the sensory qualities, which help the brain perceive the image.”

Things that are perceived easily by the brain tend to be perceived as aesthetically pleasing

In theory, Niranjan explains, the “best” kind of image would convey the most information with the least cognitive effort. According to a theory called “processing fluency”, things that are perceived easily by the brain tend to be perceived as aesthetically pleasing.

He explains with an example. “When we think of apples, the most standard-looking apple is going to be the best representation of all apples. This property is called prototypicality, and the more prototypical things are, the more easily they are processed by the brain,” he says. Symmetry also enhances fluency. Because a symmetric object contains duplicated elements, according to the processing fluency theory, the brain can process it more easily, making the object look more pleasing.

Yet, the processing fluency theory cannot account for why people like abstract art, which does not have easily perceptible information. Context, meaning, and even the viewer’s expertise and training influence aesthetic valuations. “The second component of the aesthetic triad – meaning and semantics – is where we find that the viewers’ individual differences matter: education, cultural background, the point in history you are living in, and so on,” explains Anjan.

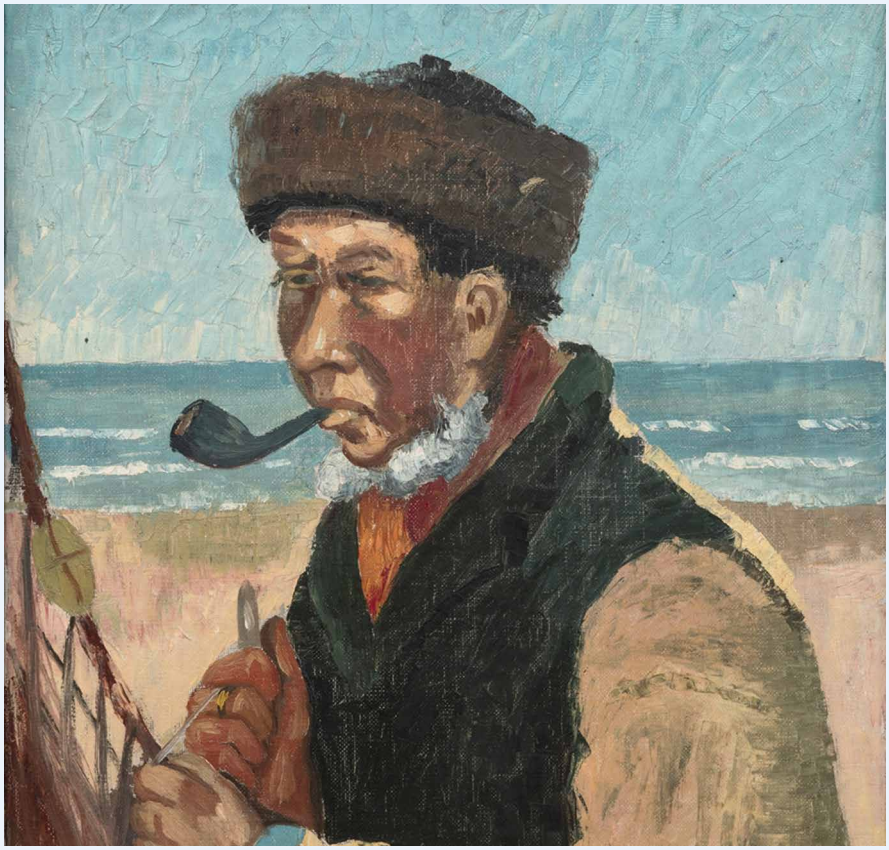


Photo courtesy: Wikimedia Commons

Knowing the artist and story behind an artwork influences how we perceive it. This obscure painting, bought for under $50 at a garage sale, was appreciated more when it was discovered to be a long-lost Van Gogh and became worth $15 million (though it was later disproven)

Even social context can influence the aesthetic evaluation of art. “My current favourite artist is my daughter,” says faculty member SP Arun, who leads the vision lab at the Centre for Neuroscience, IISc. “But of course it’s because I have a personal connection to her,” he reasons, emphasising the role of personal relationships in aesthetic evaluation.

The psychologists who proposed the processing fluency theory conducted an interesting experiment to test the role of context. They showed volunteers artworks accompanied by accurate descriptions, ambiguous descriptions, or no descriptions at all. They collected participants’ ratings of the art and measured their subtle facial muscle activity. They found that the zygomaticus – the “smiling” muscle – was most activated when participants were viewing paintings with accurate descriptions. These paintings also received higher ratings, suggesting that knowing the context of the artwork increases processing fluency and enhances aesthetic experience. Even labelling artworks as having been displayed in museums improves people’s judgments about their beauty.

Photo courtesy: Wikimedia Commons

Visual simplicity and symmetry enhance our brain’s processing fluency and make art appear pleasing. Christ Giving the Keys to Saint Peter *by Pietro Perugino (c. 1481–1482)*

"The third component of the aesthetic triad involves emotions that are evoked by sensory cues," says Anjan. "If we're talking about beauty, it's typically pleasure, though art can have nuanced emotions as well."

Natural rewards that satisfy innate human needs like food, water, or a mate, activate reward circuitries in our brain that make them pleasurable. The same reward circuits are also activated while viewing art, suggesting that the brain's reward system has been co-opted by things like art, which represent social needs.

Emotion reflected in the artwork is "felt" by observers

"When you look at a face which has some emotion on it, you can't help but know what that emotion is. There is a level of automaticity to that," says Arun. This mirroring effect was first observed in the mirror neurons of macaques – scientists found that the same neurons in the primate's premotor cortex fire whether an individual is performing an action or observing another individual performing the same action. Similarly, empathetic responses to artwork have also been reported, where the emotion reflected in the artwork is "felt" by observers through the same underlying emotional circuitry.

Colour also elicits strong emotions. "Colour gives art meaning, links it to our real-world experience, creates depth, and elicits emotion," says Anna Franklin, Professor of Visual Perception and Cognition at the University of Sussex, UK. "According to the ecological valence theory, our colour preferences are determined by what objects we associate with colours and how much we like them." For example, she explains, we generally like blue since it is associated with pleasant things like clear sky and clean water, whereas we generally dislike dark yellow-green since it is associated with unpleasant things like biological waste and mould.

Ultimately, when we look at a piece of art, a lot of processing occurs in our brains. Studies show that regions involved in processing visual features and those encoding contextual information interact within 200-300 milliseconds of viewing an artwork. In cases of dynamic artworks, such as van Gogh's *The Starry Night*, the area of the visual cortex that processes motion also lights up. The "aesthetic triad" – ease of perception through fluent features, context and meaning, and emotions – helps explain that our perception of beauty in art emerges from the neural interplay between all these various processes.

Bias colours opinion

How is beauty – or the lack of it – perceived when we view AI art?

In a 2018 study published in the *Psychology of Aesthetics, Creativity, and the Arts*, researchers asked participants to classify artworks as human-made or computer-generated and then rate their aesthetic value. The participants rated artworks identified as AI-generated as less pleasing, revealing a clear negative bias. The study also showed that this negative rating was not due to specific visual statistical features, but a cognitive bias against the creative capacity of computers.

It turns out that the context – merely knowing that an artwork was AI-generated – played a major role in people disliking it.

Another study published in 2023 in *Computers in Human Behaviour* showed similar results – people found art labelled as AI-made to be less awe-inspiring than human art. The authors attributed the aesthetic judgments to an anthropocentric impulse to defend human uniqueness, particularly in creative domains like art.

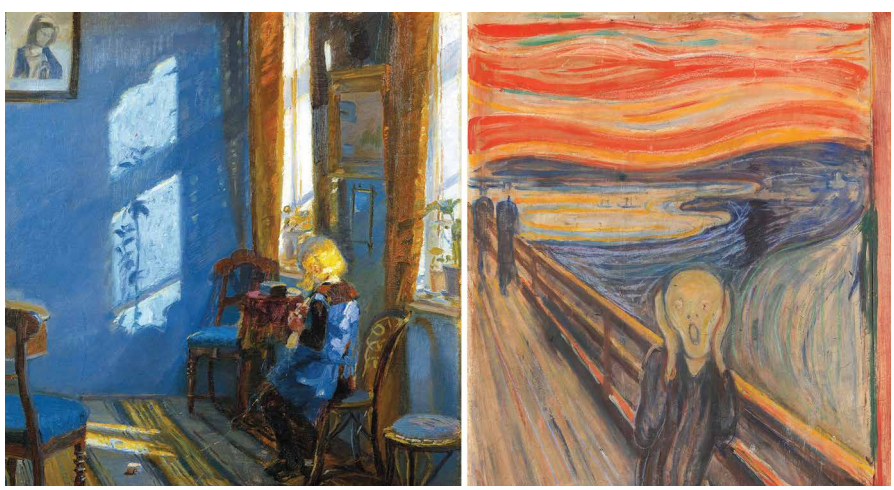
"We value the effort and the agency of the artist. So, when a machine creates the art, there is no "agent" in the same way. That could be a factor as to why AI art is devalued," Anjan explains.

Interestingly, when participants observed machines "creating" the art, this negative bias reduced. Using a public experiment setup by French artist and scientist Patrick Tresset, participants in a 2018 study observed *Five Robots Named Paul* – a group of robotic arms with cameras on sticks, programmed to draw human portraits. These robots mimicked human behaviour, such as occasionally "looking" at the subject by moving the camera back and forth between subject and paper. Though this did not really help the robots draw better – they were programmed to draw from an image of the subject captured earlier – the movement invoked a sense of intentionality in the robots. Participants subsequently rated the robot-generated portraits higher than they rated other computer-generated art.

"We very easily attribute a mind to things that move with an intention," explains Arun. "A great example is the Pixar lamp. It just sits there at first, and then it starts jumping. You can totally feel like it has a mind of its own."

Other studies show that the negative bias is so strong that even when participants couldn't visually distinguish between AI-made and human-made artworks, they still rate explicitly labelled AI art less favourably, especially on traits like artistic skill and monetary worth.

Image courtesy: Wikimedia Commons



(Left) Anna Ancher's Sunlight in the Blue Room *(1891), with its bright blues and hints of warm tones, evokes tranquillity; (right) Edvard Munch's* The Scream *(1893), with its haunting expression and intense colours, evokes anxiety*

Image courtesy: Human perception of art in the age of artificial intelligence/Frontiers in Psychology (2025)

Participants in a study viewed unlabelled pairs of human-made artworks (left) and AI-generated imitations (right); interestingly, most people showed a preference for the AI art

So, what happens when this labelling bias is removed? A recent study used OpenAI's powerful image generative model DALL-E 2 to produce artworks in the manner of 36 famous artists. Participants were shown pairs of images – the original and the DALL-E-generated imitation in the same style – with no labels. Surprisingly, participants preferred the AI-generated art significantly more than chance. This also shows that AI art created by the latest models is not visually distinctive, so much so that the bias against AI art is eliminated in the absence of explicit labels.

Roots of bias

One reason that can explain this negative bias against AI art comes from studies of authenticity. "There are some studies suggesting that even children are oriented towards authenticity," explains Anjan. "If you give children a choice between an original toy and a replica, they prefer the original." The same bias for authentic objects is carried over in adulthood. Volunteers who were shown art labelled as fake or original overwhelmingly judged the originals to be more beautiful and valuable, even though visually, only an expert could tell them apart.

Our aesthetic judgments seem to be not just based on what we see and feel, but also on who we think made it. Whether it's a robot arm mimicking human motion or a diffusion model trained on centuries of human creativity, perceived agency and authenticity deeply influence how we respond to art.

There are social parameters behind this bias, too. Many people feel that AI poses a threat to the livelihoods of artists. "Moreover, these AI companies are ignoring copyright laws," says Kay. "And no one is holding them accountable." Additionally, the datasets used for training these AI models largely include the work of male, Caucasian artists, causing the outputs to reflect the same biases and stereotypes, risking further marginalisation of underrepresented artistic styles.

Whether we like it or not, it seems like AI-generated art is here to stay. A lot of artists have embraced AI as a tool in their creative processes, such as Bangalore-based artist Amith Venkataramiah, whose *Plastic Animals* series, created with Midjourney, envisions marine life coexisting with plastic waste. There are now AI art exhibitions and auctions, and even plans for an exclusive AI art museum in Los Angeles, USA.

Perhaps, with time, *who* or *what* made the art won't matter as much. "Think of all the art in churches across Europe or temples in India during prehistoric times. We admire that art, but we have no idea who created it, and it's not even important," says Anjan. "I wouldn't be surprised if, over time, this bias begins to fade – especially in younger generations – as AI-generated art improves and the boundary between digital and analogue dissolves."

For now, the bias against AI art seems to prevail. When Anisha and Kay were asked whether they would use AI in their art, they said:

"Never!"

"Artists want to think. We want to be sad about things and then fuel that sadness into creativity. AI takes away this creative process, so no."

Sheetal Potdar has a PhD in neuroscience from JNCASR. She is currently the content lead at Diverge Communications and freelances as a science writer.

(Edited by Abinaya Kalyanasundaram, Ranjini Raghunath)

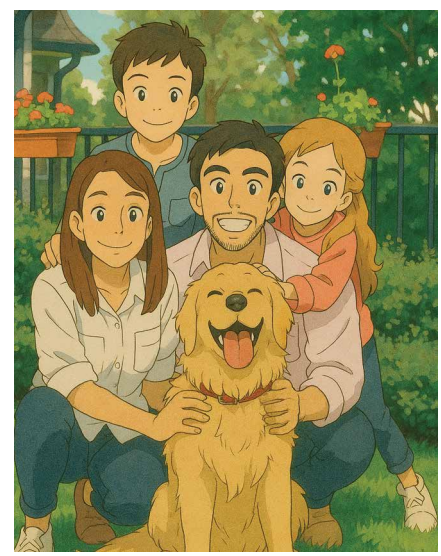


Image: ChatGPT

An image created by ChatGPT, in the aesthetic style of Studio Ghibli. Generative AI models are trained on datasets of artists' work, which can be a violation of copyright

Choosing Academia

- Shrivallabh Deshpande

Image: istockphoto.com

Faculty members in academia want more than what a lucrative corporate package following a conventional career path has to offer. The modest income compared to industry jobs is just a known feature of their decision to join academia and not a problem that they're trying to solve. It's the call to heed something bigger than themselves and the spirit to serve society that brought them to academia. They are also looking to go above and beyond to nurture and mentor the new generation of students, year after year. To celebrate the spirit of such researchers on this Teacher's Day, we spoke with a few of them about what put them on this path. Their stories capture unique choices to join academia for diverse reasons rooted in their passion for imparting knowledge.

Dreaming big

Photo courtesy: Punit Rathore

From an early age, Punit Rathore wanted to become a teacher. When he was in high school, he would take tuitions for younger students in his colony, in Sarangpur, Madhya Pradesh (MP). "I liked teaching and evaluating them," he adds. However, having considered the economic hardships faced by a teacher in India, and to channel his inner drive to reach for bigger and better opportunities, he moved to Kota for additional training for his engineering entrance exam after completing high school. He secured a decent score in the state engineering exam, the MP Pre-Engineering Test. Heeding a senior's advice that the computer science stream was saturated, he picked Electronics and Instrumentation Engineering for his Bachelor's. This idea continued to guide his decision after his Bachelor's, when he chose to pursue a Master's degree in Instrumentation at IIT Kharagpur in 2009. He had looked forward to this day since his early days in high school. "I come from a tier III city," he says. "When I heard about IITJEE, of course I wanted to prepare for it."

After two years at the institute, he was ready for a career in the industry and joined Tata Steel in 2011. This transition allowed him to deploy his expertise to solve real-world problems, and also exposed him to the then upcoming technology of machine learning (ML). "At that time, I was not thinking about a PhD; I knew that I would work for a couple of years and then think about it," says Punit. He worked for three years at Tata Steel, and this time in industry prompted a momentous shift in his future career aspirations. His work on ML and computer vision ignited a deep fascination for research in that field, but he noticed that the industry didn't care so much about the research – they cared more about the finished product. He realised two things. "First, I should go for research, and second, if I have to grow in research, I need a PhD," he says.

In December 2014, Punit went to the University of Melbourne for a PhD, where he worked with leading experts in the field of machine learning. Working in the industry had made him an expert in finding problems and judging their real-world viability, something his peers who came to do a PhD right after graduation lacked. This "nose for problems" meant that he graduated with over 10 first-author publications in seven top-tier journals, the most for any student from his lab. A PhD also gave him confidence in his abilities to find a problem and work towards solving it. Coupled with his love for teaching and the desire to work independently, he decided to enter academia. After a postdoc at the Massachusetts Institute of Technology (MIT), he sent out applications to leading IITs and IISc. On the day of Diwali in 2021, he was selected as a faculty member at IISc, where he is now an assistant professor at the Robert Bosch Centre for CyberPhysical Systems (RBCCPS) jointly with the Centre for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP). "It was my best Diwali ever," recalls Punit.

> ***'India now has lots of opportunities to develop products and implement solutions that can impact society'***

Punit believes that there is no correct answer to how one should pursue their professional interests. "It depends on what you want in your life," he says. While the industry offered the chance to earn more money, he knew that wouldn't satisfy him in the long term. What drives him is serving society, he adds. "India now has lots of opportunities to develop products and implement solutions that can impact society," he adds. His advice for young researchers? "Raise your standard and don't settle."

Following instincts

Photo courtesy: Susmita Dash

It was during her later years as an undergrad student at the National Institute of Technology, Rourkela, that Susmita Dash was first exposed to research via an institute programme, while she was working on a fluid dynamics problem. "It was the first time that I was exposed to conducting experiments, something which I had no idea about," she recalls. Upon graduating, she started working for Schlumberger, an oil and gas company, but quit just a year later because she wanted to study more. She joined Purdue University's Cooling Technology Research Centre for a PhD. While attending a class there, looking at the way one of her professors taught, she recalls thinking, "I want to be like this." Susmita believes that these small things have a big role to play in one's decisions. Another such incident took place after one of her biannual work presentations. Despite her nervousness, her advisor told her that she presented really well and should consider becoming a faculty member. "It was almost like an inception [of an idea]," says Susmita. A PhD also instilled the confidence in her that even if she didn't know something, she could always learn and figure it out. By the time she finished, she had formed the impression that she wanted to become a professor. She pursued a postdoc at MIT, which helped "in further establishing my own research ideas", and then joined IISc as an assistant professor at the Department of Mechanical Engineering.

'You have your entire team of students who are learning and figuring things out along with you'

"Academia is a package," says Susmita. It involves teaching, research, writing grant proposals, mentoring students, and more. "Sometimes it can be overwhelming." However, she admits that the great thing about academia is that you are not alone in the journey. "You have your entire team of students who are learning and figuring things out along with you," she says. Her journey, she believes, is one of constant navigation, with the decisions taken at every step shaping the path. "It's about taking a decision based upon informed instinct at every junction when figuring out the next thing to do," she says.

Doing more

Photo courtesy: Rajiv Soundararajan

Rajiv Soundararajan chose to pursue his Bachelor's in Electrical and Electronics Engineering from the Birla Institute of Technology and Science in 2002. "I wanted to work on ideas that would let me do more on a daily basis," he recalls. He explored the domains of communication and signal processing, and by the end of his undergraduate programme, he was clear that he wanted to pursue research and applied for an integrated PhD right after.

The PhD programme at the University of Texas at Austin gave him multidisciplinary training in theoretical as well as applied aspects of signal processing, which opened the doors to both industrial and academic opportunities. This is when he heard of Qualcomm starting an advanced industry research lab in India, and he joined in 2011. "I wanted to spend some time in the industry to figure out what's happening there and see if I like it," says Rajiv. It was a startup-like environment, with a small group working on an application to detect text from naturally captured images. He soon realised that in the multimedia domain, the line between the work done in industry and academia is very thin. A couple of years into his role, he started to think of switching to academia. "While the work was exciting, it focused on a very narrow region of a product in a particular scenario. But academia offers you a grand open space to explore and have more impact on whatever you try," he shares.

Rajiv joined IISc in October 2015 and is currently an Associate Professor at the Department of Electrical Communication Engineering. He believes that a top academic position is much more demanding than a position in industry. He says, "You have to be motivated by all aspects of the job – research, training students, doing service." He points out that working in academia requires a lot of patience to correct the same mistakes year after year. "But it's really amazing to see the learning curve. I feel rewarded when I get new research ideas just from interacting with my students," he says.

'I feel rewarded when I get new research ideas just from interacting with my students'

Being free

Tarun Rambha was always fascinated by learning new things. During his Bachelor's in Civil Engineering at the Indian Institute of Technology, Madras (IITM), he explored various internships, including working at a transportation firm on the construction side of operations and at Larsen & Toubro on design. He also began working with a professor at IITM on transportation networks, which inspired him to study further instead of going for an industry role. He joined the University of Texas at Austin for his Master's and PhD in Civil Engineering (Transportation). A semester of being a Teaching

Photo courtesy: Tarun Rambha

Assistant during his PhD made him realise that he enjoyed the interaction and feedback sessions with students. He became confident that he could communicate ideas clearly, even when he used to teach his friends back in his undergraduate days. Thus, despite having a fellowship, he continued being a TA for a few more years, more than what was required. The love for teaching and the exploration of his topic of interest turned into a desire to join academia.

'Being in academia gives you a bit of freedom that I always wanted'

Tarun joined IISc as an associate professor at CiSTUP in October 2017. "Being in academia gives you a bit of freedom that I always wanted," says Tarun, who adds that he likes being his own boss. However, academia comes with its own set of challenges. While incremental improvements suffice in an industry job, in academia, you have to really beat the state-of-the-art benchmarks to be successful, he explains. Another challenge plaguing academia is the modest economic outlook that hampers the decision of many considering it. "You always make compromises," Tarun says.

Together with like-minded faculty, Tarun is now working on building a programme, a Master's in Smart Mobility and Logistics – the first of its kind in the country – that can attract and sustain talent. He is driven by this passion to mentor the next generation of thinkers. "When I can explain something well, the look of wonder on the faces of students makes the three weeks that I spent thinking about how to present a topic for an hour and a half lecture worth it," he says.

Nurturing curiosity

Being in medical school pretty much convinced Ramray Bhat that it was not the path for him. "Much of the time is spent in treating patients rather than stopping to think and understand how a disease occurs," says Ramray. While he enjoyed the training in fundamental clinical sciences in his early undergraduate years at the Calcutta Medical College, University of Calcutta, he started making a concerted effort to live a parallel life through his third and fourth years of MBBS. He began working at research labs in Calcutta while still pursuing his medical training. "I could not let the medical curriculum, or its limitations, come in the way of what I wanted to achieve," he shares. These efforts paid off when certain aspects of his parallel life, like journal clubs in research labs, convinced him that this was the world that he wanted to inhabit.

He then chose to pursue a PhD in Developmental Biology with Stuart Newman at New York Medical College."It was a very multidisciplinary field which straddled evolution and development, but also brought in a lot of physics and mathematics to model biology," he recalls. Continuing his multidisciplinary training, he went on to do a postdoc with Mina Bissell at the Lawrence Berkeley National Laboratory. This laid the foundation for starting his own lab, which he did upon joining IISc as an associate professor at the Department of Developmental Biology and Genetics in May 2015.

'This is something I try to pass on to my students by creating the right vibe for doing exciting research'

Ramray says that he doesn't regret this transition on any level. He recalls a story from his PhD when an investigator from a neighbouring lab told him: "If your experiment is not working out, but you wake up the next day in the bone-chilling cold and still feel the urge to go to your lab and try it one more time, then you know you are in the right profession." He jokes that while Bangalore doesn't have the same bone-chilling cold, he still feels that urge to work. "This is something I try to pass on to my students by creating the right vibe for doing exciting research," he says. He feels that curiosity is the necessary, not the sufficient, condition to be in science. "If you're curious, you owe it to your society to also make others curious."

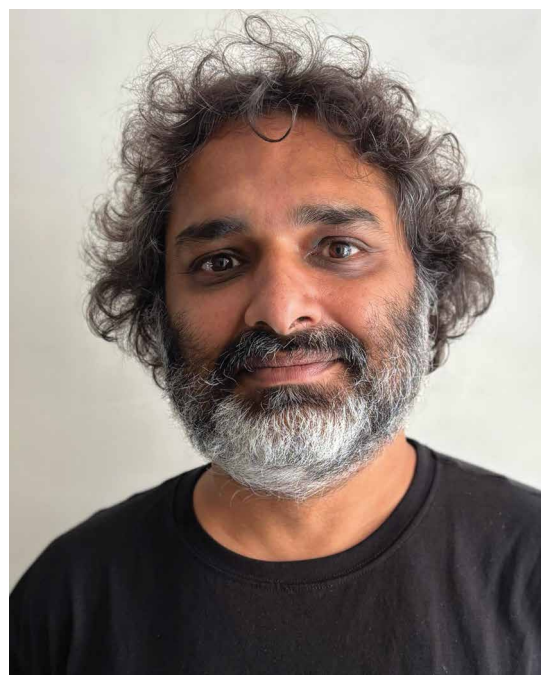


Photo courtesy: Ramray Bhat

Shrivallabh Deshpande is a PhD student in the Centre for Neuroscience, IISc, and a former science writing intern at the Office of Communications

(Edited by Abinaya Kalyanasundaram, Ranjini Raghunath)

Better Brews

- Rohini Subrahmanyam

Photo courtesy: Pexels/Juan Pablo Serrano

Researchers are using science to improve our coffee

How long and how fast coffee beans are roasted determines their acidity levels

It's a crisp, windy morning in Bengaluru. I open my jar of fresh coffee powder and pack some tightly into my coffee filter. I then gently pour some boiling water over the bed of coffee grounds, filling it to the brim. Watching the water burble over the dark brown powder, I take in the rich aroma of the myriad little molecules released by the grounds. I cover it with the lid and wait.

The water starts seeping through the coffee bed – gravity helping it weave its way around each granule, adopting the flavour as it makes its way to the bottom. The water – rather the decoction at this point – softly drips into the bottom container.

For people who make filter coffee at home, there's nothing particularly intriguing about this process; it is, at best, a comforting ritual. However, as it is for most things in the kitchen, there is precise science behind every seemingly mundane step in preparing coffee.

From growing coffee beans to roasting, grinding, and brewing, it is as much a scientific journey as it is a gustatory one

Take, for example, the water seeping through coffee grounds. Scientists have looked at how exactly the size of these grounds influences the strength of the coffee (pro tip: don't grind too fine or too coarse). From growing coffee beans to roasting, grinding, and brewing, it is as much a scientific journey as it is a gustatory one. Researchers around the world are trying to further understand coffee, not just to brew a better cup but to make the ritual of coffee drinking more sustainable.

Coffee and conservation

Arshiya Bose, a scientist-turned-entrepreneur based in Bengaluru, was doing her PhD at the University of Cambridge in 2014. Researching the ecological and social outcomes of sustainability certifications for coffee, she learnt that these processes don't really help ecosystems and farmers' lives. She started Black Baza Coffee, a for-profit company, to work with farmers and ensure that their coffee plantations do not affect the local ecosystems.

Globally, companies have been shifting towards growing coffee under the sun for higher yields in the short term, leading to deforestation. "In the Western Ghats, particularly in some of the largest coffee-growing districts, there's been quite a lot of removal of forest cover," admits Arshiya.

To combat this, she and her team are supporting small-scale farmers who grow coffee under native tree cover and use sustainable methods, like avoiding chemical fertilisers and pesticides.

They also observe large wildlife movement around the farms through camera trapping, conduct surveys of insects and birds, and keep an eye on soil biodiversity.

"We monitor certain indicator species, like bees, beetles, or earthworms, that tell us this kind of farming practice is having a positive impact," says Arshiya.

The Black Baza team is also exploring how the post-harvest process influences coffee flavour.

After pulping the coffee fruit (removing the fleshy part), a sticky, sugary layer called the mucilage remains on the coffee bean. As the bean is dried under the sun, this mucilage gets fermented naturally, leading to unique flavours.

"You can wash the bean, [removing] the mucilage, so essentially reducing the amount of fermentation; that produces a cleaner flavour," Arshiya explains. "Or you can carry out a controlled fermentation, which allows certain bacteria to do really well."

Lactobacillus is one example of bacteria that work on freshly pulped coffee fruits, producing various metabolites and acids that impart novel flavours. Arshiya and her team have co-fermented freshly pulped coffee fruits with sugarcane juice, ginger or kombucha.

They are also working with the farmers to monitor how factors like the pH or temperature of the fermentation change with time. The pH, for example, always goes from alkaline to acidic as the bacteria start metabolising; once it hits an optimum level, the farmers stop the fermentation to prevent the coffee from becoming too sour.

"It's so much fun; it's like being in a chem lab," Arshiya says, with a laugh.

Roasting with rigour

After pulping the fruit and drying the coffee bean, the next step is to roast it.

"The coffee bean has a lot of moisture and a bunch of sugars in it. The first part of the roasting process is pushing the moisture out," says Arshiya.

Photos courtesy: Arshiya Bose

After pulping the washed cherries (left), producers closely monitor pH levels as the beans ferment and their natural sugars break down (right)

Photos courtesy: Dusty Whitaker, University of Oregon

Grind size can affect the strength of the extracted coffee

Roasting coffee is almost like making popcorn. As you start applying heat, the beans expand, building up pressure and volatile gases like carbon dioxide. As the temperature rises, the pressure reaches a tipping point, popping the beans open and letting out the moisture and gases with a sharp "crack", called the first crack. Once the bean has dried out, it starts changing colour with more heat. The beans get browner as the Maillard reaction – a chemical reaction between amino acids and sugars that leads to the formation of melanoidins – swings into motion. Melanoidins give browned food its distinctive flavour.

If the roasting process is stopped soon after the first crack, the result is a light roast with fruity coffee beans. However, with continued browning, a second, softer crack signals the release of more pressure and gases from the beans and oils start to come up. By now, the beans are almost black with more caramelised flavours, known as a dark roast. The medium roast falls between two cracks and has a smooth, sweet taste, less fruity than a light roast and not as rich as a dark roast.

Roasters can vary how fast they change the temperature with time – which is the rate of roasting or the roast profile. Laudia Anokye-Bempah, a graduate student at the University of California Davis Coffee Center, USA, works on the kinetics of coffee roasting and is particularly interested in how changing the roast profile affects coffee beans.

In a 2024 *Scientific Reports* paper, Laudia and her co-authors looked at how titratable acidity (TA) in the beans – a measure of the total amount of acids – changes with the roast profile. They chose to measure TA because it correlates with the sourness of the coffee.

She found that regardless of the bean or roast profile, the TA is highest at first crack. By the time of the second crack, the TA nearly drops to the levels at the start of the roast. "When people buy a light roast, [they are] getting coffee with maximum acidity. So, your coffee will be bright and sour," Laudia explains. "When people buy dark roast, they are buying coffee with minimum TA, [which may taste] dull and not as fresh or sour. "

'Many people have no idea that so much goes into making a cup of coffee'

In another recent *Scientific Reports* study, Laudia and her teammates showed that the colour of coffee beans changes similarly during roasting, irrespective of the bean or roast profile. However, how fast the bean colour and acidity change still depend on how you roast the beans. Which means, even if acidity peaks at first crack and decreases by the second, how quickly it changes between the two points can vary. Depending on when one decides to end the roast, these variations could affect the taste and appearance of the coffee.

"Coffee making is complicated," Laudia says in a UC Davis news article about her work. "Many people have no idea that so much goes into making a cup of coffee."

When size matters

After roasting, the coffee beans have to be ground. How finely or coarsely one should grind the beans depends on the desired filter or brewing method.

For example, for an espresso – where hot water is forced through a bed of packed coffee at high pressure – the finer the grounds, the larger the quantity which can be packed into a smaller volume. The increased surface area to volume ratio allows for more extraction of flavour. However, a few years ago, Christopher Hendon, Associate Professor of Chemistry and Biochemistry at the University of Oregon, USA, discovered that if the grind is too fine, then the coffee extraction yield goes down.

Christopher – a materials chemist who also runs a coffee lab – wanted to understand why espresso shots have variable tastes. Using mathematical modelling and experiments, he looked at what set of conditions gives maximum extraction yield (EY) – the ratio of the mass of extracted liquid coffee to the mass of dry coffee used.

In a 2020 *Matter* paper, he and his team described that there is a critical grind size at which EY is maximum; any finer and the espresso shots become less concentrated and more variable. "At some point, [if] you grind fine enough, the particles seem to clump together and give rise to inhomogeneous flow," he explains.

They found that even if you use less dry coffee mass but grind a bit coarser, water flows homogeneously through the bed, giving more concentrated coffee. When they implemented this technique in a small specialty coffee shop in Oregon, it both reduced the amount of coffee used and the time taken for making the shots.

Diving deeper into *why* grinding finer leads to poorer extraction, Christopher and his team found that grinding really fine forms static, which causes the clumping. "You think you have a high surface area. But effectively, you've got relatively low surface area," he explains.

They also found a quick hack to turn off this static buildup: simply squirting water on coffee before grinding it. But the role of water remains a mystery. One possibility is that being a good dielectric medium, water can store charge and reduce electrostatic forces. But Hendon is more excited about the bigger picture, that water seems to work so well at all.

"It can allow you to access more grind settings for espresso, and so you can start to push up the extraction yield," he says. "I could then do espresso experiments and show that there's actually a meaningful difference in the espresso you prepare."

Perfect pour-overs

The pour-over is another method to brew coffee. The trick is to pour hot water over the coffee grounds inside a conical coffee filter and collect the filtrate below. How you pour influences the taste.

Arnold Mathijssen, Assistant Professor at the Department of Physics and Astronomy, University of Pennsylvania, and his lab were curious if physics can help with the perfect pour-over.

"We have a lab notebook on our coffee table, we write down our experiences every day, and then at some point you start finding patterns," Arnold says. "There is quite a lot of research in the physics of avalanches and also in the physics of liquid jets. However, the two combined have not been studied as much, and that is exactly what a pour-over coffee is."

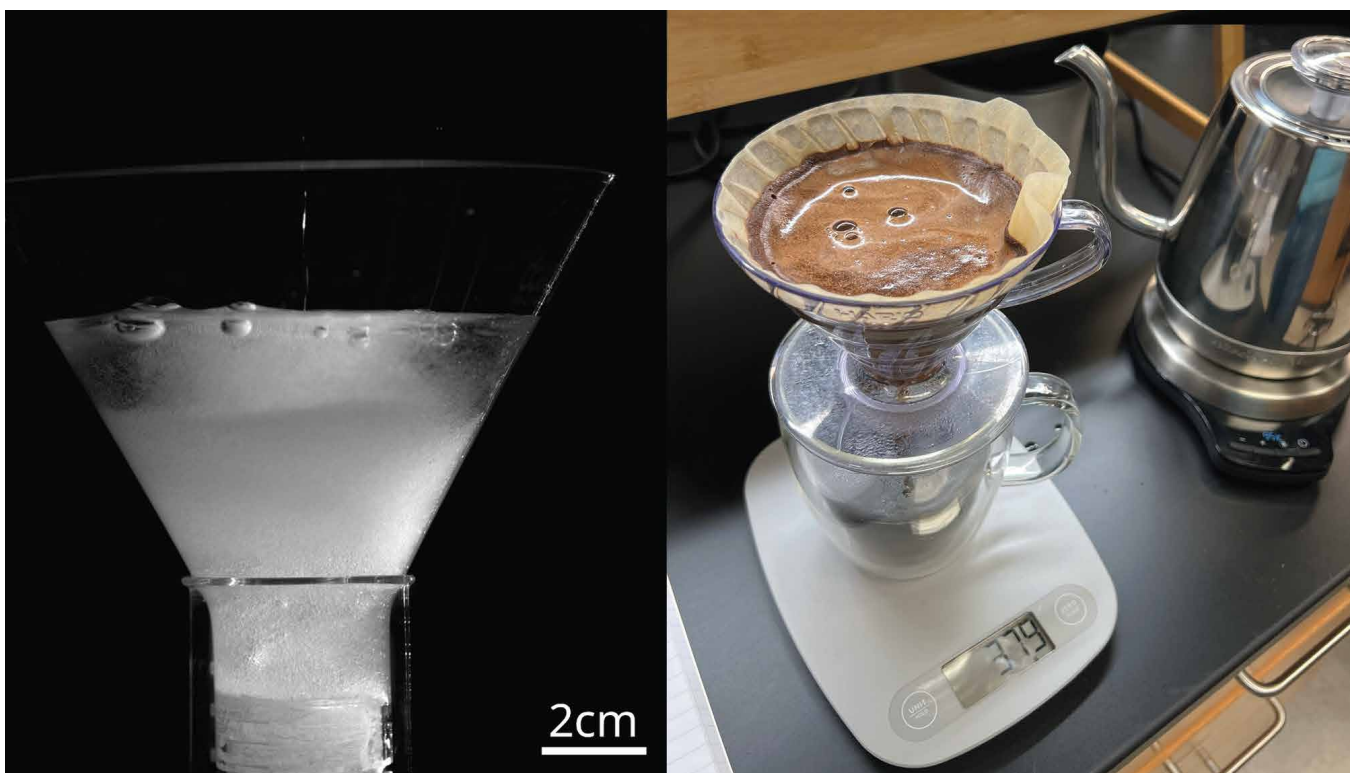
Detailing their findings in a recent *Physics of Fluids* paper, the researchers simulated a pour-over coffee set-up using transparent glass beads inside a conical filter. While pouring water into the bed of beads, they imaged the set-up using a laser sheet and a high-speed camera to track the movements inside the cone.

They used a gooseneck kettle, through which water falls like a gentle jet, and poured from different heights.

When the kettle was 10-30 cm above the cone, the beads seemed to mix better with the water. They found similar results when repeating the experiments with coffee grounds; pouring steadily from this height increased the mixing of the coffee grounds with the water, thus improving extraction by a few percent.

'How do I get more high-quality flavours and use less coffee so that we have a more sustainable future?'

This is a result of the "avalanche" effect, created by the falling water eroding into the centre of the coffee granule bed. "A very slender stream of water can still dig down quite deep, as long as it has enough momentum," Arnold explains. "If you dig all the way down the centre of the cone to the bottom, the coffee grounds on the side start sliding down the cone walls, like an avalanche. They mix



Photos courtesy: Ernest Park (left) and Arnold Mathijssen (right)

Simulating a pour-over coffee set-up with transparent glass beads (left) revealed how pouring water from a certain height leads to an "avalanche" effect

with the water, get resuspended, move upwards, and aggregate again at the top of the cone, on the sides. And then the whole thing starts over again."

Pouring slowly also helps – water gets more time in contact with the coffee grounds. However, a slow stream cannot create a dramatic avalanche effect, thus lifting the kettle a bit higher increases the momentum of the liquid jet. "But don't go too high, or too slow, because then the jet will break up into small droplets, and then the avalanche effect disappears," Arnold adds. "Go slowly but steadily."

While Arnold's work may have focused on pour-over coffee as a physics phenomenon, he, like others, was motivated by the recent rise of coffee prices in the US. Rising temperatures have made it harder to grow the Arabica coffee plant, which prefers a slightly cool climate. Unpredictable weather patterns have also led to prolonged heavy rains and increased periods of drought, which affect the plant's productivity. Places that grow coffee – like South and Central America, Indonesia, and India – are all grappling with climate change, making it one of the most urgent issues facing the coffee industry. Both coffee-suitable land and worldwide yield are expected to decrease by 2050.

Coffee is one of the most consumed beverages in the world, so it is no wonder that researchers are focused on cracking the science behind it. But, as Christopher points out, the goal is not just to brew the best cup but also to be more conservative with the coffee we consume. "How do I get more high-quality flavours and use less coffee so that we have a more sustainable future?" he asks.

"If we can reduce the amount of coffee needed by just a few percent, we could alleviate the demand on coffee beans," Arnold says. "If everybody would do this every day, it could make quite a big difference."

(Edited by Sandeep Menon, Abinaya Kalyanasundaram)

The math of percolation

In the South Indian filter coffee or the Kyoto-style cold brew process, water meanders through a porous bed of coffee grounds and slowly drips down to form the decoction or the brew. This is loosely analogous to what happens in the mathematical theory of percolation.

Imagine an infinitely large 2D grid, with nodes connected by edges. Sometimes, the edges may be open, with some probability p. When open, water can pass through, or else the water is trapped. In the context of coffee grounds, the nodes represent the packed coffee particles, and the edges are the spaces between them.

When the coffee grounds are too fine and are tightly packed, the space between them (edges) will be closed, and the probability of opening edges (p) is small. This will prevent water from passing through the grounds properly, thereby leading to very little decoction. Conversely, if the grounds are very coarse and loosely packed, there will be lots of open spaces as p will be high – water will flow through fast and end up in a dilute decoction.

There is one particular value of p, called the percolation threshold p_c, such that if p is smaller than p_c, then there are no infinite open paths. But if p is greater than this threshold, then there exists a unique infinite connected component consisting only of open edges. "If p is large enough, the water will find a path to infinity," says Arvind Ayyer, Professor in the Department of Mathematics, IISc.

For a 2D grid, mathematicians have proved that p_c equals 1/2, and that there are no infinite open paths at this critical threshold. That is, there is a continuous phase transition – from being trapped to passing through.

One can imagine that above this critical point, the water – instead of being trapped in the bed of coffee grounds – can *just* pass through, thus finding this threshold might lead to the perfect decoction. But in 3D, what happens at p_c is still unknown. "Proving that the phase transition is continuous in 3D is a very big open problem," says Sanchayan Sen, Associate Professor in the Department of Mathematics, IISc.

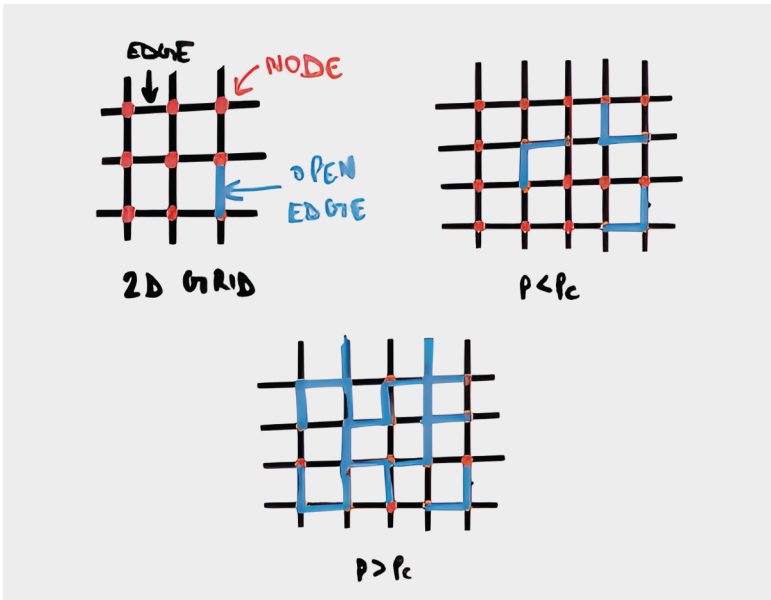


Illustration: Rohini Subrahmanyam

At p above the critical threshold p_c, there exists a unique infinite connected component made up of open edges

‘Call me when Decroos is here’

- Interview by Kavitha Harish

Photo courtesy: Dorothy Susan

Mariadasan Anthony Decroos (known as MA Decroos) dedicated more than 40 years of service to the Institute from 1965. He worked with five Directors, handling sensitive, confidential, and strategic planning assignments that contributed significantly to the Institute’s growth. When CONNECT reached out for an interview, the 85-year-old promptly agreed to reflect on his life and career – something he had recently considered documenting and publishing himself.

Tell us about your childhood.

I was born on 3 September, 1940, in Bengaluru. My father, George Mariadasan, an ex-serviceman, began his career as a trainee musician in the Royal Army Band, serving with dedication until 1947. He later joined the Ceylon Army Band, where he worked for 10 years before ultimately returning to his homeland, India. My mother, Susaimary, was a devoted homemaker, with a beautiful singing voice and a natural mastery of cooking.

I studied Science and Accounts at St John's College, Colombo. I also completed stenography training in English in Colombo. When applying for a position at IISc, I underwent an additional shorthand skill test at the Institute.

How did you come to know about IISc, and when did you join?

In December 1964, after working as a stenographer at an insurance company in Colombo, I returned to Bengaluru. My uncle informed me that IISc was hiring clerical staff. I cleared the required tests and was appointed to the Students' Section as a Lower Division Clerk (LDC) under the late R Vaidyanathan. With his guidance and training, I gained expertise in managing Senate affairs, scholarships, tuition fees, and oral examinations. I frequently took dictation and honed my skills in a wide range of clerical responsibilities, laying the foundation for my long and fulfilling career at the Institute.

When did you move to a stenographer role?

I was promoted to Stenographer in 1968. This was a significant turning point in my career, as it expanded my responsibilities beyond routine clerical tasks to include administrative functions like organising visits by international guests and dignitaries, including APJ Abdul Kalam, Rajiv Gandhi, and Kiran Mazumdar-Shaw. I had to pay great attention to detail while representing the Institute's hospitality and professionalism.

I was also entrusted with coordinating lectures and managing symposia, which involved preparing schedules, corresponding with speakers and delegates, arranging venues, and ensuring that events proceeded smoothly.

This phase sharpened my administrative skills and also gave me the privilege of interacting with eminent personalities from around the world.

You were then promoted to various other roles at the Institute. How did that happen?

I worked my way up from a clerical position to stenographer, supervisor, superintendent, personal assistant, and finally personal secretary. Although these were different streams, I was frequently reassigned and adapted as needed.

One of my most sensitive responsibilities was the secure handling and confidentiality of sealed question papers

I consider myself a workaholic, ensuring that work is done to the highest standard – earning the appreciation of every officer I served.

In 1974, I was promoted to Office Supervisor and was entrusted with responsibilities in the Admissions Section. This was a period of transition for the Institute, as a new entrance examination system had just been introduced, significantly expanding the scope and urgency of the work.

My role involved overseeing a newly recruited clerical team, ensuring tasks were executed efficiently and in strict adherence to timelines. One of my most sensitive responsibilities was the secure handling and confidentiality of sealed question papers, which demanded the highest level of integrity and precision.

My work often extended well beyond regular office hours, and I used to stay late into the evenings and work on weekends. This instilled in me an even deeper sense of responsibility toward the Institute's academic mission.

Eventually, you moved to the Director's office. How was your experience working with five Directors?

In 1976, I was posted to the Director's Office, working directly under Satish Dhawan, one of India's most respected scientific leaders. This role demanded exceptional diligence, attention to detail, and a high degree of confidentiality.

It was during this period that I first met APJ Abdul Kalam, then serving as a Scientific Officer at DRDO. I remember

Photo courtesy: Dorothy Susan

MA Decroos receiving the Champion trophy from Indumati Rao, spouse of former IISc director CNR Rao, for winning the open snooker tournament in the Faculty Club in 1991

personally arranging refreshments during his visits – a small gesture that became a lasting memory. When Kalam returned to IISc in 2002 to meet Goverdhan Mehta, he immediately recognised me and greeted me warmly, a moment I deeply cherish to this day.

From 1979 to 1982, I served in the Director's Secretariat, providing secretarial assistance to S Ramaseshan, the then Joint Director of the Institute. During this period, I also interacted closely with S Ramakrishna (Aerospace Engineering), Chairman of Emerging Areas and a member of the Director's Advisory Committee, who was also the son of S Bhagavantam, former Scientific Adviser to the Ministry of Defence and a former Director of IISc.

From 1981 to 1984, I served as S Ramaseshan's personal assistant. I consider my association with him one of the defining experiences of my professional life. During this period, I helped organise several high-profile meetings attended by eminent personalities, including Nobel Laureates Linus Pauling and Dorothy Hodgkin. My responsibilities included managing significant correspondence, preparing documents, and coordinating critical planning discussions. These efforts contributed to proposals for the Sixth Five-Year Plan, initiatives in emerging and thrust areas, and the landmark project introducing India's first supercomputer.

From 1984 to 1994, I worked closely with CNR Rao during his tenure as Director, providing comprehensive administrative support, which included handling both personal and professional documentation and assisting with his academic publications. I also collaborated extensively with MN Srinivasan, initially Chief of Administration and later Chief of Planning. Together, we implemented numerous innovations, a few notable ones like the computerisation of administrative processes, infrastructure development, including the JN Tata Auditorium, modernisation of telephone systems, and alumni fundraising campaigns, which successfully raised over Rs 1 crore from more than 2,500 alumni.

From 1992 to 1998, I continued my role with G Padmanaban, who became Director. I managed his appointments, travel schedules, meetings, and other crucial administrative tasks until his retirement in July 1998.

If I was not in the office, the Director [Goverdhan Mehta] would refuse to enter

In 1998, Goverdhan Mehta assumed the Directorship, and I was appointed as his Secretarial Assistant and later as his private secretary. My tenure was extended beyond the usual service period, allowing me to continue supporting him until his retirement on 31 July 2005. Being new to the Institute, he relied heavily on my support for administrative matters, trusting me implicitly. If I was not in the office, the Director would refuse to enter, saying, "Call me when Decroos is here."

I finally retired fully in 2010, concluding a career of deep engagement with some of India's most distinguished scientific leaders.

Which memories and experiences do you cherish the most from your time at IISc?

I received a lot of support from both the faculty and the administration. I am deeply grateful to the many former Registrars with whom I had the privilege to work closely, including SS Prabhu, T Nanjunda Rao, HV Venkataramaiah, PS Venkateswaran, BR Srinivasa Murthy, RG Nadadur, BV Ramakrishna, Udaya Balakrishnan, R Mohandas, and BK Subburaman.

The work itself was fulfilling, but campus life offered even more joy and enrichment. I actively participated in the Faculty Club and was honoured to win three state-level snooker tournaments, adding a sporting highlight to my professional life.

Living on campus was a truly rewarding experience, as it nurtured close friendships with neighbours who gradually became like an extended family. Even now, residing in JRD Tata Nagar, I frequently visit the Institute, carrying with me the fondest memories of an extraordinary journey.

Photo courtesy: Dorothy Susan

MA Decroos with former IISc director Goverdhan Mehta

Photo courtesy: Dorothy Susan

MA Decroos with his family

Serving under five distinguished Directors was both an honour and a privilege. I retired proud of my small but significant role in IISc's legacy.

Can you tell us about your family?

I married Emelia Josephine on 19 February 1977, in Bengaluru. My wife, Josephine, has dedicated 37 years of her career to the Accounts Section at the Bangalore Baptist Hospital. Her compassion and commitment have been a pillar of support in our lives. Our daughter holds a Master's degree in microbiology and an MPhil in Biotechnology. She completed her MSc project at IISc under the guidance of former Director G Padmanaban. Passionate about teaching, she later earned an MA in Education and is now a Grade 9-12 teacher at a reputed school in Bengaluru. Our son, Samson Vidyanand, earned his Bachelor's degree in engineering in Bengaluru and a Master's degree in mechanical engineering from the USA. During his undergraduate years, he completed a project under Udipi Srinivasan and worked briefly as a Project Assistant under the late SK Biswas at IISc before moving to the US. Today, he serves as an IT Director in Columbus, Ohio, USA.

How do you spend your time in retirement?

After retirement, my association with IISc evolved into a new phase of meaningful service. From 2010 to 2016, I served as the General Secretary of the Pensioners' Association. I regularly visited the Pensioners' Office and the Faculty Club, where I indulged in my lifelong passion for snooker and billiards. These visits kept me closely connected to the vibrant campus life I had cherished for decades.

Even today, I look forward to my visits to the Canara Bank at IISc and the Health Centre, which give me a continued sense of belonging

Transitioning from a 45-year professional routine to retired life was a gradual process. The absence of daily work rhythms and familiar schedules took some adjusting to, but I soon found joy in the simple yet profound pleasures of family life. I spent quality time with my wife, children, and grandchildren, sharing laughter, conversations, and treasured family moments. Learning from my grandchildren's curiosity became one of my greatest joys.

Reading has always been a personal passion, particularly about current affairs, and retirement has allowed me to devote more time to it. One daily ritual I deeply enjoy is solving the cryptic crossword puzzle in the *Deccan Herald*, which keeps my mind sharp and engaged. I have also made an effort to keep up with emerging technologies and occasionally explore social media, thanks to the patient guidance of my tech-savvy grandchildren.

Even today, I look forward to my visits to the Canara Bank at IISc and the Health Centre, which give me a continued sense of belonging. A cup of coffee and a light snack at Nesara has become a comforting ritual. I particularly look forward to the annual Faculty Club lunch, where I can reconnect with old friends and relive memories.

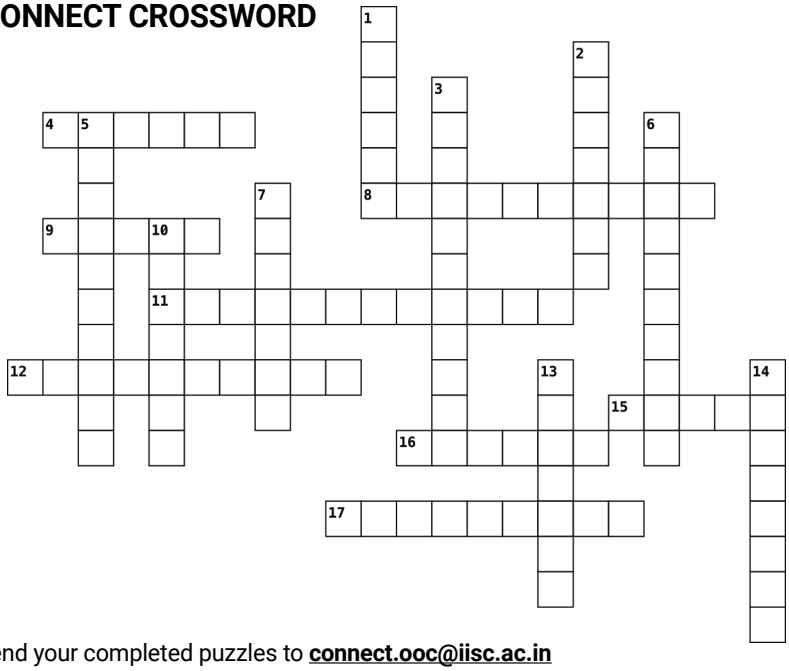
By the grace of God, my wife and I have also been blessed with opportunities to travel widely. Together, visiting our son's family in the USA, exploring South and Western Asia, and especially Europe. Each trip adds its own charm and learning to our lives.

(With special thanks to Dorothy Susan for facilitating the interview)

(Edited by Kavi Bharathi)

Fun Corner

CONNECT CROSSWORD



ACROSS

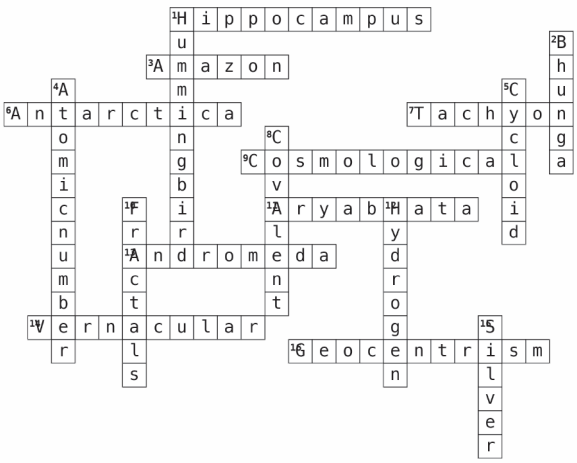
4. Mammal species which forms groups with related species in the Nilgiris
8. Microscopic 'water bear' that can survive extreme environments, even space
9. Capital of the Vijayanagara Empire
11. Where the ozone lies
12. Proposed the uncertainty principle
15. Mosquito genus that transmits the dengue virus
16. First Indian woman to win an Olympic medal
17. Powerful fictional metal from the Black Panther movie

DOWN

1. Hard natural stone used in Moai statues of Easter Island
2. Highest cotton-producing state of India
3. Key symptom of rabies in man
5. Continent with no native reptiles
6. Generative AI platform for art
7. First human-made object to leave the solar system
10. Developed the first rabies vaccine
13. Popular variety of coffee known for its sweet, chocolaty taste
14. Smokeless burner stove invented by Amulya KN Reddy

Send your completed puzzles to **connect.ooc@iisc.ac.in**
The winner will be announced in the next issue!

Last Issue's Answers



LAST ISSUE'S WINNER!

Arindam Khan,
Associate Professor,
Computer Science and Automation

CAMPUS CARTOONS

Life of a PhD student

By Kirtana Vasu,
Integrated PhD student, Department of Biochemistry