CONNECT

WITH THE INDIAN INSTITUTE OF SCIENCE

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HISTORY OF THE MESSES
Alumni recall the good times

A PIONEER IN TB RESEARCH
Chronicling the work of T Ramakrishnan

FIGHTING PARKINSON'S
Why regular exercise is good

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EDITORIAL

"There was a separate Iyer mess and a separate Iyengar mess, and never the twain would meet." That quote by Violet Bajaj, a 101-year alumnus who studied at IISc until the mid-1940s, stayed with us when we interviewed her earlier this year, and we decided to look deeper into our archives for more information about eating habits on campus since its inception.

In this issue of *Connect*, we bring you a brief history of the messes on campus, fleshed out by the recollections of former students and faculty; a student's letter from 1943 vehemently opposing the creation of a common mess; an account of the special Common Dining Hall that was completed in 1944; and an interview with VC Amanan, who worked at the messes for 37 years.

We also examine the role of artificial intelligence in research today and profile the work of T Ramakrishnan, who was in the forefront of tuberculosis research in India before dying of Parkinson's disease. In another story, Michael Zigmond, an IISc-DST Chair Professor, tells us more about this neurodegenerative disease and how exercise can help combat it. And we speak to Indian mathematician Arni SR Srinivasa Rao, whose mathematical model proved crucial in the battle against AIDS in India.

Don't miss recollections by metallurgist and IISc alumnus YC Subrahmanya, British-born mathematician Eric Lord, former librarian Uma Jagannath, and former resident Lily Harish-Chandra about their days in IISc.

And finally, we have a couple of amusing documents from the archives: a circular from the 1960s offering a reward to those who captured monkeys, and a 1930s letter to the Institute from the erstwhile Government of Madras asking about a faculty member's role in a ganja investigation.

Published by the Archives and Publications Cell (APC) at the Indian Institute of Science (IISc), *Connect* is a quarterly magazine that seeks to bring together the IISc community and engage with the outside world – through stories about life in the Institute, its research, and rich heritage.

Team Connect

Deepika S | Karthik Ramaswamy | Kaushal Verma | Manu Rajan
Megha Prakash | Nithyanand Rao | Rohini Krishnamurthy

Contact

connect.apc@iisc.ac.in

91-080-2293 2066

Archives and Publications Cell,
Indian Institute of Science,
Bangalore 560 012

http://connect.iisc.ac.in

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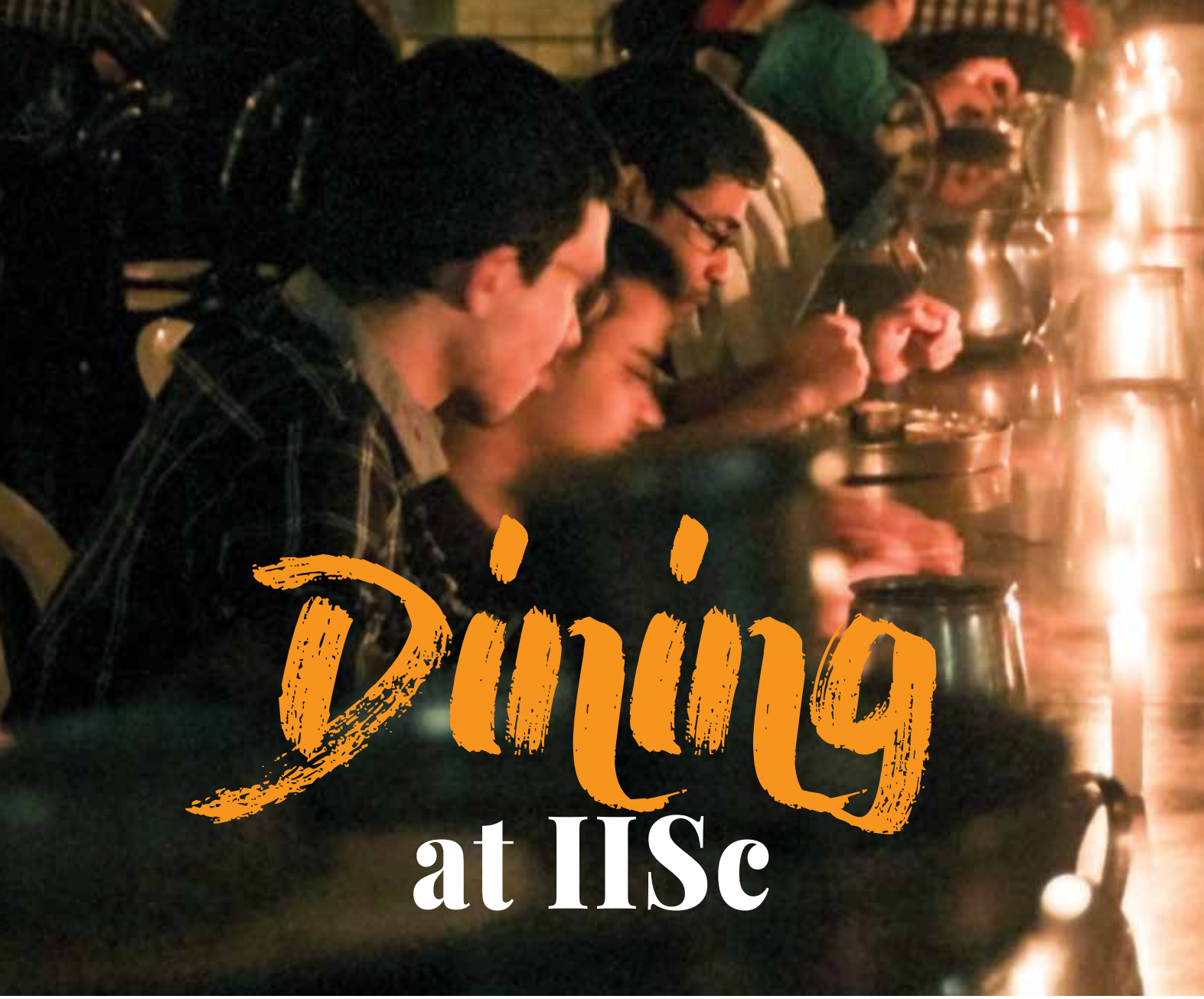


Dining at IISc

- Deepika S

A short history of the messes

In 1954, Morris Travers, who had been IISc's first Director, wrote to AG Pai, the then-Registrar. In a letter looking back on his time at IISc, Travers (who had worked at the Institute from 1906 to 1914, and had been involved in setting it up) said:

"When I first went to India one of the first things I did was to look into the question of housing and feeding students drawn from all over India. I came to the conclusion that I should have to have several messes. Then I was right, for when we opened I found that we had to have five. Then a Muslim student turned up, and as no mess would take him in, I had to make a oneman mess for him. I still wonder how fish-eating Bengalis get on with meat-eating Punjabis."

If it should sound strange that five messes were necessary, here's something that will make it sound stranger: classes began in 1911, and that academic year saw only about 20-odd students at IISc. A 1911 leaflet printed just before IISc opened to students said of the hostel, "There are seventy-two single rooms, and eight mess rooms, each with its own store and kitchen, so that members of different races and castes can form separate groups, each observing its own customs." Later documents say provisions were originally made for 10 messes.

Students eating a candlelight dinner at the mess during Diwali
(Photo: Chirantan Pramanik)

When IISc first opened to students, the world was a rather different place. India was still governed by the British and by regional kingdoms, and journeying abroad involved arduous journeys by sea. Bangalore had only recently become one of the first cities in Asia to get electric streetlights. Travel was limited, and so was people's exposure to other Indians. The influence of caste and community on one's identity was strong. With food being a large part of cultural practices – including the dictates of caste 'purity' and 'pollution' – this influence was strong enough that caste and community were taken into account in the very structuring of the hostel and its messes.

In the early years, every student at IISc who lived in the hostel had his own room and ate in the mess of his choice

> *The men's hostel was originally built to accommodate 72 students, with 10 different messes for people of various communities*

(the students' hostel only accommodated men). But in the 1940s, a combination of factors meant that things would soon have to change. India's freedom struggle was building, and more women were knocking on the doors of IISc (in 1942, a small hostel was built for them that would quickly prove insufficient). A period of expansion

had begun at the Institute, kick-started by World War II, with new engineering departments like Aeronautical Engineering being set up. That meant an inflow of more students, and there was talk of having to "double seat" all the rooms in the men's hostel. Nine messes were in operation in the early 1940s, but they occupied too much space – space that could be used to accommodate even more students at the hostel.

With over 200 students on campus in total, new and unpopular rules for the hostel and messes were formulated and circulated in 1942, including this one that seems strange for several reasons today, in the 21st century: "All mess and other servants of the Hostel shall be under the control of the Warden. No private servant shall be entertained by a student without the permission of the Warden." It was also decided that a new "Common Dining Hall" would be built and the nine existing individual messes shut down. Once the plan became known, it set off a widespread student protest in 1943.

> *In a 1943 letter to the Director, a student who claimed to be on indefinite hunger strike complained about the "curtailment of liberties" in having a common mess*

According to Violet Bajaj, a 101-year-old alumnus who studied at IISc in the 1940s, the Institute was a "caste-ridden" place at the time, and that even Iyers and Iyengars, two Tamil Brahmin communities, would not eat with each other (there were no such divisions among the women students, she points out – they ate together in their own hostel). The idea of a common mess – which was promoted as way of bringing unity among students – seemed the last straw, setting off tensions that already appeared to have been brewing between students and the management over the new hostel rules.

In a 1943 letter to Director JC Ghosh (reproduced in this issue of *Connect*), a student who claimed to be on indefinite hunger strike named M Jagannadha Rao complained about the "curtailment of liberties". "I know that all other students have also unanimously opposed the idea and did all that is constitutionally possible – by way of individual letters, combined representations and collective demonstrations – to prevent a Common Mess coming into existence," he wrote, asking for "democratic principles rather than using these imperialistic methods against which a greater war is taking place."

Rao's letter makes it sound like the conflict was less a case of liberal versus conservative ideas than the management's financial considerations versus students who demanded a say in decisions affecting them. Minutes of Council meetings from 1942 do show that GT Kale, who served as Librarian, Lecturer in French, and also took on Warden and Registrar duties at various points during his time at IISc, was involved in preparing a note on the "probable saving" in having only two messes – a vegetarian and non-vegetarian one. But it was the Director's personal beliefs that appear to have been the original driving force for the Common Dining Hall. In an interview with the Archives and Publications Cell in 2008, Ghosh's children mentioned that he disliked the practice of having people from different provinces eat at separate messes, and felt that "for the integration of the country", eating together was important. In an introduction to a collection of Ghosh's papers published by the Asiatic Society, Sushil Kumar Mukherjee writes that at IISc, Ghosh "did not like caste and creed way of students' hostel [sic]" and was insistent that the students eat side by side. Mukherjee mentions that when Ghosh became Founder-Director of IIT Kharagpur in 1950, he persuaded students to eat together there as well.

But back in 1943, the protests appear to have gotten out of hand, prompting a statement to IISc's Council by Sir Sorab Saklatwala on behalf of the representatives of the Tata family, in which they indicated they were unhappy with how the issue was being managed and felt strongly that there was no "proper disciplined atmosphere". Included in their statement was a threat: "[A]ttempts are made from time to time by some members of the staff as well as the students to obstruct well-considered policy of the Council. If such an atmosphere is allowed to continue it will be very difficult for the Tatas to continue their policy of helping the Institute by means of ad hoc grants for research and expansion projects, and for the institution and maintenance of scholarships."

The Council went ahead with the plan of the Common Dining Hall, which came up in 1944. The kitchens for vegetarian and non-vegetarian food were built on opposite sides of the building. But the tradition of students being in charge of deciding the menu and its rotation at the mess continued – as it does even today.

A thali at the mess *(Photo: Ipsita Herlekar)*

With every significant expansion at IISc, the mess system has expanded too. In 1949, the mess split into A, which served South Indian vegetarian food, and B, which served vegetarian and non-vegetarian North Indian food. Around the late 1940s or early 1950s, women began to eat at the messes too. In the 1970s, a C mess was added as well – a "universal mess". All of these have gone through various iterations and shifted location a few times – some even appear to have loosely acquired their own regional identities. The latest addition to IISc's messes is the D mess, set up in 2012.

For many IISc alumni through the years, the messes have held a powerful place in their memory. In their accounts of life at IISc in *Down the Memory Lane* and *Reminiscences* (two collections of memories put together for IISc's centenary celebrations by the Archives and Publications Cell and the Office of Development and Alumni Affairs), former students and faculty spoke fondly of their messes, as did members of the alumni association who recently wrote to Connect when asked about the messes.

Many recall the quality of food, and specific dishes such as the "Emergency Curry" – made of tomato, onion and potato as a quick fix if students arrived after food had run out – and the unlimited quantities available. BC Pradhan, who was a BE student in Metallurgy from 1958-60, writes in high praise of the mess, saying, "[W]hen I was a student, food in the mess was excellent and is the best I have tasted at any time in my life, including that in the 5-star hotels and many countries I have visited in the last 50 years." Several alumni mention the dosas served on Sundays at the A mess, which once drew visitors from the city to campus. Renuka Ravindran, who completed a PhD in Mathematics in 1968 and went on to be Professor at the department as well as a Dean at IISc, speaks of the Wednesday night special at the B non-veg mess: "Wednesday nights were special with dosa and half a grilled chicken – with the champion consuming up to 20 dosas.[...] There were special dinner days – where we ate a fare, which was truly royal, under the full moon outside."

Alumni also spoke of the role the messes played in their social lives. Some write about themselves or fellow students being gauche when it came to table manners, and learning to use forks and knives for the first time. Being in close contact with others at the mess also meant witnessing some peculiar food habits. N Siva Kumar, a BE student from 1983 to 1986 who was Mess President for two years, writes, "The batch was made up of students from a cross-section of India and it indeed looked like a mini-India with a southern bias. We enjoyed the mess and remember us calling the 'A' mess as 'Madras Café' and 'Aiyar Mess' as they served only vegetarian [food] and I remember 'A' mess using separate plates for serving omelettes as the vegetarians refused to eat from the same plate!" VC Amanan, who supervised messes at IISc from 1980 to 2017, laughs as he recalls seeing students stirring jam into their coffee before drinking it up.

Others mention that at IISc's messes, they were learning to mix with people of different genders for the very first time in a casual environment. N Appaji Rao, Emeritus Professor at the Department of Biochemistry, recalls his time as a student between 1956 and 1960. He writes, "The mess served good food and was lorded over by a strict supervisor who kept watch on your attendance (much stricter than the departments) and chased away any student who dared to sit at the central table. It was reserved for the ladies! It was all right to meet them in the sylvan surroundings of the campus but not share a lunch in the mess!"

One common feeling expressed by several alumni was the genuine warmth they shared with mess staff – many used the word "family" to describe the relationship between students and mess staff. PR Mohapatra, a student and

Devaraj and Hanumantha, contract workers at the B mess, preparing navrathan korma for dinner *(Photo: IISc Photography Club)*

later faculty member at the Department of Aeronautical Engineering from the 1960s onwards, says, "The servers were seen more like brothers by the student community rather than as employees." Over 60 years since they graduated, some still remember the names of bearers, cooks and supervisors at the messes.

Although agitations over the mess never quite reached the same heights that they did in 1943, things haven't always been smooth sailing. There were student agitations in 1956, according to an alumnus who joined IISc that year, when the mess rate rose beyond Re 1 a day. A series of letters in the Archives shows that the Student Mess Committee locked horns with the management in 1956 because there was insufficient crockery for the mess to run smoothly. The messes used porcelain cups and plates made of porcelain – a cheaper option at the time than stainless steel – which were not replaced as often as they were broken.

"One incident that my friends and I will never forget," writes Gopi Chandran, who was a student at the Department of Inorganic and Physical Chemistry from 1984 to 1991, "is the time when mess staff went on strike for a few days due to tighter controls from students in the mess community. During this time with no food in the mess the institute tried outside vendor support. This did not work that well. We as students decided to cook for 400-plus students. There was a big team put in place and I was one of the cooks. This was the best time I have seen in my life. Enemies turning friends, everybody chipping in with whatever skills they had in cooking. We were able to deliver food a few notches above the normally good quality from the staff. We celebrated after the strike was called off and could see the staff feeling bad about what they did and they quickly made up for their only mistake. Family became one again in no time." G Padmanaban, a former student (with fond memories of the "Emergency Curry") at the Department of Biochemistry who went on to be professor and later Director of IISc, writes, "I was appointed as Deputy Director [in] 1993.[...] There were always ticklish issues with sections of employees and between students and mess employees. We were even gheraoed once for not taking immediate action on a complaint!"

From the mid-1980s onwards, as the number of students grew and the business of managing the messes was handed over to contractors rather than permanent employees, that feeling of being around family appears to have slowly eroded. Today, not all recent graduates remember the messes fondly. "One place that signifies an excess of security and discipline is our hostel mess. Students are required to adhere to timings, always carry ID cards to have meals or be at the mercy of the mess card checker," writes Arjun Gopal, who completed an ME from the department of Chemical Engineering in 2017.

It isn't only students who have been fed on campus – employees once had a mess of their own, and today, faculty are still served food at the Faculty Club. Currently, Prakruthi, Nisarga, Nesara, and most recently, Tattvah (opened in 2018) are among the restaurants and cafeterias that offer everyone on campus – whether students, staff or faculty – a range of options to choose from as part of a long tradition that also includes tea, coffee and juice joints. Students from as far back as the 1970s recall being able to get food on campus late at night after leaving their laboratories. Eateries existed at the time too: the predecessors of Nesara and the like. Prahlad Harsha, from the Civil Engineering class of 1977, says that when he and his friends ran out of money at the end of the month, they would hang out at the cafeteria on campus. He says, "Our order to the waiter would be, 'pani, bina ungli'"!

Students went on hunger strike in protest against the proposed Common Dining Hall, which was eventually completed the following year. Today, this building is used as the Hostel Office *(Photo: Karthik Ramaswamy)*

A student's letter of protest

M Jagannadha Rao's 1943 missive against having a Common Dining Hall

In 1943, construction began on a new dining hall-cum-auditorium designed by Otto Koenigsberger, meant to serve as a common dining hall for all students. It was meant to replace the nine messes on campus in which students ate with their respective communities or according to the dictates of their caste and religion, but not everyone welcomed the idea. Here is a letter written on 12 March 1943 by M Jagannadha Rao, a student who went on hunger strike in protest against the management's decision to have a common dining hall. Addressed to the Director at the time, JC Ghosh, the letter is long, impassioned, and – with the benefit of hindsight – on the wrong side of history.

Dear Sir,

I write this letter after a day's fast. I feel weak enough to pen this letter physically but I find myself strong enough morally to undertake this ordeal. I cannot convince my own conscience that I am undertaking this fast on such an apparently simple issue of a Common Dinwing Hall. It is not a question of prestige. It is a question of reason to me. The Common Dining Hall issue seems to me the final culmination point of a series of injustices done to students against their wishes in the matter of curtailment of their liberties.

Before I came to the Institute I lived in three of the leading Universities in India. Even then it is easy for me to realise that the system of messing here and the management of the hostel entirely on democratic principles by the students themselves is the best I have so far seen and is consistent with the nature of the responsible students admitted here. But I saw this system crumbling before my very presence without my being able to prevent it. A gradual curtailment of facilities and a slow crushing of our independence followed with a stern hand. The Hostel Presidentship was managed to be taken over first. It was followed by the appointment of a Warden who does not take any interest in the students or their comforts. New Hostel Rules were framed which affected us financially very badly. I have submitted to all these because of my own fear and weakness.

I was then told of the proposed Common Mess. I wrote my own objections and unwillingness to join the same. I know that all other students have also unanimously opposed the idea and did all that is constitutionally possible–by way of individual letters, combined representations and collective demonstrations–to prevent a Common Mess coming into existence. I was told that in one of your meetings with the representatives of the students, you have promised to get a new block of rooms if, in principle we agree to a reduction of the messes. As your proposal was reasonable we agreed to reduce the number of messes from NINE to SIX and to accommodate 30 more students in those messes than what these nine messes normally are expected to hold. All this compromise we agreed to, believing that this would solve our accommodation problem once for all since you promised to get a new block of rooms. I sincerely trusted that you will be able to keep up your promise. At least I expected you would be good enough to inform us what happened to our proposals before you decided on any action. But I am surprised and pained to find suddenly a building for Common Mess constructed before the Hostel without any official information communicated to us.

We, as students, have all placed our confidence in you as a Director. In such a case what makes us, a body of more than 100 students, deserve this discourteous treatment? Why should this secrecy creep in our dealings? Of what use have been our attempts at compromise if we are not even considered worthy of attention? I believed in you and the goodness and reason of those who govern us. But the treatment accorded to us, although deserving with all the previous history of ourselves, is too much even for us to bear. You have thrown at us an open challenge by the commencement of the construction of a Common Dining Hall although you are fully aware there is no justification for the Common Dining Hall without a Common Mess.

Having failed in our representations and attempts at compromise not only to achieve our objective but even to deserve any attention from you, regarding our opinion in matters concerning our food, we resolved to prove to you our disapproval by our self-suffering and decided to go on Hunger-strike on the 11th instant giving you a notice three days before, believing that it will be possible for you to stop the construction within this time.

At our meeting on the 8th instant while handing over the resolution you have once more invited us to compromise saying that the Governing Council is no more particular about a common Mess but only particular about a Common roof over four or five messes. You have questioned us to show our objections without telling us the reasons which are so strong from the viewpoint of the Governing Council as to necessiate [sic] an expenditure of 40,000 rupees in utter disregard of the unanimous wishes of all the persons affected by it. You even told us that the Governing Council did not decide as to how many Messes there should be, or how they are going to work out and manage excepting that they are determined to carry out this construction at any cost even if necessary driving us all out of the Institute. You even continued in the same breath to say that the Institute is not meant for the students, that we may all have to go away in the interests of the Country which surprised me and at the same time explained to us what the Director, in whom we entrust all our faith, our future and prosperity, thinks of us. It is this attitude that gives me the moral strength to undertake THIS LIMITLESS FAST. But is it true? Can the Director of the Greatest Scientific Institution in India afford to think so insignificantly of all his students? Am I not selling my own soul to tolerate this attitude? Is not this attitude going to ruin for ever the future of the generations of students that pass from here? I can't imagine the justification for the existence of this Institute without its students. The very objects of the Founder himself would be frustrated otherwise. Is there any work in the Institute which is not the result of a co-operative effort of the students and members of the staff?

I have asked myself the question once more "Is our attitude which gives us, all the students, the moral courage to fast, so unreasonable and at the same time coming into conflict with the interests of our Nation?" Can there be any reason so strongly in favour and at the same time so unfathomable by all of us? If reason is on their side cannot the authorities convince us by the power of their reason about the better they wish for us instead of adopting these peculiar enslaving methods by striking terror at us? Why should an agreement to join a Common Mess be made a condition precedent to admission? If the system is devised for betterment, cannot the authorities get the free will of the students to join the system? I should say that the method adopted in enforcing opinion in favour of a Common Mess at the cost of admission is unworthy of any Institution, much less of a National Institute of this stature which is controlled by the Great leaders and Scientists of our Country, whom we all respect.

I am told that one of the arguments in favour of this Common Dining Hall is to achieve our unity. I do not know what makes the authorities think of our disunity. And what more proof

can we, in return, show in support of our unity than this unanimous hunger-strike. We wanted unity and social contact with the members of the staff. That is an ideal practised in all the leading Institutions of the World. But what did you do? You have ruined the opportunities for social contact with them by separating us and starting a separate Staff Common Room for them. Where we crave for unity and social life you divide us and isolate us and even punish us for asking for it and when we feel we are united and comfortable as we are, you tell us that we are disunited—at least with regard to our food—and try to enforce something on us against our wish. Is there any reason to justify all this?

We are all scientists. We are expected to obey reason, but not prestige or prejudices. In our scientific investigations our reason points us all to only one way. Why is it that the same reason is not able to lead us to all the same unanimity in matters relating to our social life? Even now I am prepared to argue and submit to that one reason to which all scientists bend. But I do not like to bend to this unreasonable attitude of yours for the sake of my flesh.

After all what did we say—'We are all happy with this system of messing. Please do not change it.' But you insist upon bringing out this change at any cost. And when we say we are all unhappy at the scanty accommodation and these double-seated rooms and request you to provide us with a new block of rooms and instead of spending all that money on this Dining Hall against our wishes, you refuse to pay any attention to that cry of ours. This attitude of the authorities leads me to only one conclusion. It appears as though they always wish us to continue in unhappiness and that for some unknown reason which we are not aware of, or made aware of, they are bent upon crushing our individuality as students, just because they have power and fair name behind them.

JC Ghosh, the Director of IISc from 1939 to 1947 *(Photo courtesy: APC)*

You have tried to impress upon us, that by this attitude of ours we are challenging in principle the authority of the Governing Council to decide the policy of the Institute. I must say, with the full force of my conscience, that it is far from that. I can prove that it would be a deliberate misinterpretation of our attitude. I have never questioned the authorities when they started the Aeronautical Engineering Department; in fact I can prove that I have co-operated with them at a great inconvenience to myself by solving the problem of the accommodation of those students although, in fairness it is the duty of the authorities to provide for their accommodation, when they have started a new department. One of the arguments in favour of this common dining hall advanced to us is that that authorities feel the need of an auditorium for us. I am clear that if the authorities have thought of building this common hall for this purpose alone we would all have been extremely happy for their well wishes and good interest in us. But as is made clear to us, they have started with the idea of a common mess and evolving a common diet by experimenting on us and incidentally they had to think of a common dining hall for that purpose. This argument seems to be only an eye-wash for me. Otherwise I would ask them to prove their argument by constructing a common hall without changing the existing system of messes. I am clear that I never question the authority of the Governing Council their right to effect any change in the Institute. But in matters relating to our food and comforts, I do wish to assert my right to be heard as a student, especially when such a change appears to the reason of all students to bring about unhappiness. I wish them to show and prove the justification for such a change. In the absence of any justifiable reason I am inclined to believe that the authorities are questioning the very fundamental rights of a human individual to seek and strive for his happiness. I get the strength through this view of mine.

You have told us that in keeping with the practice of all the leading educational institutions of India, the Council feels the necessity of a common dining hall. What purpose does this Common Dining Hall serve if the intention is not to finally bring about the common mess? Is there any other Educational Institute in India which is working on the basis contemplated by you, where different tastes are served in the same Dining Hall? Why not the Governing Council put forward their exact plan of working out this Common Dining Hall before they build it and spend upon it in face of this opposition? Why not they explain their reasons which justify this attitude of theirs and not able to find which, we are suffering. I have no belief any more in oral promises. I find no meaning also in the attempts at compromise. And how many times should we go on thus compromising, when our attempts are thrown away as of no significance. I want you to support the promise you have given to our representatives and restore their faith in you that is shaken. I request the members of the Governing Council to support their actions by the power of their reason, as I support mine. If they can convince our reason, I will not have the strength to continue this fast. But I am clear that no compromise is possible on the idea of this common roof, because I fear the final outcome would be the common mess. There is no necessity of a common Dining Hall without the idea of a Common Mess. There is an immediate necessity for the construction of a block of rooms.

I am conscious that I may be rusticated and penalised. What significance does it convey to one who is determined to ignore flesh for the sake of reason? But by adopting these very methods are you not training the pick of your country to be slaves for ever by forcing them to submit not to reason but to threats and disciplinary action? I have been a slave till now, but I am glad that these very methods have goaded me to know my strength.

It is clear that the issue of a Dining Hall is paling into insignificance before these fundamental issues. The issue is whether the Indian Institute of Science is meant or not for the students. If it is meant, to what extent can the students have a right to say in matters affecting them, their food, their comforts and their social life, whether or not they have a right to represent their views before a change is contemplated and whether anything can be enforced against their unanimous disapproval by force? I wish that we are given a training here which makes us free people and not slaves. I request that you should control us by allowing our Hostel to be run on the democratic principles rather than using these imperialistic methods against which a greater war is taking place.

I find this utter disregard of our opinion not only in our social life but even in our scientific life. I have tried to impress upon you during these last eight months how simple things have been standing in the way of our progress, how our facilities in the Library are curtailed day by day, how we are forced to waste our time in the Institute without achieving much. I do this penance for a change in the whole outlook which is guiding the destinies of the most brilliant scholars gathered here. I know I am fighting now for a cause which justifies me morally for this decision.

I wish to communicate to you my resolution that I shall go on Hunger-Strike until the construction of the dining hall is stopped and until it is agreed upon in principle that in matters relating to the food and comforts of the students, their majority opinion prevails.

With my due respects to you,

I remain,

Sir,

Your most obedient student,

M Jagannadha Rao

P.S.:– In trying to explain to my own conscience the reasons behind my determination I have tried to explain to you also my whole attitude. Will you please forgive me for this lengthy letter. M.J.

Strange Encounters of the Kheema Kind

- KV Chaubal

"Fed up of eating ragi, some of us went in procession, with plates in hand, to the Founder's statue" *(Photo courtesy: APC)*

Rations, blunders and too much ragi in the late 1940s

When I joined the Institute (specifically, the Department of Electrical Technology) in 1947, the many messes attached to each of the four wings of the hostel had already been closed down and a common mess had started in the newly built auditorium. If there was resentment about the common dining hall or kitchen, it had disappeared by 1947.

The common mess had south Indian, north Indian and north Indian non-vegetarian options. Breakfast included both south Indian as well as north Indian menus (eggs were optional); lunch and dinner usually involved three courses, and tea/coffee with snacks was served at 4 pm. The meals were served in western style in china plates with knives and forks, instead of thalis.

The Students Mess Representative Committee was consulted for setting up the menu. The monthly mess bill was about Rs 16. The menu varied daily, the food was tasty, and the staff friendly. But those were the days of food rationing, and the government supplied ragi instead of wheat. Fed up of eating ragi, some of us went in procession, with plates in hand, to the Founder's statue. We sat on the steps after arranging the plates in front of the statue, to form the word "FOOD". The Director, Sir J C Ghosh, came out to us and assured that he would request the Registrar, AG Pai and the hostel boss, Kunchitpatham, to make fresh efforts to get some wheat. But wheat was just not available.

By 1949, a new hostel block was commissioned with a dining hall and the North Indian section was transferred to it with the menu unchanged. One day during lunch the non-vegetarians were served kheema (minced mutton) in a bowl. It looked like dal to a strict vegetarian friend sitting with us. Pointing to the kheema, he asked the waiter to serve him "that dal". Presuming it to be vegetarian, he very much relished eating the kheema and said "Aaj dal badhiya ban hai" ("Today's dal is excellent"). To his request for some more 'dal', the waiter disclosed that it was mutton. On hearing this, my friend involuntarily and instantly threw out the whole lunch.

KV Chaubal retired as chief of Bombay Suburban Electric Supply Ltd (now Reliance Infra Ltd), spent three years in winemaking, and set up small industries for manufacturing heat exchangers, loud speakers and rubberised coir products. Among other assignments, he was a member of IISc's Court in the 1980s. He is 92 years old and lives in Ahmedabad.

PRO TIP: HOW TO GET DOSAS

WITHOUT WAITING IN LINE

– Vikrant Naik

"There always comes a time when you get so sick of the mess food that you want to start a revolution" *(Photo courtesy: Vikrant Naik)*

When you go to a mess, you realise why it's called a mess. There always comes a time when you get so sick of the mess food that you want to start a revolution. IISc messes were no different. However, what compensated for that were the conversations with friends, sometimes making new friends and knowing about different people – their scientific work or their culture. Many ideas – academic and non-academic – were born there. I remember the intense political discussions about reservations that led to the creation of the Notebook Drive over the course of several dinners at B Mess.

I would always change the mess every few months. This was the time when the student population of IISc was increasing linearly, if not exponentially.

The fondest memory I have of these messes is the breakfast. I could drink 2-3 glasses of milk with my Bournvita, which I am sure some of my friends "stole" from time to time. And then the Sunday dosas. Remember that we were boys in the age group of 22-28 years and hence had voracious appetites. I remember gobbling 9-10 dosas on some Sundays. These days, when I feel I have better sensitivity, I hope the mess contractors made enough profit despite that.

With time, like it happens with every mess, the mess food became messy and at one point, I could not eat anymore. The food became too oily and too spicy for me. That is when I discovered Guptaji Ki Mess. Every day I would take my bicycle out of the campus and eat there. When my professor discovered what I was doing, he became unhappy – for reasons varying from the safety of cycling outside the campus in traffic to hygiene. And at some point, he made me stop going out. Since it came out of concern, I did not mind it, and so I was back in A Mess.

Two things to note: I was in south India but because I was always in the campus, I wasn't really exposed to the real Karnataka. The sambar and rasam that I learned to eat and began to love was one south Indian identity I picked up from the mess. Second – perhaps a tip for some of you. The queue for the dosas on sundays would be long, at times extending way outside the mess. To evade this, I would go to the kitchen and tell one of the many nice gentlemen there that I need three dosas without oil. And then, they would make it specially for me and I didn't need to stand in line. A bit naughty but hey, it worked!

Vikrant Naik did his PhD at IISc in the Department of Inorganic and Physical Chemistry from 2004 to 2011. Presently he works as a scientist in Goodyear SA, Luxembourg.

The Common Dining Hall
(Photo courtesy: APC)

'Neither Indian nor European, but something new'

– Karthik Ramaswamy

The Common Dining Hall built by Otto Koenigsberger in 1944 was a creative experiment forced upon him by circumstances

The Students' Hostel Office in IISc is located in a unique building. Sandwiched between Nesara and Kabini restaurants, its unusual form is surprisingly well-concealed, even from the discerning eyes of those who walk past it routinely.

The building also has a lecture hall maintained by the Centre for Continuing Education (CCE), which sometimes doubles as a venue for social gatherings. It is not entirely surprising that it serves assorted functions – it was designed to be a multi-purpose building.

Commissioned in 1942, the Common Dining Hall – as it was called – was meant to be both a dining hall and an auditorium. It was among the many buildings that came up in the 1940s as the Institute expanded under its then Director JC Ghosh. Built at a cost of Rs. 60,000, it became functional towards the end of 1944, according to IISc's 1945 Annual Report.

The Common Dining Hall was one of the buildings on campus for which the Institute sought the help of the architect Otto Koenigsberger, a German refugee who fled Nazi rule and eventually ended up as the Chief Architect of Mysore State. His legacy in India, extending from the late 1930s to the early 1950s, has been chronicled meticulously by Rachel Lee, an architectural historian at the Technical University in Berlin. In an interview with *Connect* in 2015, she reveals how Koenigsberger, who designed and built a number of buildings in Bangalore, became involved with the Tatas – and therefore IISc – and their shared philosophy of nation building. "The Tatas were very committed to

Today the building serves as the Students' Hostel Office and a CCE Lecture Hall *(Photo: Naina Vinayak)*

***Otto Koenigsberger** (Photo courtesy: Rachel Lee)*

industrialising and modernising India in the same way that Mysore State was. And I think that's why the Tatas had a strong connection with Mysore State. Koenigsberger came into contact with the Tatas through Homi Bhabha. They had very similar approaches. They were both committed to science, industrialisation, modernisation, and progress."

In IISc, Koenigsberger designed and built the old Aeronautical Engineering (now Aerospace Engineering) Department, the Common Dining Hall, Metallurgy (now Materials Engineering) Department, and a hydrogen gas plant (the building now having commercial establishments including Prakruthi Restaurant and the Tata Book House).

> *Koenigsberger could not use steel or concrete because of their unavailability. Other materials like cement and glass were also in limited supply*

The Common Dining Hall was Koenigsberger's second project in IISc after Aeronautical Engineering, which came up in 1942. Its design and construction presented him with a set of unenviable challenges, detailed in the June 1946 issue of *Architectural Forum*, an American architecture magazine. For one, it was going to be built during the war years. This meant that he could not use steel or concrete because of their unavailability. Other materials like cement and glass were also in limited supply. Two, it had to serve both as a dining hall for 120 students – with separate vegetarian and non-vegetarian kitchens – as well as an auditorium for 300 people. The audience had to be able to hear musicians, including soloists, performing and lecturers lecturing without microphones. And the sound had to be carried with minimal distortion. Besides, he was on a tight budget.

Fortunately for Koenigsberger, he received much needed help from a young engineer called NB Bhatt who joined IISc as a lecturer in electro-acoustics on 21 December 1942. The article in *Architectural Forum* credits Bhatt as a co-designer of the building. "That's something Koenigsberger always did. He always credited the people he worked with," Lee says.

Bhatt, who obtained a Master's degree in physics from IISc under CV Raman, did his PhD at the Massachusetts Institute of Technology on the application of wave theory to architectural acoustics. He returned to the Institute where he spent most of the 1940s – he was first at the Department of Electrical Technology and then at the newly created Department of Electrical Communications Engineering. He also served as its first acting Chair. According to Sriram Shastry's obituary for Bhatt published in *Current Science* following his death in 2005, he went on to distinguish himself both as a scientist and an institution builder. "His (Bhatt's) role in founding several institutions at the forefront of scientific research in the decades around India's independence is unique among scientists in India," Shastry writes. For his contributions to Indian science, he received the Padma Shri in 1969.

Bhatt was not just an acoustic engineer, but was also a trained Hindustani Classical vocalist. Shastry observes that Bhatt's dual love for acoustics and music led him to design several theatres and concert halls later in life including the first 70 mm cinema theatres in India (Sheila and Odeon in Delhi) and the Birla Matushree Sabhagruha in Mumbai.

***Part of the auditorium is today a lecture hall** (Photo: Karthik Ramaswamy)*

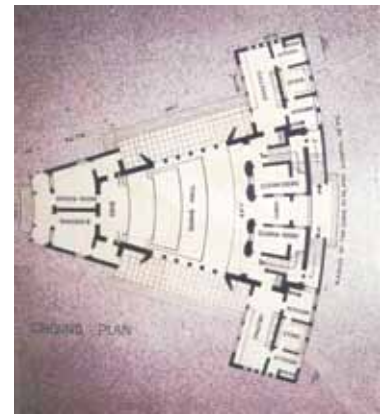
NB Bhat collaborated with Koenigsberger
(Photo courtesy: ECE Department)

In the early 1940s, even though he was still an inexperienced researcher, Bhatt would have been an ideal collaborator for Koenigberger's Common Dining Hall. In a research article titled "Constructing a Shared Vision": "Otto Koenigsberger and Tata & Sons", published in the journal *"Architecture Beyond Europe"* in 2012, Lee elaborates on the design of the building, one which allowed him to meet the exigent architectural demands placed on him and work with the limited construction materials available.

> *Bhatt's dual love for acoustics and music led him to design several theatres and concert halls later in life*

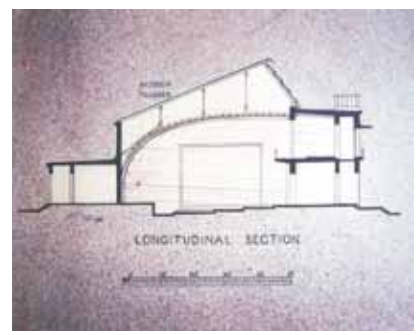
To accommodate both the dining hall and the auditorium, Koenigsberger came up with a T-shaped blueprint for the building, which Lee writes is "based on a central wedge-shaped auditorium space around which the subsidiary spaces are symmetrically arranged." According to her description of the plan, the narrow end of the building would house the stage, the green room, and the warden's office. The curved section on the opposite end would contain the cloakrooms, lobby, and kitchens. The cloakrooms and the lobby would separate the vegetarian and non-vegetarian kitchens so they could operate independently (they had their own pantries).

Because the Common Dining Hall was going to hold concerts and lectures, the plan had to pay close attention to the physics of sound transmission. "To improve the acoustics, the ceiling of the auditorium space, which includes a balcony area, is parabolic and the rear wall is punctured with openings and punctuated by convex columns to minimise reflections," Lee notes.



The T-shaped blueprint showing the hybrid function of the building
(Image courtesy: APC)

In her article, Lee also reveals how Koenigsberger overcame what was perhaps the biggest handicap: to construct the building in the midst of a severe shortage of resources. In the absence of concrete, the structure was built using only bricks and plaster. And because steel was not available, timber trusses were used for the roof, giving it its sloping form. The parabolic ceiling suspended from the timber roof was made of teak, as were the window frames and doors.



The curved ceiling suspended from wooden trusses to reflect sound deep into the auditorium *(Image courtesy: APC)*

Lee describes Koenigsberger as a practitioner of "scientific architecture" and also one who enjoyed experimenting with local architectural styles. Evidence of this claim is seen in how he dealt with the side walls of the Common Dining Hall. Each wall is dominated by a large block of doors and windows, providing both access and lighting to the hall. "These openings," Lee continues, "dominate the side elevations and are framed by chajjas [eaves or sun shades] that wrap around their sides and tops. These playful chajjas have a welcoming effect, as if they are trying to draw people into the interior of the building, or broadcast the performances, and are an example of Koenigsberger's creative experimentation with indigenous architectural elements."

For Lee, what stands out about the Common Dining Hall is its hybridity – both in its function and architectural expression. "The wrap-around chajjas and large glazed openings are neither Indian nor European, but something new," she explains.

‘They Still Remember Our Food’

- Deepika S

When VC Amanan joined IISc in 1980, he was 26 years old. He had wanted to be a scientist, and applied to the Government Arts and Science College near KR Circle for a course in Chemistry, Biology and Zoology. But as luck would have it, he missed the interview for the seat as the letter summoning him arrived too late. He began a diploma in mechanical engineering, abandoned it to study in a catering college, worked for some time at Hotel Ashok, and wrote an exam to become a clerk. Then in 1979, his brother spotted an advertisement to work at the mess in IISc. He applied and got the post, and began what would be 37 years of service. In 2007, he was appointed Mess Superintendent, and after he retired in 2015, his employment was extended for two more years on a temporary basis. He saw IISc’s messes through a period of considerable expansion, from around 300 students spread over three messes in 1980 to four messes with a capacity of 700-800 students each in 2017. Connect *interviewed him at his home in Coffee Board Layout about his time at IISc.*

(Photo: Deepika S)

What were the messes like when you started working at IISc?

There were three messes in 1980. A – south Indian vegetarian, B – north Indian vegetarian and non-vegetarian and C, the universal mess which served south Indian food, north Indian food, veg and non-veg fare.

You could regularly change which mess you ate in, but many people would join one mess and stay there for 5-6 years. The kind of staff we had at the time made them loyal to the mess. When I joined most of the staff were very senior, including the cooks and bearers who served the food. And they were very dedicated. They used to take care of the students as if they were their own children. Good, prompt service, no arguments. When I joined, the cost of eating at the mess for each student was around Rs 3 or Rs 3.50 per day!

How have things changed over the years?

In the early years, people with professional experience were hired for the job. I am from a catering background – that's what I studied in college.

Around 1985, the management began to put restrictions on new recruitments. When the existing employees retired, their positions were not filled. The management started outsourcing those jobs on a contract basis. We had to compromise, and perhaps that led to a slight deterioration in preparation of food. There used to be 120 regular employees in all the messes put together – including supervisors, cooks and bearers. Now there might be around 30.

Employees need a good salary, benefits, job security, and they need to have a sense of belonging and responsibility to do the job well. That's how things used to be, but now with the contract system, the new people who come in don't always have proper training or experience, and no job security. It's a hire and fire system. However, we tried to manage and do our best by giving them [the contract workers] training, and arranging for classes.

We were very liberal about mess timings. Particularly during breakfast in the mornings, which was supposed to end at 9.15 am, but we used to leave it open until 10 am. We did that for quite a long time. But somewhere in 2012 or 2013, we started to be strict about closing on time.

Did you ever take your family to eat at the mess?

No, I didn't. In fact in the last ten years, except for my weekly day off, I didn't take casual leave at all. I hardly used any of my LTC [Leave Travel Concession]. Nearly two years worth of my Earned Leave lapsed. [My wife] used to tell me [in frustration], "You have thousands of rooms there. Why don't you just stay there? When I require you, I will give you a call!"

For any festival, I would have to be there – it would be a big day at the mess, because we would have to prepare a special lunch and dinner. The mess closed for half a day only on five occasions in a year – Independence day, Republic day, Ganesh Chaturthi, Rajyotsava Day, and a general election. But I enjoyed going around speaking to employees and students at the mess, and having to manage both groups. Those were good times.

Although I'll tell you one thing – when you are hungry, I cannot argue with you.

Were there any instances of conflict with the students or management?

Very few. In the 80s, the mess employees went on strike because they thought they were being neglected. But that was resolved very quickly.

In the 90s and 2000s, we started growing very big. By the time I retired three years ago, the average had become around 750 students in each mess. In 2004, they built the new A and B messes where the support staff quarters used to be (the quarters were shifted near Janata Bazaar), and the old A and B messes were given to Nesara and Kabini. The new C and D messes were built in the new hostel complex, with a capacity of around 800 each.

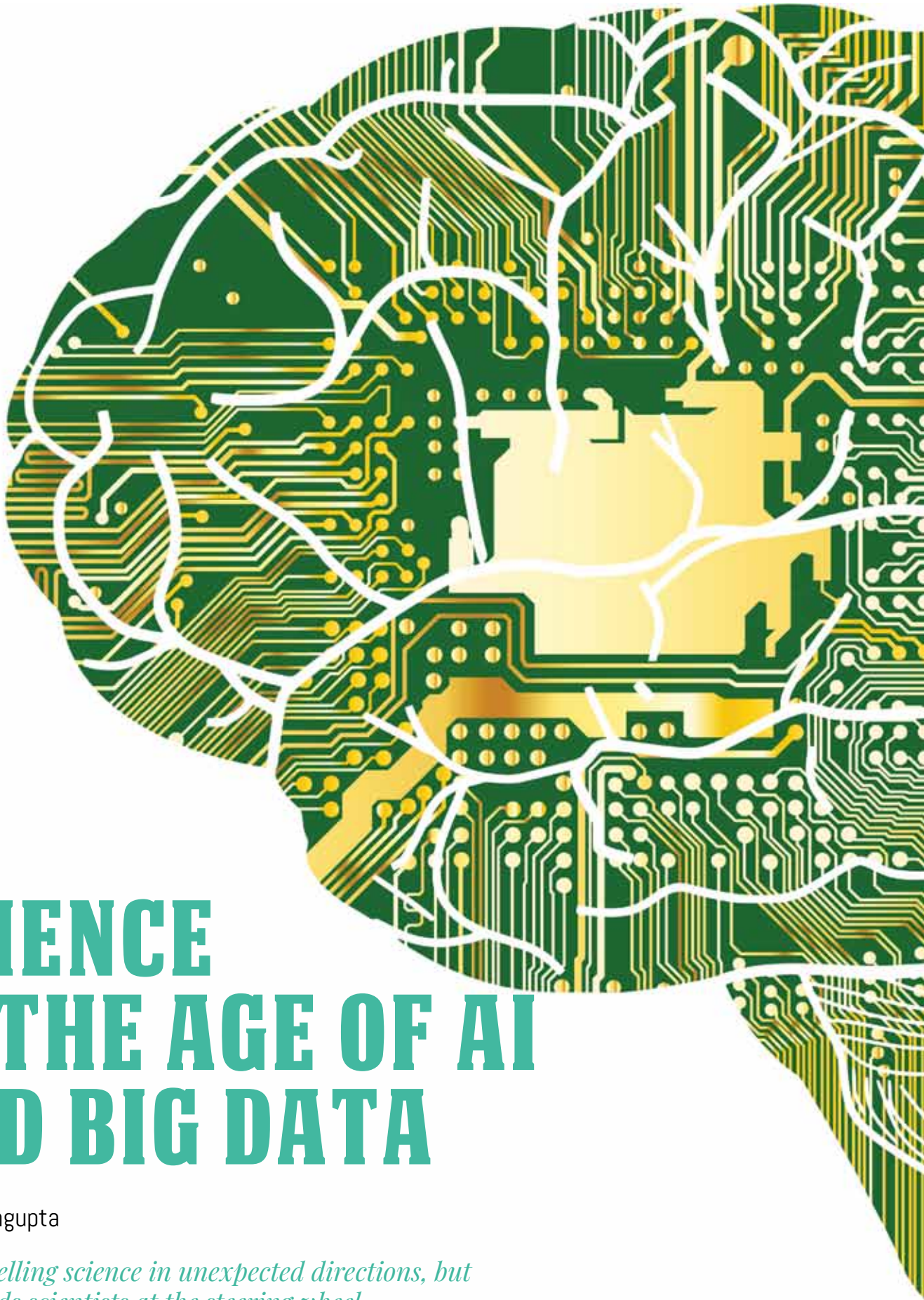
In the 2000s, during admission time, sometimes the food would get over. We would plan everyday to feed around 600 people. But during admissions, we wouldn't know how many new people would be eating that day – and sometimes we would suddenly have an extra 100-150 people, not including their parents. We usually had a margin of 50 extra people for each meal. During this sudden inflow, we would run out of food – that would create problems and the students would protest. Otherwise, students used to be very cooperative and understanding.

Any memories from the mess that will stay with you?

There was a small accident in the new A mess, around 2006 or so. In all the years I have worked here, we have never had a major incident, such as mass food poisoning or anything like that. But one day, a contract worker switched on the stove for the large steam cooking range, where we would boil milk and rice. He forgot to open the valve to let the steam circulate. Pressure started building within one vessel (which had a double layer for insulation), and it burst. The worker had burns on his chest and stomach and had to be rushed to the hospital by the contractor. It was a very scary and serious problem. That's why I feel there should be a core group of permanent employees to manage the messes, to ensure that everyone under them is properly trained and so that incidents like this do not happen.

You know, the students from here might have gone to live in the US or UK or elsewhere in the globe. But they still remember our food and when they come back to IISc, they come to us. Sometimes they also eat at the mess – they cannot forget that food. That's the kind of rapport we developed with the students.

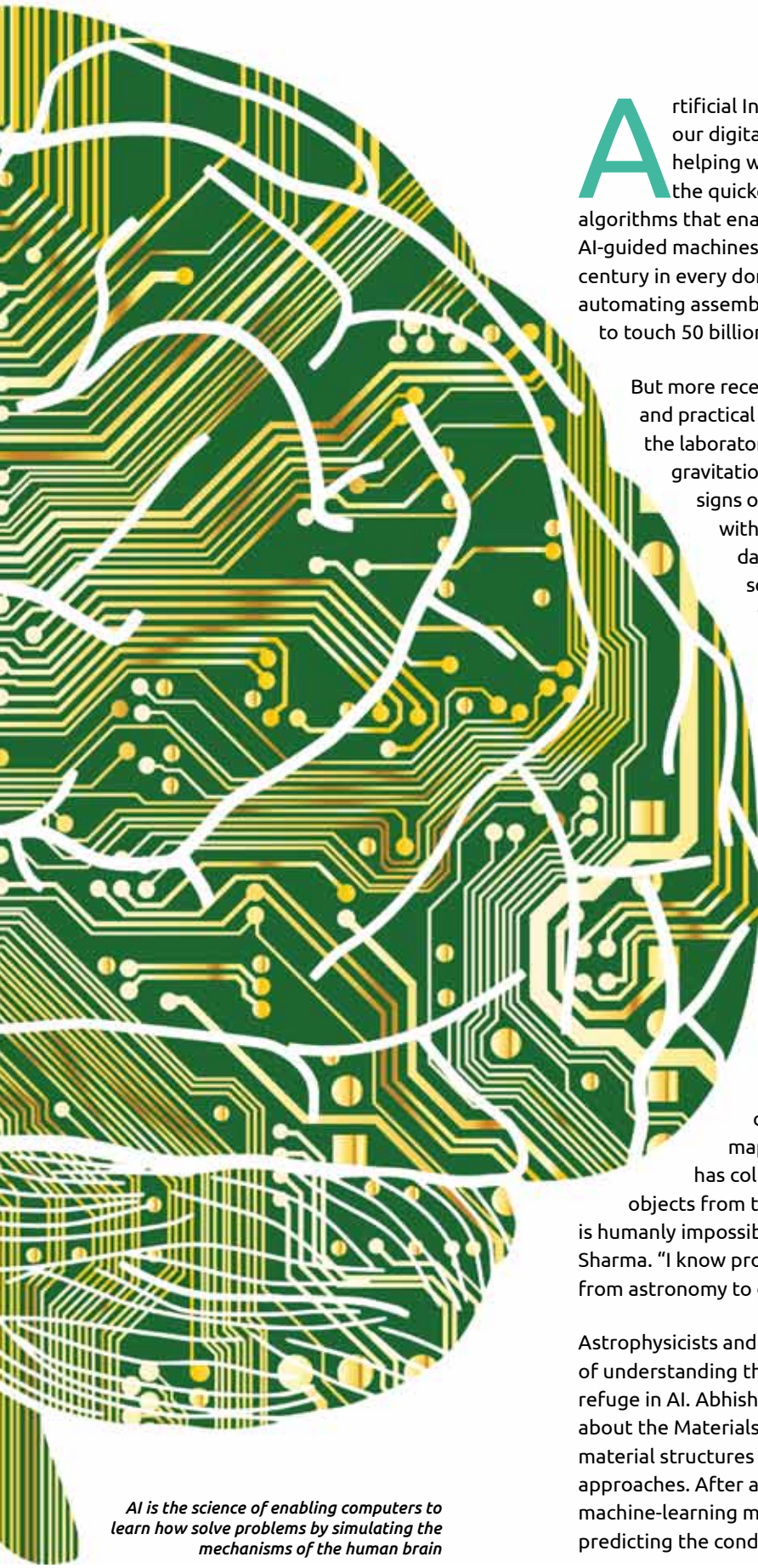
Anyhow. IISc is growing, and I think the messes are doing a good job of catering to the growing number of students. Changes have to happen, no?



SCIENCE IN THE AGE OF AI AND BIG DATA

– Ranit Sengupta

AI is propelling science in unexpected directions, but it still needs scientists at the steering wheel



AI is the science of enabling computers to learn how solve problems by simulating the mechanisms of the human brain

Artificial Intelligence, or AI, has penetrated every corner of our digital world. From aiding email servers identify spam, to helping websites recommend movies and GPS apps map out the quickest route through traffic, we increasingly depend on algorithms that enable computers to learn how to solve new problems. AI-guided machines are rapidly becoming a powerful tool in the 21st century in every domain of human activity from farming to finance, automating assembly lines and self-driving cars, with revenues estimated to touch 50 billion dollars by 2020.

But more recently, AI has entered an arena beyond the immediate and practical demands of economics and industry and into the laboratories of almost every branch of science, detecting gravitational waves from colliding black holes, spotting early signs of Alzheimer's disease, and designing new materials with novel properties. Leveraging the large amounts of data being generated by experiments around the world, scientists are now employing AI to ask questions that were formerly impossible to address and training them to recognise patterns in their data that are invisible to the human eye and difficult to anticipate.

Applications of AI in scientific research can be traced back to the end of the 20th century when experiments aided by rapid technological advances started generating data at an exponentially increasing rate, which were archived and shared freely over the Internet, ushering in the age of big data. But scientists are now faced with the daunting task of navigating this flood of information and are turning to AI to mine its depths.

Prateek Sharma, a professor of astrophysics at the Indian Institute of Science, talks about the Sloan Digital Sky Survey, a wide-angle telescope that collects optical data to create a detailed 3-dimensional map of the universe. Since it began operating in 2000 it has collected images of more than 3 million astronomical objects from the outermost limits of the observable night sky. "It is humanly impossible to look through each and categorise them," says Sharma. "I know professors of astronomy who have switched entirely from astronomy to getting their hands dirty in big data."

Astrophysicists and astronomers, who bear the unenviable responsibility of understanding the whole universe, aren't the only scientists seeking refuge in AI. Abhishek Singh, a materials science researcher at IISc, talks about the Materials Genome Project – an initiative to discover new material structures through data-driven and machine-learning-assisted approaches. After a 2012 study published in Nature reported that "a machine-learning model outperformed traditional human strategies" in predicting the conditions for successfully synthesising a new material,

***Abhishek Singh, Associate Professor at the Materials Research Centre, IISc** (Photo: Ranit Sengupta)*

Singh grasped the importance of AI in materials research and took the plunge. "After realising the power of AI in materials science, we formed a small group consisting of students and postdocs and started to develop machine learning-based models to accelerate the discovery of new functional materials." AI refers to the field, and machine learning (ML) refers to the tools of designing computers than can act intelligently; they are frequently used interchangeably.

Sharma and Singh are among a wave of scientists who see promise in this new approach to employing machine intelligence for knowledge discovery in scientific research. What makes it possible to apply the same type of AI algorithm that can identify new astronomical objects in distant galaxies as well as predict the photoelectric properties of a new material is, in fact, a simple exploit that the human brain performs all the time: recognising patterns. Like a digital calculator multiplying two 16-digit numbers in a split second by using high-speed processors, AI is pattern recognition on steroids, enabling high-speed processors powering machines to mine vast oceans of information teeming with hidden patterns that hold the key to new discoveries, but which no individual can hope to swim alone or even together.

Broadly speaking, AI is the science that enables computers to learn how to solve problems to accomplish a specific goal, like recognising and classifying objects. But instead of explicitly programming the problem-solving steps into the computer, as was traditionally done, modern AI systems autonomously learn to solve problems by recognising patterns in data, simulating the learning mechanisms of the human brain. Neural networks, which are a simplified mathematical model of the brain, are one example of such an AI technique that helps machines learn patterns. A neural network is first trained to recognise images, of say animals, by presenting them with several labelled examples of different animals. The network parameters are tuned in the training process according to precise mathematical rules for optimally distilling the essential features of animals from the training data. If properly trained, when the neural network encounters a new unlabelled image of one such animal, it is able classify it correctly with high accuracy.

Training a machine to recognise simple images may seem trivial, but even a simple class of objects like dogs can have infinitely many variations depending on colour, size, breed, and postures. The learning algorithms must learn to identify the regularities among different dog images – eyes, nose, whiskers, ears, tail, etc. – from the training data and associate the regular patterns with the labels while ignoring the details that are inessential. The engine that powers AI technologies comprises such learning algorithms that can extract these statistical regularities hidden in the data unique to each label or class.

The same general strategy works for any kind of training data. So long as they are appropriately labelled and large enough in numbers for the statistical regularities to be robustly computed, the algorithms can distil and extract these patterns. With properly trained AI, data such as astronomical images, material structures, and brain activity patterns can be classified as supernova or a gamma-ray burst, semiconductor or photodiode, Alzheimer's patient or healthy.

Sridharan Devarajan, a professor of neuroscience at IISc, is developing new tools for the early detection of Alzheimer's Disease (AD), a devastating brain disorder with no known cure that destroys memory and cognitive abilities. AD is typically preceded by symptoms of dementia followed by abrupt decline of mental abilities. "It will be great if we can predict two years in advance if the disease is going to set in," says Sridharan, "but the diagnosis of AD can be confirmed only post-mortem, making it challenging to diagnose before severe behavioural deficits onset." Machine learning tools have proved indispensable in this effort.

To train his algorithms, Sridharan relies on large databases such as the Alzheimer's Disease Neuroimaging Initiative (ADNI), which contains neurological data from over thousand participants, both healthy subjects and AD patients. By analysing the archived data of brain activities of patients collected over several years, machine learning algorithms are being trained to isolate and classify the patterns in brain activity that reliably signal the onset of AD. These symptomatic patterns can then be applied to diagnose at-risk patients who show similar brain activity patterns before the symptoms start manifesting behaviourally, when it's too late to intervene. Early detection may allow medical interventions and lifestyle changes that are known to delay its onset.

Such datasets are essential in AI for training the learning algorithms. Many scientists are now routinely archiving and sharing their experimental data freely over the web, ushering in a new era of collaborative research on a global scale. Singh has started such an initiative at the Materials Research Centre called aNANt, an online repository of functional materials freely available to scientists anywhere in the world. The still-growing database contains information about structures and electronic properties of over 15,000 computationally designed materials. aNANt joins similar databases in the United States, Europe and Asia as a part of the Materials Genome Initiative. The total number of such materials adds up to more than a billion worldwide, and can be used to train machine learning models anywhere on the planet for predicting the properties of new structures. "Tomorrow, if you come up with a completely new material and you don't know anything about it, if you just put its features into these models, it will tell you if it's a good photo-catalyst or a good electronic material or a good sensor."

Sometimes, however, there's a dearth of experimental data for problems that are still in the early stages of research, as in the case of gravitational wave detection. Gravitational waves, first observed in 2016, are perturbations in the fabric of space-time that are caused by catastrophic events billions of light years away, such as the collisions of massive black holes or the merger of neutron stars, both extraordinarily heavy and dense objects confined in a small region of space. The precise signal of a gravitational wave detected on Earth due to such a collision depends on many factors. Sharma explains: "You have observed a signal, but there are so many parameters to calculate. What are the masses, the plane's inclination, what are the spin directions?" To identify these parameters, scientists are now using AI. But instead of analytically working out the solutions to the to their equations, which requires tedious calculations, astrophysicists are simulating thousands of such collisions on supercomputers to generate surrogate data with varying masses, spins and planes of orbits for training their learning algorithms. Once the patterns are learned, they can then be used to identify new gravitational wave signals and immediately predict the locations, spins and masses of the black holes. Astronomers may soon benefit from trained algorithms operating continuously without sleep or break to classify images detected by telescopes.

Despite the growing enthusiasm and initial success of AI in science, the progress hasn't come without concerns. Stephen Hawking famously said, "The development of full artificial intelligence could spell the end of the human race." Some scientists echo the fear that AI could diminish the role of scientists and strip science of human creativity, mechanising research and fundamentally altering the spirit of scientific discovery. Others, however, believe that the fears are premature, if not entirely unfounded. While AI is still in its infancy and expected to become significantly more powerful with better hardware, faster processors and improved algorithms, there are obstacles that may be too high for even fully developed AI to scale all by itself. The true potential of AI can be realised not by blindly applying machine learning algorithms on scientific data but by understanding how the algorithms work in conjunction with scientific insights acquired through rigorous education and experience.

Any sufficiently large dataset will have a plethora of hidden patterns like faces in clouds, but most of them are unlikely to be scientifically meaningful. For the learning algorithms to successfully identify the relevant and meaningful patterns and provide real scientific insight, the data has to be organised carefully, labelled appropriately and presented methodically to the AI algorithms and that requires understanding of the research context and question. Moreover, even when the datasets are optimally organised, AI systems cannot recognise meaningful patterns that they haven't been trained for. Recognising novel phenomena cannot be achieved without human imagination and an ability to conceive and expect new possibilities and scenarios.

Furthermore, AI algorithms require well-defined goals and in science the goals depend intimately on the question being posed. For example, the goal of a clinical researcher may be to answer the question: what are the brain activity patterns of Alzheimer's disease in a specific brain area? AI has no ability to formulate even simple questions without which patterns have no intrinsic value. Sridharan sums up this limitation of AI succinctly: "With AI you may be able to extract knowledge, but when it comes to extracting meaning and understanding the bigger picture, I doubt if AI can do that."

Werner Heisenberg, father of the uncertainty principle, once said, "What we observe is not nature itself, but nature exposed to our questioning." Perhaps, with the task of identifying patterns and extracting knowledge delegated to machines, the human mind will be free to devote itself more fully to asking new questions that are currently inconceivable, perhaps even unreasonable, but which could become seeds of new discoveries and bigger adventures.

Ranit Sengupta was a postdoctoral researcher in The Cognition Lab directed by Sridharan Devarajan at the Centre for Neuroscience, IISc. He currently works as a freelance writer based out of Bangalore.

T RAMAKRISHNAN, A PIONEER OF TB RESEARCH

– Rohini Krishnamurthy

The story of an IISc scientist who brought molecular techniques into research on the deadly disease in India

Ramakrishnan receiving the Watumull Award in Microbiology in 1964 *(Photo courtesy: M Venugopalan)*

A young T Ramakrishnan, who lived with his family in Ernakulam in Kerala, helplessly watched his mother being sent to Andhra Pradesh's Madanapalle sanatorium, one of the few such medical facilities in the country created to treat people suffering from long-term illnesses. His mother was battling the highly infectious disease, tuberculosis (TB).

This was in the early 1930s when TB had no cure. Though TB has been around for over thousands of years, it was only in 1882 that Robert Koch, a German physician and microbiologist, identified the bacterium responsible for the disease in humans – *Mycobacterium tuberculosis*.

With abysmal treatment options, TB was one of the main causes of death worldwide, especially from the end of the 19th century to the beginning of the 20th century. The only option at that time was to admit TB patients to a sanatorium, where they would receive ample rest, nutritious food and calcium supplements. But Ramakrishnan's mother's immune system was not strong enough to fend off the disease – she never returned home.

"This loss may have drawn him to the field of TB research," M Venugopalan, Ramakrishnan's brother, tells me as we sit at IISc's Archives and Publications Cell office.

Ramakrishnan would go on to spearhead TB research in the country. He introduced molecular biology at the Institute at a time when researchers were reluctant to embrace this field at IISc.

Born in 1922, Ramakrishnan excelled in academics: he was a triple gold medallist, standing first in the entire Madras Presidency. But growing up he had serious health concerns – he would get bouts of migraine that continued into adulthood. This worried Ramakrishnan's father, K Karunakaran Nayar, the Principal at Maharaja's College in Eranakulam. On his insistence, Ramakrishnan stayed home for two years after his graduation, says Venugopalan.

But soon things changed for the better. One day, Ramakrishnan's stepmother happened to notice something in an old newspaper that was used to wrap groceries. It was an advertisement from IISc, inviting applications for master's programme. She encouraged Ramakrishnan to apply.

This was a turning point in Ramakrishnan's life, Venugopalan adds with a smile. After Ramakrishnan graduated in biochemistry from IISc, he was sent by the Government of India under the International Science Exchange Programme to the University of British Columbia (UBC), Canada, to pursue his PhD. He studied metabolism in microbes, paving the way for his future research on TB.

Ramakrishnan after receiving his PhD from UBC *(Photo courtesy: M Venugopalan)*

In 1957, when Ramakrishnan returned to his alma mater as a lecturer in the Pharmacology lab [now called the Department of Microbiology and Cell Biology], the situation of TB in India was grave. To control TB, in 1951, the government had launched a campaign of mass vaccinating people with Bacillus Calmette-Guerin (BCG). This vaccine was a breakthrough that came out in 1908, when researchers, Albert Calmette and Camille Guérin from the Pasteur Institute in Paris, found that weakened bacteria could provide protection against TB. And in 1921, after relentless years of research and the First World War, they tested this on a young boy in Paris. The vaccine contained a weakened Mycobacterium bovis, which causes TB in cows. It works by provoking the immune system to attack the bacteria, preventing a possible TB infection in the future.

Though the vaccine continues to be used to this day, its impact on preventing transmission is limited. Ramakrishnan pointed this out in his 1999 review, while also stating that several countries have been successful in controlling infectious diseases, including TB, by improving nutrition and adopting public health measures such as better sanitation, safe drinking water, and so on.

Besides control, they were other means of fighting TB. In 1943, researchers made a discovery that would change the way that TB is treated. From soil samples collected at the Rutgers Agriculture School, USA, researchers, Albert Schatz and Selman A Waksman, isolated the bacterium, *Streptomyces griseus*, which produces the antibiotic streptomycin. This antibiotic proved effective against many bacterial diseases including TB. However, not long after, some strains of *M. tuberculosis* began showing resistance to this antibiotic, making it a huge threat.

In the years that followed, many scientists across the world began zooming into genes of bacteria to understand how they cause disease. This was around the time that the structure of DNA had been revealed by James Watson and

Francis Crick. Biologists were beginning to understand the link between DNA, RNA and proteins – how the information in DNA makes proteins. This was the beginning of the era of molecular biology.

But scientists at IISc still used the classical and tedious approaches of biochemistry: they would isolate a protein, purify it and analyse the enzyme kinetics.

"People didn't appreciate that molecular biology could provide any insights or valuable information. We can say that he [Ramakrishnan] embraced novel approaches," explains MS Shaila, Ramakrishnan's PhD student and now, Emeritus Professor at MCB.

This change didn't happen overnight. In 1961, four years after he joined IISc, Ramakrishnan met Jacques Monod, a pioneer in the field of molecular biology, at the Society of Biological Chemists in Delhi. Monod encouraged him to carry out molecular biology studies on *M. tuberculosis*, according to Shaila. Since molecular biology hadn't yet found its footing in India, in 1962, Ramakrishnan spent two years at EA Adelberg's lab in Yale University to train himself in this field.

Back in his lab at IISc, Ramakrishnan now combined techniques from both molecular biology and biochemistry to understand the differences in metabolism between harmful and harmless strains of *Mycobacterium*. He showed that the harmful strains showed increase in levels of isocitrate lyase enzyme with age, while the harmless strain showed no such increase. *Mycobacterium* depends on this enzyme for its survival. Humans lack this enzyme, making it an ideal drug target. Researchers are now trying to design drugs that can inhibit this enzyme.

Ramakrishnan was also interested in understanding how antibiotics work against the TB-causing bacterium, and how *Mycobacterium* developed resistance to the antibiotic. In a study published in 1973, Shaila and he showed that streptomycin acts against TB by blocking protein synthesis in *Mycobacterium*.

In another study, Ramakrishnan along with another PhD student, CV Sunder Raj, discovered a virus called I3 mycobacteriophage from a soil sample at IISc. The virus was shown to attack the bacterium, *Mycobacterium smegmatis*, which is related to *Mycobacterium tuberculosis*. These viruses integrate their genome into the bacterial genome. He published this discovery in the journal Nature. "Phages are genetic tools to map the chromosomes of the bacteria. He isolated and characterised this phage", explains Shaila.

Ramakrishnan wrote an account of his work titled *The Agony and Ecstasy of One of Midnight's Scientists*, in which, he says that experiments in modern biology require fairly expensive chemicals and instruments, which were not easy to come by in those days, as they were not supported by Indian agencies. Thanks to international grants he received from Rockefeller Foundation, Wellcome Trusts and Nuffield foundation, he could carry out sophisticated experiments. "Through one such grant from the Wellcome Trust", says Shaila, "he could import a whole lot of radiochemicals". She adds that though he kept them in his lab, students from other labs were also given access to them.

Ramakrishnan also established IISc's first facility to study viruses with the help of WE Levinson from the University of California, San Francisco, USA, who spent a year at the Institute. Levinson studied Rous sarcoma virus, known to cause cancer. They together showed that the anti-TB drug, Isoniazid and their metal derivatives inhibit the growth of this virus. They found similar results with other viruses as well.

From then on, he set out to address other diseases that India was grappling with at that time. He studied the virus Rinderpest that caused major outbreaks, killing thousands of cattle, goats and pigs. The virus is now eradicated. He also worked on rotavirus that causes extensive diarrhoea in children. Collaborating with the Vani Vilas hospital, Bangalore, Ramakrishnan and team screened about 500 children in Bangalore for the presence of rotavirus and to determine its type as part of a WHO project. Their results helped WHO compile a list of the types of rotavirus, a crucial first step in the fight against them.

> *"He [Ramakrishnan] had the vision to do something which was taken up by others in the country, maybe five or 10 years later", says Shaila*

Ramakrishnan also was instrumental in setting up the plant tissue culture laboratory at IISc with the help of CS Vaidyanathan from the Department of Biochemistry. Ramakrishnan then hired Lakshmi Sita, who went on to work on developing disease-resistant sandalwood trees and other transgenic crops in her lab.

Ramakrishnan retired in 1982 as the Chair of his Department. He was then made senior scientist in a DST project, where he collaborated with Shaila to study rinderpest. In his account, he says that he used this opportunity to tie up the loose ends of TB projects he was involved in.

Remembering his association with Ramakrishnan, P Ajithkumar, Professor at MCB, who interacted with him

Ramakrishnan (sitting, sixth from left) organised an international course on Phage genetics in collaboration with UNESCO and the International Cell Research Organization (ICRO). Shaila is seated fourth from the right.
(Photo courtesy: M Venugopalan)

as a student and later as a faculty, says, "Even after his retirement, he used to stop by my lab and talk to me about the latest developments in tuberculosis research".

In recognition of Ramakrishnan's contributions to TB research, Barry R Bloom, a noted global health scientist, lauded Ramakrishnan's work in a book he edited titled *Tuberculosis, Pathogenesis, Protection and Control.*

Ramakrishnan (seated extreme left) with his family in Ponani, Kerala. In this picture, E Sreedharan, popularly called the Metro man, is seen standing in the last row, second from the right.
(Photo courtesy: M Venugopalan)

Ramakrishnan had other interests too. Venugopal remembers him as a voracious reader. He had huge stacks of books, which he catalogued. Venugopalan calls him a living encyclopaedia as he would often quote people like Shakespeare and Bernard Shaw. "He also loved music, gardening, travelling and photography," says Venugopalan, as he shows me Ramakrishnan's photo album, in which photos are meticulously organised, with neat labels for each photograph describing the occasion and the people captured in them.

For Venugopal, what stood out about Ramakrishnan was that he remained a student throughout his life. When Ramakrishnan felt the need to have a strong grounding in mathematics, he enrolled to attend lectures of VG Tikekar from the Mathematics Department, along with his students.

"He loved meddling with gadgets", recalls Venugopalan. "Often, I used to see his bed strewn around with different tools. Occasionally, he used to blow up fuses!"

Ramakrishnan was also conscious of his civic responsibilities. Venugopalan says Ramakrishnan was appalled at the poor civic, law and order situation due to the apathy of the concerned authorities in Sharda Colony in Basaveshwara Nagar, where his family settled. "Women feared going out due to antisocial elements. The concerned authorities turned a deaf ear despite repeated complaints. So he formed a resident welfare association, Citizens for Civic amenities, Basaveshwara Nagar, in spite of facing several bureaucratic hurdles." This association, Venugopalan says, "filed a Public Interest Litigation against Bangalore Development Authority and Corporation, followed by a Contempt of Court Petition in the High Court of Karnataka for their callous negligence in discharging their duties."

According to Venugopalan, the association won both the cases and things dramatically began to improve. Sharda Colony is now one of the best residential localities in Bangalore, Venugopalan claims.

Even before he retired from IISc, Ramakrishnan was diagnosed with Parkinson's disease. But he didn't let this come in the way of his work and led an active life: he drove his Ambassador car until the age of 79, went for regular walks. His wife, Parvathy Devi was a strong pillar of support, Venugopal says. After losing his wife to breast cancer, in a few months, Ramakrishnan's Parkinson's symptoms grew worse: food began entering his windpipe, leading to pneumonia.

"He was looking forward to being a part of IISc's centenary celebration later that year. But he succumbed to pneumonia and Parkinson's at the Fortis Hospital, Bannerghatta Road, just before completing 86 years in February 2008," recalls Venugopalan.

Photo courtesy: Michael Zigmond

WHY YOU SHOULD WORK OUT FOR A HEALTHY BRAIN

– Karthik Ramaswamy

American neuroscientist Michael Zigmond's research shows that physical exercise could go a long way in fighting Parkinson's disease

Michael Zigmond is a believer. "I don't know why anybody wouldn't want to be a neuroscientist," quips the IISc-DST Centenary Chair Professor. Notwithstanding his evangelism about the virtues of a career in neuroscience, Zigmond found his own true calling by accident. In the early 1960s, when he was studying to become an engineer at the Carnegie Mellon University (then the Carnegie Institute of Technology), he was told that he was required to take a course in psychology in his third year. "I tried to get out of it. I told my Chairman that I got along pretty well with people," he recalls. When his plea failed, Zigmond grudgingly signed up for the course. But by the end of the course, which he says was taught from a biological perspective, he was more excited by chemical transmission between neurons than chemical engineering, his major. So he switched to neuroscience for his PhD. Now 76, his passion to understand the mysteries of the brain remains undiminished.

Neurodegenerative Diseases

Zigmond is an emeritus professor in the Department of Neurology at the University of Pittsburgh, where he has worked since 1970. He has spent decades studying Parkinson's disease (PD), considered a progressive neurodegenerative disease, *progressive* because the condition worsens with time and *neurodegenerative* because it involves the loss of neurons in the brain.

Though they are typically associated with old age, the origin of the various neurodegenerative diseases and how they are related to each other is still not entirely clear. "I don't think we have a good understanding of this yet, but let me try to answer it with something most people haven't heard of: the Guam complex," Zigmond says.

For centuries, seeds of a cycad plant were used by a group of people in the Pacific island of Guam as part of their diet and as a source of medicine. But the seeds had to be washed repeatedly and prepared with great care because they have a neurotoxin in them. However, by the 20th century, people had stopped consuming these seeds as they switched to a western diet (it is a US territory). When World War II started, there was a shortage of food on the island. "So they had to make their own food. They knew that you could make flour from the cycad plant but didn't know how to clean it," Zigmond says. Not long after, the incidence of neurodegenerative diseases among these islanders rose dramatically, an increase that has been attributed to the consumption of the cycad seeds. What makes this even more interesting is that not all of them got the same disease. "Some people got Parkinson's, some people got Alzheimer's, some people got ALS [Amyotrophic Lateral Sclerosis]," adds Zigmond to illustrate the complex interaction between genetic factors and environmental triggers that give rise to this suite of neurological disorders.

While neuroscientists are yet to unravel this enigma – among many others – they have over the years learnt quite a bit about neurodegenerative diseases, including PD, which Zigmond specialises in.

Parkinson's Disease

Most of the visible symptoms of PD – tremors, loss of balance, slowed walking, and muscle stiffness – are related to movement. But they are physical manifestations of a deeper neurological malaise: the degeneration of dopamine neurons.

> *Most of the visible symptoms of Parkinson's are related to movement. But they are physical manifestations of a deeper neurological malaise: the degeneration of dopamine neurons*

Dopamine is a chemical messenger implicated in several cognitive processes and emotional states including love, addiction, motivation, and attention. It is also crucial for normal motor functioning. Many of the dopamine neurons sit in a narrow passage in the brain (the passage connects the substantia nigra in the lower brain to the striatum in the basal ganglia of the upper portions of the brain). When these neurons die, it results in a loss of dopamine to the brain, thus affecting normal movement of the body.

"So what's the evidence that Parkinson's disease is caused by loss of dopamine?" Zigmond asks. But before he answers this question, he takes a detour to narrate the compelling history of neuropharmacology, one which began in India.

Indian Roots of Neuropharmacology

"For at least 4000 years," Zigmond explains, "people in India have used the root of this flowering shrub called *Rauwolfia serpentina* [known in Sanskrit as sarpagandha] to make a tea to treat a wide variety of conditions which seem to be unrelated: hypertension, anxiety and insanity, which we would now call schizophrenia."

Rauwolfia serpentina
(Photo courtesy: Forestowlet/Creative Commons Licence/ Wikimedia Commons)

The 1930s and 1940s saw a surge in the popularity of sarpagandha as a medicine when several pharmacological experiments were conducted on its efficacy in India. Among the more influential studies was Rustom Jal Vakil's demonstration in the *British Heart Journal* of its utility in treating hypertension (Mahatma Gandhi was known to use it regularly as a tranquiliser). Its reputation soon spread to Europe and North America. There was excitement in the global scientific establishment as well with over a hundred papers published on *Rauwolfia* in less than five years.

Reserpine

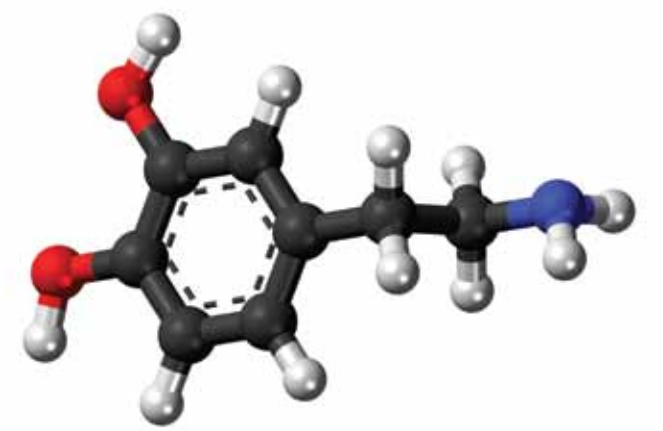
Among the major alkaloids found in *Rauwolfia*, the most significant – at least for humans – is reserpine, first isolated in 1950. "This molecule is what is responsible for all these

amazing things. Its discovery kick-started the field of neuropharmocology," Zigmond says. And it was soon marketed as a drug called Serpasil by the Swiss pharma giant Ciba Labs.

Hailed as a wonder drug, reserpine was now being used to treat various neurological conditions. But it required another breakthrough about reserpine for researchers to understand how PD is associated with the loss of dopamine. And that came from Arvid Carlsson, a Swedish Nobel Laureate who died only this summer at the age of 96.

Dopamine and Parkinson's Disease

Back in the 1950s, according to Zigmond, Carlsson was among the many scientists enamoured by reserpine. In one of his experiments, he injected rabbits with reserpine. "They became completely flaccid, completely akinetic. They stayed that way for almost 24 hours." Carlsonn hypothesised that reserpine's effect on the rabbits was either due to serotonin or dopamine (dopamine's presence in the brain had just been discovered that year but was yet to be established as a neurotransmitter). "So he injected the precursor to serotonin and the precursor to dopamine called L-dopa [into the akinetic rabbits]," Zigmond continues. Carlsonn found that L-dopa restored electrical signalling in the rabbit brain and reversed behavioural deficits, thus demonstrating unambiguously that dopamine is a neurotransmitter.



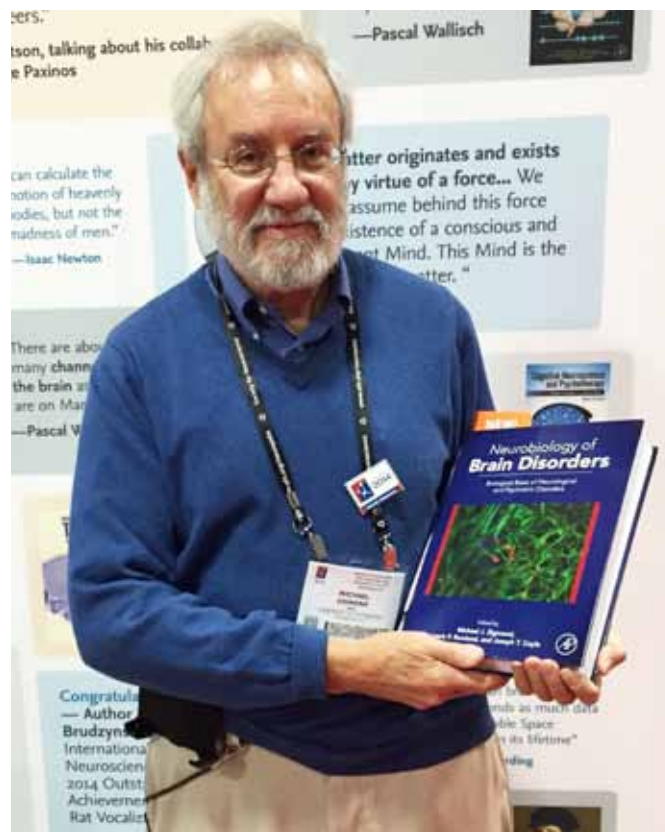
Dopamine molecule model which shows carbon atoms in black, hydrogen in grey, oxygen in red, and nitrogen in blue
(Image courtesy: Discovery Studio Visualiser/Creative Commons Licence/ Wikimedia Commons)

"But he went one step further which is extremely important for my work," Zigmond points out. Carlsonn also suggested that the loss of control over movement seen in rabbits when they were injected with reserpine was not unlike the motor effects of PD. He therefore conjectured that PD results from a loss of dopamine and could be treated by L-dopa.

Carlsonn's hunch was confirmed by Oleh Hornykiewicz, a young Austrian neuroscientist who had fled his native Poland with his family during World War II. "Hornykiewicz," says

> *L-dopa restored electrical signalling in the rabbit brain and reversed behavioural deficits, demonstrating that dopamine is a neurotransmitter*

Zigmond, "read Carlsson's paper which said that maybe Parkinson's is due to the loss of dopamine." Now a researcher at the Pharmacological Institute of the University of Vienna, he had access to freshly autopsied human brains. He studied the brains of people who had suffered from PD and discovered that they lacked the dark pigmentation associated with dopamine neurons, a feature characteristic of healthy brains. The finding was verified by several studies subsequently, and led to the use of L-dopa as a drug for Parkinson's.



Zigmond with a textbook on brain disorders he co-edited
(Photo courtesy: Michael Zigmond)

Limitations of Current Treatment

But after the burst of frenetic discoveries in the late 1950s and early 1960s, little progress has been made in how we treat

PD, claims Zigmond. "People still use L-dopa and a few other drugs like L-dopa to treat Parkinson's. But they have no effect on the disease itself; it just masks the symptoms. And in fact, L-dopa becomes less effective with time." (Dopamine itself is not used as a drug because it struggles to break the blood-brain barrier.)

Exercise

A few years ago, Tim Schallert, a researcher at the University of Texas at Austin, called Zigmond up (Schallert, who was a close friend of Zigmond, died earlier this year from complications due to PD). "He [Schallert] said that maybe exercise could protect against Parkinson's. I said that's crazy." Zigmond clarifies that there had been some studies published on exercise and PD, but their focus was on how exercise could ameliorate the symptoms of PD. None of them had considered the possibility that regular physical activity could provide what Zigmond calls "neuroprotection". In other words, these studies did not ask whether exercise could delay the progression of the disease, and perhaps even prevent it. And why would they, he thought. Exercise affects muscles. There was no reason he could think of to assume that it would have anything to do with the health of neurons.

> *"He [Timothy Schallert] said that maybe exercise could protect against Parkinson's. I said that's crazy."*

Schallert persisted. And prevailed in convincing his friend to do a joint study. As a first step to test their ambitious idea, the two researchers (along with their colleagues), injected a toxin to selectively kill dopamine neurons in one side of the brains of rats and induced motor neglect – the failure to move muscles voluntarily – in their right front limbs, mimicking the motor effects of PD. The animals were then put in cylindrical observation chambers. "What the rats will do is to rear up on their hind limbs and explore the chamber. They like to explore just like we do," says Zigmond. But because of motor neglect, they would explore with their left limbs and also land on them.

They then put casts on the "normal" limbs of the rats compelling them to use their impaired limbs (Zigmond credits Schallert for coming up with this enterprising trick). After seven days of forced exercise, they removed the casts and observed the rodents. What they found surprised them: the rats were now using both their limbs with equal proficiency.

Neuroplasticity

There was more good news. The authors also demonstrated that exercise more than just improves motor functioning; it also alters the underlying neurochemistry. This experiment was led by Ann Cohen, now an assistant professor at the University of Pittsburgh, who was then a graduate student in the Zigmond lab. She showed that the depleted dopamine in the neurons of the substantia nigra made a comeback after merely seven days of exercise. "So it seemed like it wasn't just behaviour that is protected, neurons are also protected," Zigmond asserts.

Zigmond and his collaborators followed up this finding with more studies. They used mice and monkeys. They changed the way the animals exercised – with hamster wheels and treadmills. They increased the duration of exercise. The results of these experiments only confirmed that regular physical exercise provides neuroprotection, at least in animal models.

Mechanisms of Neuroprotection

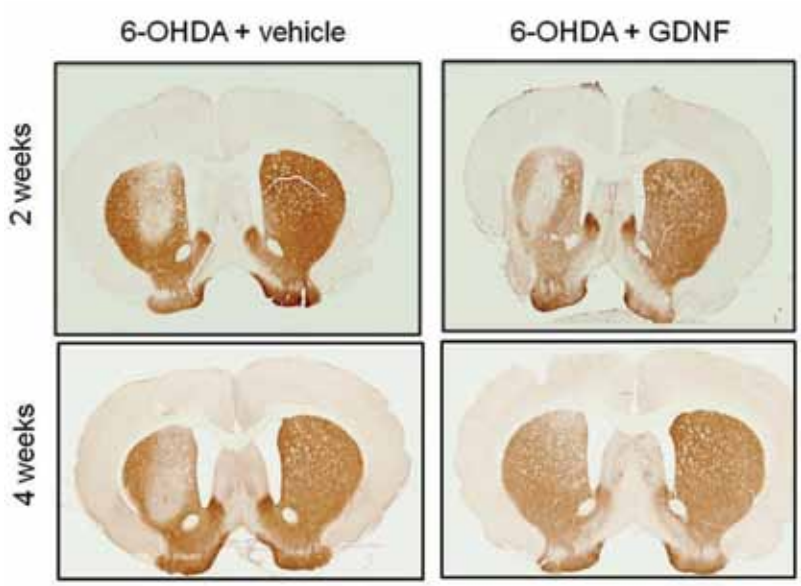
A huge body of literature has demonstrated how moderate physical activity alters human physiology at the cellular level: it increases mitochondrial ATP synthesis and antioxidant defences and reduces inflammation and ROS (Reactive Oxygen Species). Now we know that it can also increase the number of neurons and synapses in the brain. Remarkably, these are exactly the opposite effects of PD. "So exercise seems to reverse many of these factors that we know are altered in people with Parkinson's disease," Zigmond says.

> *Schallert, Zigmond and their colleagues demonstrated that exercise more than just improves motor functioning; it also alters the underlying neurochemistry*

But Zigmond is most excited by one other physiological change that exercise brings about: an increase in neurotrophic factors, biomolecules known to support the development, growth and survival of neurons. He was particularly interested in a neurotrophic factor called the Glial cell line-derived neurotrophic factor (GDNF) because it had also been shown to be neuroprotective by several researchers, including Barry Hoffer, then at the National Institutes of Health.

"We know that exercise increases GDNF; we know that GDNF protects dopamine neurons. So our hypothesis was very simple: an increase in GDNF is the primary mechanism through which exercise provides neuroprotection," Zigmond explains.

"Then Annie [Ann Cohen] said, 'If this hypothesis is correct, we can bypass exercise. We can put GDNF directly into the



The neurotoxin 6-OHDA selectively kills neurons as seen in by the pale tissue on the left side of the brain in both panels. But when GDNF is also injected (right panel), the neurons make a comeback in less than four weeks. The effect is more pronounced in eight weeks *(Image courtesy: Ann Cohen)*

brain, and that should be just as good as exercise,'" recalls Zigmond. So Cohen injected rats with both the dopamine-killing toxin and GDNF. But there was no change in the number of dopamine neurons in the first couple of weeks. "I was with Annie when she collected this data. She was heartbroken because this was going to be her PhD thesis. But miraculously in two months the "degenerated" dopamine neurons came back." Apparently, they had just turned off their capacity to show the typical markers of dopamine while they fought off the effects of the toxin.

Following this significant discovery, Zigmond and his team have also been able to understand the molecular underpinnings of how GDNF protects dopamine neurons. They did these experiments not on animals but on cellular models in petri dishes.

Environmental Enrichment

But it's not just exercise which seems to trigger rejuvenation of the brain. "Richard Smeyne [also a collaborator of Zigmond's, from Thomas Jefferson University] came up with the idea of taking mice and putting them in what he called an enriched environment," Zigmond says. "Six to twelve mice were kept together for three months in a large living space containing exercise wheels, toys, and objects to climb over or under. And they kept changing things around every three to five days to keep the environment novel. The mice did what kids do in a playground – they explored, they played, they interacted," he elaborates.

At the end of three months, when the researchers dissected the brains of these mice, they found that it had effects similar to what they observed with exercise, even though the amount of physical activity they indulged in was much less. They found more neurons and synapses, and lower levels of inflammation and oxidative stress. They also found elevated levels of neurotrophic factors.

Zigmond concedes that more studies are required to say with absolute certainty that exercise and social interactions can provide neuroprotection to humans with PD. But he is encouraged by a number of promising epidemiological studies. "What people have begun to do is to look backwards," Zigmond states. "And what they are finding is that people who routinely exercise are less likely to get Parkinson's than people who don't."

Ancient Genes in a Modern World

Zigmond contends that we can better understand neurodegenerative diseases and indeed other lifestyle maladies such as diabetes and cardiovascular disease if we viewed them through the lens of evolutionary psychology. Up until about a few thousand years ago, our ancestors lived as hunter-gatherers in an environment that was unpredictable and often hostile. According to him, this meant that they spent enormous energy in hunting down animals, collecting wild plants and escaping from predators. It also meant that they spent a considerable amount of time engaging in social interactions since they had to cooperate with other members of the group. "People stuck together in small groups in which they shared food, protected each other, and raised children."

Today, however, we live radically different lives in a radically different environment. This, Zigmond says, is a problem because biologically we are still almost identical to our ancestors who roamed the savannas of Africa. "We have more or less the same genes because evolution proceeds very, very slowly," he points out. The mismatch, he believes, has consequences. "We sleep less, we exercise less, we eat all the time, we interact less with others. As a result, our 'healthspan' has decreased. We suffer from more non-communicable diseases – heart disease, lung disease, neurodegenerative diseases, clinical depression. It also has a huge financial and emotional cost," he laments.

To Zigmond, the way out of our current predicament is straightforward: exercise more, eat better, and spend quality time with family and friends. "We don't have to have these diseases in many cases. And when they do emerge, they will emerge at a later age than what we are seeing now," he concludes.

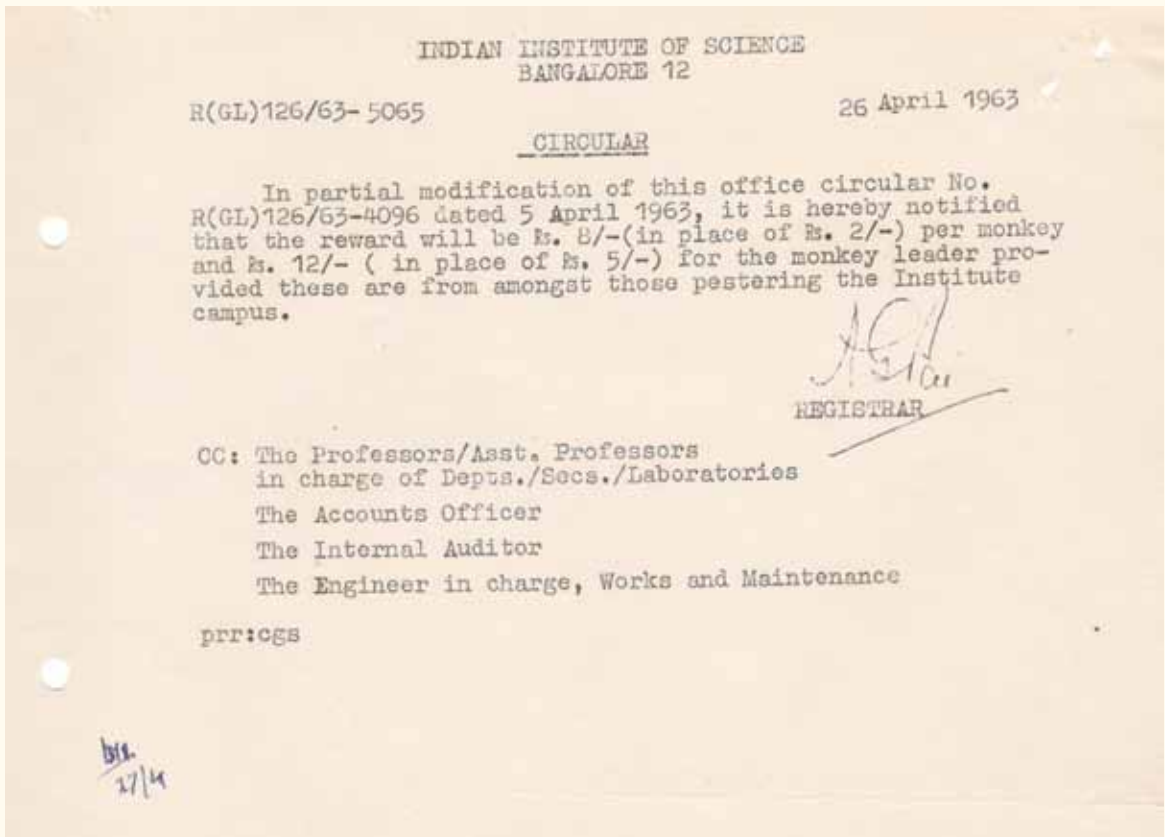
MONKEY BUSINESS

A 1963 memo about a certain kind of 'pest' on campus

IISc offers a home to a range of flora and fauna, from the slender loris to stray dogs, and has a number of visitors passing through, including rare birds such as the Kashmir flycatcher.

In a circular from the archives, dated 26 April 1963, we learn that monkeys were seen as a menace on campus, enough to prompt two such memos offering a reward for captured monkeys. While our archives does not seem to have the first of these circulars, the second, in our possession, was issued to office bearers, and professors and assistant professors in charge of departments, sections and laboratories by AG Pai, Registrar of the Institute. It says, "In partial modification of this office circular No. R(GL)126/63-4096 dated 5 April 1963, it is hereby notified that the reward will be Rs. 8/- (in place of Rs. 2/-) per monkey and Rs. 12/- (in place of Rs. 5/-) for the monkey leader provided these are from amongst those pestering the Institute campus."

Were the rewards offered for monkeys that were captured and brought in alive or dead? And how could the "monkey leader" be identified? Unfortunately, the archives doesn't give us the answers!



INDIAN INSTITUTE OF SCIENCE
BANGALORE 12

R(GL)126/63-5065 26 April 1963

CIRCULAR

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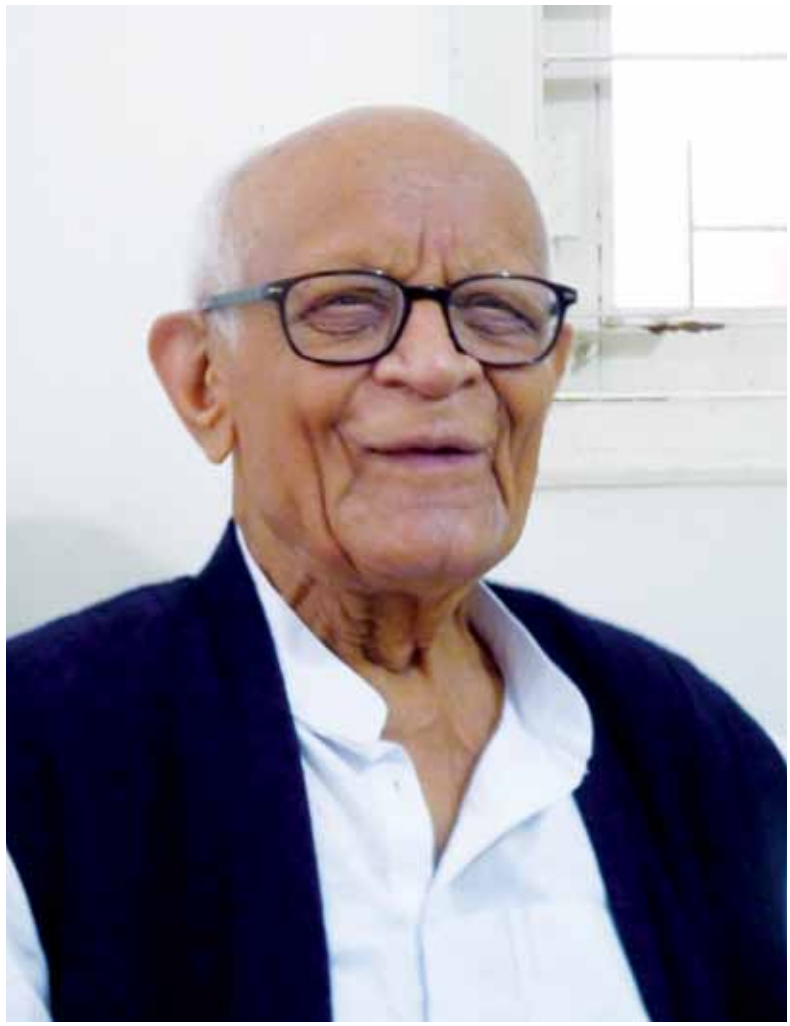
REGISTRAR

CC: The Professors/Asst. Professors
in charge of Depts./Secs./Laboratories
The Accounts Officer
The Internal Auditor
The Engineer in charge, Works and Maintenance

prr:cgs



(Photo: Nithyanand Rao)

Meet the metallurgist who champions people's science

– Nithyanand Rao

YC Subrahmanya studied metallurgy at IISc, during 1948-51. He was taught, among others, by Brahm Prakash, who was later an important member of India's nuclear and space research programmes. Subrahmanya then joined the Ordnance Factories as an Assistant Works Manager and went on to have a long career, retiring as a Deputy Director-General. Now 93, he is engaged with the Bharath Gyan Vigyan Samithi, part of the people's science movement in India. He spoke to Connect about how his time at IISc changed him in many ways. Excerpts from the interview.

When did you join the Institute and what did you study?

I joined the Institute in 1948 for the metallurgy course, a three-year course. We were awarded the DIISc, the diploma of IISc, equivalent to a bachelor's degree. When I was doing the course, MS Thacker was the Director. He was the first engineer to be the Director of the Institute.

The 1947 batch was the first in the metallurgy course. I was in the second batch and there were only eight of us in it. This was after I did my honours in chemistry from Central College in Bangalore, in 1947-48. The first batch in metallurgy had a professor in this area, Prof Adcock, an Englishman. But by the time we arrived, Adcock had already left. And our department went without a head, a professor, for about one and a half years or more.

Who were your teachers?

There were two who were part of the department: One was EG Ramachandran – he passed away recently – and his field was physical metallurgy. Mr Balachandra was the other, and he taught electro-metallurgy. He was an electrical engineer. Apart from that, the ancillary subjects used to be looked after by people of other departments.

The department underwent a transformation when Prof Brahm Prakash joined as Professor and head of the department. I can claim that I'm a student of Brahm Prakash. [Laughs] Wonderful man, a great character. He joined in late 1950. He came here on a loan from the Atomic Energy Establishment, Trombay (later renamed the Bhabha Atomic Research Centre). Bhabha agreed to release him under the condition that after his stint at the Institute he would go back to Trombay. Ramachandran was assistant professor by then.

What subjects did Brahm Prakash and Ramachandran teach?

Ramachandran was a physical metallurgist, with a particular interest in phase transformations, heat-treatment, metal

The department underwent a transformation when Prof Brahm Prakash joined as Professor and head of the department

structure, metallography and such. Brahm Prakash was well-versed in all aspects of metallurgy and excelled in the principles of extractive metallurgy and process metallurgy – their chemistry, thermodynamics and physics. He did his PhD from the Punjab University and had a DSc from the Massachusetts Institute of Technology. He was a very friendly person but could also be very tough.

In the Institute, we did not address our teachers or professors as "sir". That was a change from the pre-degree colleges. So we called Brahm Prakash "professor", and Ramachandran "doctor".

Do you have any memories of your personal interactions with Brahm Prakash?

I remember a great instance of Brahm Prakash's attachment to and concern for students. The previous batch, when they passed out, had a get-together, and invited the professor, all the teachers and staff to the party. When we finished our course in 1951, we thought that we should also do the same, that it should become a tradition. So Prof Brahm Prakash and others joined our farewell party. When it was almost over, he said to us: "What is this? You are going out and are having a party for those people who are going to stay? It is you who should be given a party."

After the function was over, true to his word, he took us all out for a great evening. We watched a cinema in the MG Road (then South Parade) area and then we dined together. This is the person that Brahm Prakash was.

EG Ramachandran
(Photo courtesy: RRI Digital Repository)

Brahm Prakash
(Photo courtesy: Department of Materials Engineering)

It is he who suggested to me to apply for the job at the Ordnance Factories. After I joined service, he used to send me New Year greetings without fail – and once, he sent me greetings from Tokyo while he was on a visit there!

Did your time at the Institute change you in any way?

I joined the Institute with a fair amount of keenness and interest in science from the college days. This was consolidated and taken to a higher level in the Institute and I continue to nurture it to this day.

Attitude and self-confidence were big gains. Still, I learnt to pause and ask: Are you right? This I believe makes self-confidence more assured. In the Institute, you grow, but then you are in the midst of so many evolved and endowed people, and you cannot but be humble. Could there be a greater gain than that?

> *Brahm Prakash was a very friendly person but could also be very tough*

Whether I gained anything in metallurgy or not, I don't know [laughs], but I learnt tennis here. For one who has always been keenly interested in sports, tennis was a big gain. While here I could play a game like basketball, such team games are not possible at your workplace. I continued to play tennis right through the years at our workplaces – and win a few prizes and tournaments! Indeed, I was playing tennis till a few months ago.

If a student is really interested in doing something apart from what he learns in the classroom, even in terms of the subject, the Institute provided opportunities and it did make a difference in you. You learn as much as you want. And you weren't in a class where your attendance was marked.

I should also add that, in 1950, I was awarded the Nuffield Foundation Vacation Scholarship in Metallurgy, and was a student trainee for three months in the Steel Works of Stewarts and Lloyds in Corby, UK.

Why did you choose to come to IISc for your studies?

It could have been so because the Institute is located in Bangalore, my hometown!

Many of us in the BSc Honours wanted to go to the Institute because we felt that our acquaintance with science needs to be deeper. From what we heard from our seniors who had gone to IISc, such as AR Vasudeva Murthy – we used to go visit him at the Institute – we were certain that if you are interested, this is where perhaps you will get to know something about science. I was not disappointed in that, as mentioned earlier.

It was known that the Institute was a place where openness was easy and so was communication. As a student applicant, I could personally meet the Acting Director, EV Ganapathi Iyer, in his office and talk to him about my admission.

Youngsters like me at that time grew up amidst the atmosphere of the World War II, an intra-imperialist war; there was the dominance of fascism in Europe; there was the Soviet Union; there was the civil war in Spain; there was the Long March and the Revolution in China; and then, there was our own freedom movement – many of us had participated in the

Quit India movement of August 1942. All this could not but send messages of disquiet in young and inquisitive minds and raise uncomfortable questions. It was so with me as we were completing the honours degree. In a situation such as this, the Institute beckoned, with its mostly open environs and discussion. Equipped with science, however lacking in maturity it could be, one had a real opportunity to dwell on the issues with the aid of science and scientific methods and approaches in an institution like IISc.

No wonder then that we had a branch of the Association of Scientific Workers of India on campus. And the president of this association was none other than Satish Dhawan!

When you were at the Institute in 1951, the Indian Science Congress was held at IISc.

Yes, and Bhabha was the President of that Indian Science Congress. In our department itself, certain exhibitions and things like that were there. We were mostly doing some voluntary work at the event – looking after the exhibits, taking people around, attending the general assembly, helping the organisers. I remember that there was MS Subbulakshmi's concert on one evening and Bharatanatyam by Maya Rao. It was something that we enjoyed. It was a sort of icing on our stay in the Institute.

> *We were certain that if you are interested, this [IISc] is where perhaps you will get to know something about science*

Bhabha was an artist himself. I have seen Bhabha sketching on the back of an invitation card a troupe of nadaswaraa artists, with his left hand! It was at a wedding reception at Prof K Sreenivasan's place where Bhabha was a guest.

After your retirement, you have been associated with the Bharath Gyan Vigyan Samithi (BGVS) for a number of years.

Yes, I've been associated with BGVS for over 15 years. They are a very committed set of people working with society to bring home to them the need to be aware of what science is with reference to the issues of society. Their aim and work is to inculcate in people, in general, the need to adopt methods of science in understanding and finding solutions to societal issues, develop a rational approach and have a scientific

YC Subrahmanya, in 1950
(Photo courtesy: YC Subrahmanya)

temper. Without following the methods that science follows, it is not really possible to find out what happens and why it happens, particularly when applied to society. Today, natural science people are not isolating themselves and are into these sorts of issues.

It is a desire in me that I should be associated with a group of people who have this approach to things – that their attainments in science is not the end of science. You should apply science elsewhere too, have a rational attitude and not be driven almost entirely by what is given to you. But our beliefs are so hardwired in us and so deep that people feel comfortable with that. This is something that has to necessarily change and BGVS works towards that.

All the state-level organisations like BGVS are brought together in the All-India People's Science Network. Every three years they hold a people's science congress; I had gone to one in Lucknow. These are things which keep alive my interest in this area of application of science.

At BGVS, we have regular monthly meetings where we discuss our programmes. My interest is not that I have something to give and that other people should benefit from that. No – I want to benefit myself.

How mathematical modelling helped control AIDS in India

Photo courtesy: Arni R Srinivsa Rao

– Rohini Krishnamurthy

The limited success of National AIDS Control Programme (NACP) I and II set up in the 1990s meant that the government had to something different to control HIV spread: India had roughly one-eighth of the world's HIV burden. And in 2002, the US National Intelligence Council projected that by 2010, about 20-25 million people will be living in India with HIV. So the Indian policy makers approached a mathematician, Arni SR Srinivasa Rao, who was earlier a fellow at IISc, to develop a model to shape prevention strategies, which was eventually incorporated in the NACP III.

Rao led this effort from the University of Oxford by collaborating with colleagues in India and the UK to build a mathematical model, and predicted that by achieving a 50% target with antiretroviral treatment along with prevention, care and support, the government could bring down the number of people living with HIV from 2.4 million in 2006 to 2.08 million in 2011. This prediction turned out to be close: in 2011, the infection burden was brought down to 2.089 million individuals.

In an email interview with Connect, *Rao, who is now Associate Professor in the Medical College of Georgia, Augusta University, USA, spoke about his work and how he was drawn to mathematical modelling for disease control.*

What drew you to the field of mathematical modelling of diseases?

During high school and early college days in Vizianagaram in Andhra Pradesh, my teacher, M Perisastri who had published seminal works in number theory in the 1950s and 1960s that attracted researchers worldwide, inspired me a lot. His teachers were prominent Indian mathematicians at Andhra University, such as T Vijayaraghavan, V Ramaswami, S Minakshisundaram, and so on. Vijayaraghavan pursued his PhD under the famous British mathematician, GH Hardy.

I found Perisastri's lectures on analysis and algebra amazing and he used to add lots of interesting stories on Indian and western mathematicians in his lectures. Then I spent a couple of years as a PhD scholar at the International Institute for Population Sciences in Mumbai, where I got exposed to real-world population analysis. I then moved to Indian Statistical Institute (ISI), Kolkata, as a Senior Research Fellow and later became Visiting Scientist.

At ISI, I primarily worked with JK Ghosh who was instrumental in my move from Mumbai to Kolkata. I closely interacted with many people at ISI and attended analysis and probability classes by eminent teachers like BV Rao and Somesh Bagchi. But I only started appreciating advanced mathematics due to discussions with my hostel friends, especially P Ramu who was then an MTech student at ISI and was trained from the University of Hyderabad and is now a senior scientist at Defense labs in Pune.

In 2002-2004, I was at IISc as a DST fellow in mathematical sciences, where I received early career world-class exposure in biological and engineering sciences research, shaping my interest in this field.

Was mathematical modelling of diseases actively pursued when you started out?

In the early 2000s, mathematical modelling of diseases was not an active research field in India; at least I didn't come across such things. However, I saw potential in it and tried to understand the techniques myself from a few books available in libraries and using my own intuition. My first success came in 1999 when our paper on HIV modelling was published in the prestigious journal *The Lancet*, jointly with SK Hira, a clinician at JJ Hospital in Mumbai.

I worked with Masayuki Kakehashi of Hiroshima University, Roy M. Anderson (Imperial College London), Philip K Maini (University of Oxford), interacted with Robert M May (University of Oxford), and held a postdoctoral fellowship with Chris Bauch (University of Guelph).

In the early 2000s, mathematical modelling of diseases was not an active research field in India; at least I didn't come across such things

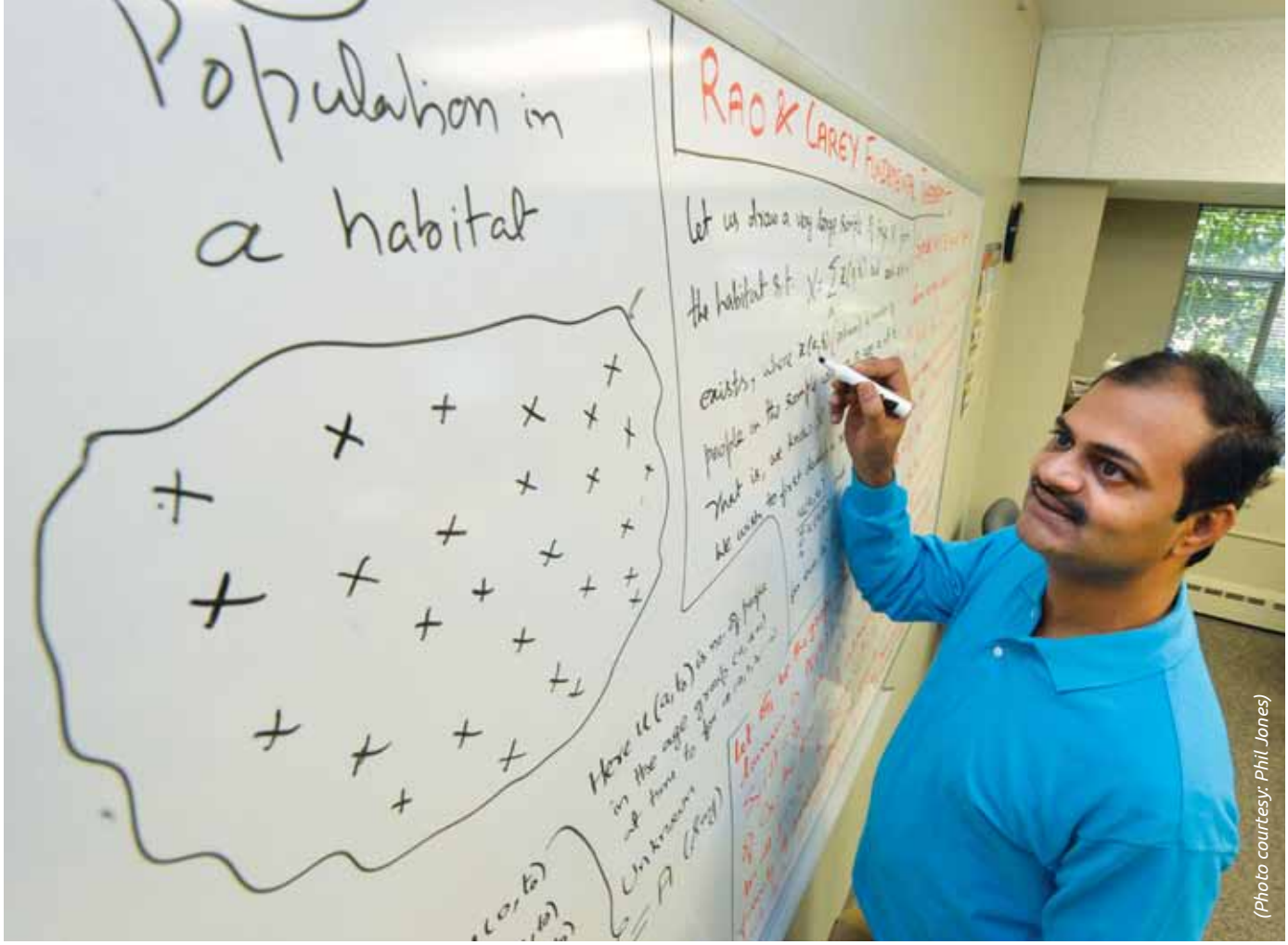
Anderson and May are eminent researchers in modelling diseases from the 1970s, and they worked as senior advisors for the UK government. My close academic association with them helped me understand how mathematical models are used, beyond academic-quality publications. The exposure I gained with Maini's group shaped my early career foundations in mathematical modelling. All my early career mentors predominantly used deterministic dynamics models [these models predict based on known relationships between states without considering random variations]. I have, over the years, evolved as a proponent of other types of modelling techniques as well, namely, stochastic, graph theory-based, harmonic analysis, hybrid models, and the like.

What is mathematical modelling and what are the factors you consider before you start modelling diseases?

For me, mathematical modelling is like approximately translating scientific phenomena or processes, be it in biology, engineering sciences, finance, medicine or physics, into well-defined, one or more mathematical equations. Often these translations are challenging, but sometimes, it can be very obvious. To understand the research question, modellers have to be very flexible in using the right kind of mathematical approaches. The goal is always to fit the model as closely as possible to the real-world process. Models usually consist of parameters and variables, and ideally, parameters obtained are either from raw data or from published literature.

My philosophy is to first have a deep understanding of the key science questions that I am handling. Then, I look for evidence to support the hypothesis and what is unknown around the question that I am handling: is the question that we are considering worth attempting through a model or not. Once we are satisfied with the discussions, my collaborators and I work on the actual mathematics and other theoretical developments. Accurate predictions using models is the most challenging aspect.

You were at IISc during 2002-2004. What were you working on here?



(Photo courtesy: Phil Jones)

> *Once we project the number of individuals who require a certain type of treatment, the government uses these numbers in preparing budgets, based on data for treatment costs per person*

During 2002-2004, I was a DST/SERC [Department of Science and Technology/ Science and Engineering Research Board] Fast Track Young Scientist Fellow in the Mathematical Sciences at IISc. I won this fellowship while I was a Visiting Scientist at the Indian Statistical Institute. I was located at the Centre for Ecological Sciences because Vidyanand Nanjundiah, who was then a professor at IISc, hosted me in his lab to give me excellent exposure to theoretical biology research that they were conducting. During my days at IISc, public health policymakers in India took notice of my work and contacted me to develop models for framing policy in India. It was their initiation and interest which led me to begin practically useful mathematical work.

Around that time, I got to work for the World Bank for the second time. I had won the London Mathematical Society fellowship to be an academic visitor at the University of Oxford and Imperial College, London. By the end of 2003, I was back at IISc and continued collaborating with national AIDS planners and with higher government officials in developing model-based prevention and treatment strategies. And during 2005-2007, when I was again at Oxford University, the National AIDS Control Policy team asked me to develop models for the third round of policy for the period 2006-2011, which I led from Oxford.

Besides research at IISc, I also taught courses for the Integrated PhD and regular PhD students at IISc, some of it with NV Joshi [also a professor at the Centre for Ecological Sciences]. For me, the good thing about IISc was that it gave me a world-class platform to think originally and to develop scientific professionalism, and of course, it gave me close friends in almost every branch of science and engineering, and in life.

Was the modelling for World Bank similar to AIDS modelling for the Indian government?

Both projects involved differential equation-type modelling and a bit of statistical setting. In my first assignment as a consultant to the World Bank (while I was

a visitor at Imperial College, London before joining IISc), the purpose was to predict the impact of antiretroviral therapies in India for controlling HIV spread. And for my second assignment for them (while I was at IISc), I was asked to develop model-based projections for district-level spread of HIV in India.

Could you please explain the model you developed for the Indian government and how it fed into the budget allocation for AIDS control?

Our aim was to understand the impact of the second and third phase of national AIDS control policies in controlling the spread of HIV in India. The co-authors of these papers were Drs T Kurien, R Bhat, K Sudhakar, and PK Maini. In our first paper that came out in *Mathematical Biosciences and Engineering* (2009), we focused on modelling of HIV transmission dynamics within sub-populations of India (without measuring the role of antiretroviral treatment). In our second paper, published in the *Notices of the American Mathematical Society* (2012), we built, for the first time, models to project the number of HIV individuals in India who require second-line therapy. We had contributed to the fourth round of AIDS policies in India, working from ISI.

Once we project the number of individuals who require a certain type of treatment, the government uses these numbers in preparing budgets, based on data for treatment costs per person.

Your model for AIDS control was close to the real estimate. Have you had experiences where your model didn't make the right predictions?

That's correct – our projection was close to the real estimate.

When the basic data for a disease is not available, there is not enough data to support accurate transmission dynamics. And when infection causes are unknown, we fail to build accurate and timely models, for example, for the Nipah virus outbreak in 2018 in India.

Are you still associated with the project on modelling of AIDS and other diseases in India?

Yes, I am involved in several practically useful and implementable modelling of AIDS and other diseases in India, and also in the USA. Recently when I visited India in the summer of 2018, I had given a talk organised at the National Institution for Transforming India (NITI Aayog, New Delhi) titled "Mathematical Modelling in Government Policy Formations".

Are people opening up to the interdisciplinary mode of approach that mathematical modelling of diseases demands?

I assume so. I would think mathematical modelling is a very important and useful way to handle real-world phenomena because it has the flexibility to blend with computational tools and data science. Pure mathematical modelling without any aim of real-world implementable solutions might be fruitful academically, but for the advancement of science and the well-being of society, an interdisciplinary approach is needed.

Credit for the practical success of our HIV mathematical models must also go to my collaborators, especially non-mathematicians, who put in an enormous amount of effort in back-and-forth discussions.

What are you currently working on?

I am heading the Laboratory for Theory and Mathematical Modelling, which I founded, within the Medical College of Georgia at our university, to do practically useful work and also, in the process, set up a math-tech company. In 2018, I invented a new technology which developed hybrid models that work with blockchain technology data (with JA Vazquez and L Ostrosky). This technology can save patients' lives with timely initiation of treatment for certain fungal infections, where the window of opportunity for treatment is shorter. We are working with our university's office of innovation and commercialisation to file a US Patent for this technology. A new collaborative work on harmonic analysis applications is in progress (with SG Krantz, my hero in mathematics since my postdoc days, whose books are very popular), and we already have our first paper, in 2018.

I would think mathematical modelling is a very important and useful way to handle real-world phenomena because it has the flexibility to blend with computational tools and data science

A few years ago, I proved a theorem, the Carey-Rao Theorem in stationary populations, jointly with biologist JR Carey, and we are working on several theoretical applications of it, and also handling disease modelling projects. Other models for infertility treatment, and graph theory models for bird behaviours and the like, are in progress, with my other collaborators.

If I had a smartphone then, I would have taken selfies with CV Raman

Uma Jagannath is currently helping IISc's archives
(Photo courtesy: IISc Photography Club)

– Kavitha Harish

On 8 February 1966, 18-year-old Uma Jagannath began her career as Readers' Assistant at IISc, even before her results were out: she had just written her Diploma examination in library science at the Government Polytechnic for Women, Bangalore. After getting her results, she was immediately made the Library Assistant. In an interview with Connect, *Jagannath recalls her 50-year association with the Institute.*

What do you recall of your initial days at the Institute?

When I received my appointment order, I didn't know that IISc was such a big research institute. Satish Dhawan was the Director and BV Raghavendra Rao was the Librarian at that time.

I had the opportunity of assisting and interacting with intellectuals, helping them locate relevant information at the right time from the ocean of books and journals available at our library.

Back then, we had no computers or online facilities. Everything was manual. We maintained records on card catalogues and registers. We used to prepare card catalogues by typing the entries on the cards.Back then, we had no computers or online facilities. Everything was manual.

> *Back then, we had no computers or online facilities. Everything was manual*

What is your most unforgettable experience?

I had the opportunity to answer a reference query from CV Raman. I remember very well that I helped him locate a few articles from the *Physical Review* and *Physical Review Letters* Journals. Now I feel if I had a smartphone, I would have taken selfies with CV Raman!

Could you share with us some of your significant

Jagannath with Maithra, PA to the librarian (left) and J Rama, Library Assistant (right) in the 1970s
(Photo courtesy: Uma Jagannath)

contributions?

I have worked on and headed several major library projects which include a reclassification project (converting all the documents in the library from colon classification system to decimal classification system), cataloguing periodicals collection, establishing and organising Compact Storage Area.

As an Assistant Librarian and Deputy Librarian, I was in charge of all sections of the library, including reference section, book acquisition section, periodicals section, circulation section, and document delivery services.

I gave a talk on the brief history of IISc in Kannada, which was broadcast on All India Radio, Bangalore.

How has IISc helped shape your career?

I improved my qualification from Diploma in library science to PhD in library science. I had the opportunity to go to the United Kingdom under the British Council Scholarship (TCTP Programme) Technical Cooperation Training Programme at the University of Sheffield in 1991-92. I could achieve all this because of the support and encouragement from the Institute throughout my career.

> *I had the opportunity to go to the United Kingdom under the British Council Scholarship (TCTP Programme) Technical Cooperation Training Programme at the University of Sheffield in 1991-92*

What was your PhD work on?

I did my PhD at Bangalore University. My research was to identify obsolescence in library collection based on usage patterns. As a part of my research study, Analysis of Obsolescence in Academic Library Collection: A case study of J R D Tata Memorial Library, I did a series of surveys and analysed them.

The result of the study gave us valuable inputs for decision-making processes in the library, such as space saving and how to efficiently utilise library space to boost the image of the library, while also making way for incoming materials. The results served as an input to the Library Committee Decisions in handling obsolete materials and also served as a MIS (Management Information System) tool in handling and weeding of obsolete materials. This study served as a useful tool to achieve an overall improvement in the academic library collections and services.

What is your association with the Archives and Publications Cell?

Soon after my retirement in 2007, Prof. Balaram, the then Director, appointed me to the Archives Cell to establish the Archives Cell Library and to organise archival documents. I worked in this cell for a year. During this period, I had started working on the Timeline of IISc project, which involved recording important events and milestones of IISc.

In 2008, I was offered a position of a Chief Librarian in an engineering college. In October 2017, I joined IISc to continue working on the TimeLine project. Now I can say that I am celebrating 50 years of my association with the Institute.

How has IISc changed over the years?

Those days, the Institute was filled with more staff members: we had more than 2,500 employees at that time. Employees' associations were very active in a few serious meetings.

> *Now I can say that I am celebrating 50 years of my association with the Institute*

Now I see a drop in regular staff and the campus looks empty, compared to those days. This is perhaps due to the shifting of the aerospace, physics and biological sciences departments to the other part of the campus; the movement of staff or students towards this area [around IISc's main building] has become less.

The library used to be filled with many students those days, the library looks empty now. I find the campus very calm and quiet.

Kavitha Harish works at the Archives and Publications Cell.

Lily Harish-Chandra, circa 1955
(Photo courtesy: Lily Harish-Chandra)

Childhood Memories

– Lily Harish-Chandra

Lily Harish-Chandra grew up on the campus of IISc, and now lives in Princeton, USA. She is the daughter of GT Kale, who was Librarian and Lecturer in French, and briefly Warden of the Institute Hostel; and H Kale, who was part-time lecturer in German. Lily later married the mathematician Harish-Chandra, who was a student at IISc during 1943-45.

My husband, Harish, came to the Indian Institute of Science when he was 20 years old to work with Dr. Homi J. Bhabha. However, Sir CV Raman, who had been his examiner when he did his MSc, took an active interest in him from the start. At that time, Dr Bhabha was not much at the Institute as he was heavily involved with starting the Tata Institute [of Fundamental Research] in Bombay. So in a general way, Harish saw much more of Raman than he did of Bhabha. While at the Institute, because of a shortage of accommodation in the hostel, Harish lived at our house for the first six months. My mother had been his Foreign Languages teacher at Allahabad University and Bhabha had suggested this arrangement to my parents. It is probably here that he also got to know Dr Jatkar with whom he enjoyed long walks and conversations. But he did his physics work with Bhabha, who later arranged for him to study with Prof Paul Dirac in Cambridge, England. My father had got a position as a librarian at the Indian Institute of Science following his return from the International Institute of Agriculture in Rome at the outbreak of World War II. My mother was appointed Lecturer in Foreign Languages. She taught French and German for scientific reading and was also a translator in other European languages. We had a house on campus, and for a child, this was an idyllic life.

> *The Institute then was much less built up than now and my childhood memories are full of space and security*

I was six years old when we came to Bangalore and one of my first friends was Vijaya Jatkar. We spent the next ten years in close contact, together with the daughters of Dr V Subrahmanian. The Institute then was much less built up than now and my childhood memories are full of space and security.

During our school years, our lives naturally revolved around school. We went to various schools in “town” and

there was a bus in the Institute that took us, first a huffy old diesel one and then a more modern one. It would pick up all the children to school from their houses around the maidan and long waits at some of the houses were legendary. On weekends and holidays was when we all played together, mostly make-believe games at each other's houses. We learnt to ride bicycles, on full-size men's bikes, Vijaya on her uncle's, and I and Lady Raman's niece on Raman's. Manoeuvring these was quite a job and for a long time, the only way I knew how to stop was to ride into the hedge in front of our house. Finally for our 11th (I think) birthday, we got a new Raleigh ladies bicycle. These we rode around and round on the Institute's grounds, allowing privileged visiting friends a spin (I was reminded of this recently!).

I believe we were all fairly lively little girls (there were young boys too but it was unthinkable for us to associate with them) and we loved to participate in all the functions that the students organized. There was, for example, Holi, when the students, particularly those from the north, would go round to the houses respectfully splashing the staff. I remember my mother always making coconut barfi to give the boisterous visitors. For the other festivals, the Institute families tended to celebrate with the students who came from their regions. As my father was Maharashtrian, as were the Jatkars, our big festival was Ganesh Puja, with lots of good food (Vijaya's mother was a marvellous cook) and good cheer, a crowd taking Ganesh to Sankey Tank for final immersion.

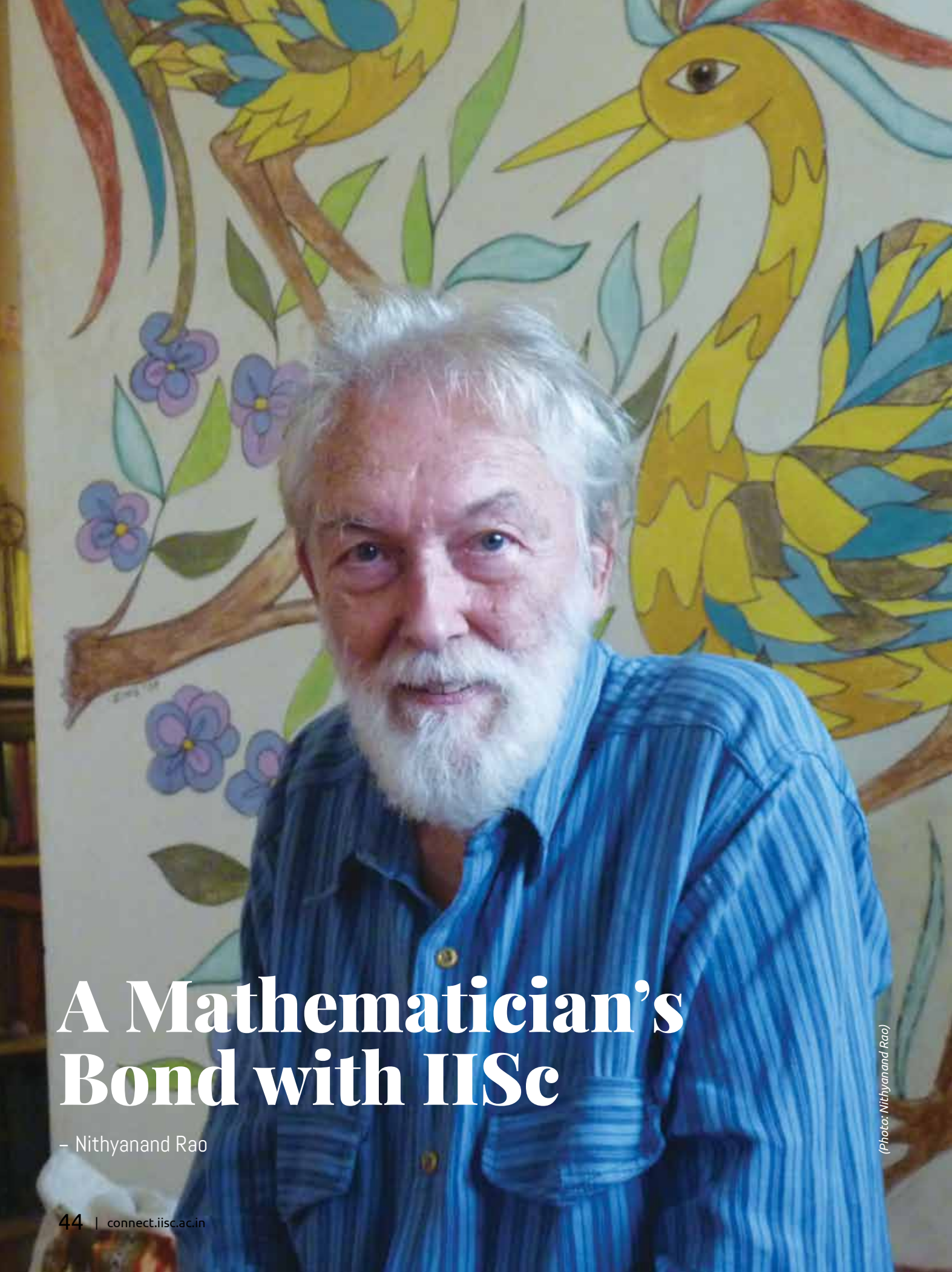
But the biggest festive occasion was, of course, Independence Day, August 15, 1947. The Institute and its students had by and large not participated actively in the independence movement although clearly their sympathies were there (Vijaya's uncle, however, whose bicycle she used to ride, had taken part and this made a big impression on us). We were all fed the sayings of our leaders and as girls particularly, this made our dreams go far and wide. For Independence Day, the grounds in front of the Main Building were spruced up and decked with flowers, especially around the Tata statue. An enormous flag was set up on the tip of the Institute tower and there was an assembly of the whole Institute in front. Sir JC Ghosh, who was the Director at that time, stood on the first floor balcony and probably gave a speech (which I cannot remember) and using some gadget which intrigued us, unfurled the huge impressive orange, white and green Indian flag. We were all choked up with emotion and I believe we then all sang for the first time in public *Jana Gana Mana*. We had been taught the words by Dr BC Guha's eldest son, Rattan, who was

Lily, in 2016 *(Photo courtesy: CS Aravinda)*

not at all enthusiastic to have to do this and this seems to have amused us no end. Vijaya remembers that the flag mast fell over the next day under the weight of the flag, but I can only remember its size the first day. I still have one of those little flags we were given to wave in the new era. It was a great excitement.

Around this time or just after (I am not clear about this), three English professors, Adcock, Harris and Carter came to the Institute. The Carters and Harrises were our neighbours, and we all became friends. We remained in contact long after they left. Later, Prof Kenneth Aston who had come back to the Institute, and Prof Havemann were also our neighbours and as they did not have their families with them, they would often come to our house for meals. Aston and Prof K Srinivasan had known each other for many years and the latter was also a frequent visitor. He had wonderful parties, even though he was strict in his habits, but he seemed to like company and had many friends. With many of the other families at the Institute where there were children, we were in and out of each other's homes a lot of the time and so felt fairly connected and this stayed till we grew up and scattered.

I hope this conveys something of the life in a bygone era. It makes for wonderful remembering!



A Mathematician's Bond with IISc

– Nithyanand Rao

(Photo: Nithyanand Rao)

Eric Lord, a British-born mathematician, was a visiting scientist at IISc for over two decades. He first came to the Institute in 1972, and later returned to Bangalore, the city he loved, for good. A man of varied interests, Eric has written books about general relativity, mathematics, crystallography, and paranormal phenomena. He has also illustrated children's books. He spoke to Connect *about his association with IISc and his work. Excerpts from the interview.*

How did you arrive in India?

I got my PhD from King's College London in 1967. I had published two papers at the time. And out of the blue, I got a handwritten letter from India, from Madras [now Chennai], from somebody I had never heard of. It was from Alladi Ramakrishnan of Matscience [The Institute of Mathematical Sciences]. He said, "I've just read your paper; we've been doing similar work here," and sent me a reprint of one of his papers. I thought "that's nice, somebody is appreciating what you've done" and then forgot all about the letter until years later when I got it out again and wrote to him, saying, "Can I come and work with you people?" Alladi's reply was: "Yes. We can offer you a year as a Visiting Scientist. We can't offer you much money because India is a poor country but Madras has a beautiful beach." I spent a year in Matscience; that was 1971.

So this was in the early years of Matscience.

Yes, it was very small back then. It was on the Adyar Polytechnic Campus and had about 30 people altogether, students plus staff.

The year went by quickly, I wanted to stay in India longer. I talked to Alladi about the possibility of extending my appointment, but he was reluctant to do that. So I wrote to various Indian research institutes, including the Ooty observatory, places like that. The first enthusiastic reply I got, from about a dozen letters, was from KP Sinha of the Indian Institute of Science.

I didn't know much about Sinha. He was in the departments of Physics and Applied Mathematics, a professor in both, and he had this bunch of half a dozen students. He was so kind and nice and pleasant to me but also very quiet and shy – like me. As soon as I met Sinha he asked me to give a series of lectures on Einstein's relativity. They were very well attended, to begin with; the lecture hall in the Applied Mathematics department was full. It dwindled later because attendance was 'optional', but Sinha came to every one of those lectures. Although he was not a relativist – his field of expertise was solid state physics – he picked up enough knowledge from my lectures to take on students in relativity! I started working with him and his students and stayed there for about three or four years.

It was a nice time of my life. I was a Research Fellow, a foreign 'Visiting Scientist', so I never had any tedious responsibilities – no 'core' courses, no exams to set, no committee meetings. I was free to just get on with my research and interact informally with the students. It was a happy time.

I left in 1975 to go to West Germany on a Humboldt Fellowship and after that, I was in Edinburgh for six years. There was a gap of nine years before I came back to IISc.

What prompted you to come back?

I always had a feeling that Bangalore is the place I wanted to be. We had Indian friends who lived in Holland (The Netherlands) people we had met in IISc that first time – Krishna and Dhun Prasad. We visited Holland a couple of times to be with them, and they visited us in Edinburgh. I remember Dhun asking me, "If you could live anywhere in the world you'd like, where would you choose?" I said I'd be in Bangalore!

It's hard to believe how lovely Bangalore was in the 1970s. It's got no resemblance to this busy, noisy metropolis it's become. But one gets used to change and it's my home now.

'It's hard to believe how lovely Bangalore was in the 1970s. It's got no resemblance to this busy, noisy metropolis it's become. But one gets used to change and it's my home now'

Participants of a conference held in Bangalore by Matscience, 1971. Alladi Ramakrishnan is seated in the centre, and Eric Lord is fourth from right. *(Photo courtesy: Eric Lord)*

In 1983 I wrote to Sinha again and said, "I hope you remember me. I'd like to come back and work with you again." Being Sinha, he said, "Yes, please come. I can provide you with a Senior Research Fellowship." So in 1984, I came back. He just kept renewing that fellowship for three or four years, and then there was a shortage of funds. For about a year or more after that I had no position, but of course I kept on working; I became interested in 'optimisation algorithms' and collaborated with SK Sen and his student Venkaiah.

You had a position in the Department of Metallurgy (now Materials Engineering) and worked with Srinivasa Ranganathan there. How did that come about?

I first met Srinivasa Ranganathan of Metallurgy in 1991, as a consequence of my article "Quasicrystals and Penrose Patterns" in *Current Science*.

I'm not superstitious but sometimes in life, it's as though things have been arranged for you and coincidences keep happening that push you in a certain direction. I used to be on the campus, just walking or cycling around. I would bump into Rangu [Ranganathan] "just by chance" every few days. He would go around the campus on a motorbike. He knew about my situation – that I had work but no official paid position. One day, he said: "Alan Mackay [British crystallographer at Birkbeck College, University of London] is coming and he has some software for investigating minimal surfaces and, in particular, those with 'triple periodicity' like crystals. Would you like to work with Alan and me on this topic?" I said, "If you can get me a position in your department then, yes, of course I will!"

I went to the library and studied crystallography, learned about the space-group symmetries and things like that, and read up on minimal surfaces. I used to keep bumping into Rangu every few days and showing him some little sketches about my ideas. Eventually, Alan came and introduced me to the software. I didn't know anything about computers then! Alan loves Bangalore and came very frequently over the next few years. I learned from him how to use computer graphics and we thoroughly enjoyed working together.

You wrote a book with Ranganathan as a co-author.

Yes, the work we did together eventually led to our book "New Geometries for New Materials" (Cambridge University Press 2006).

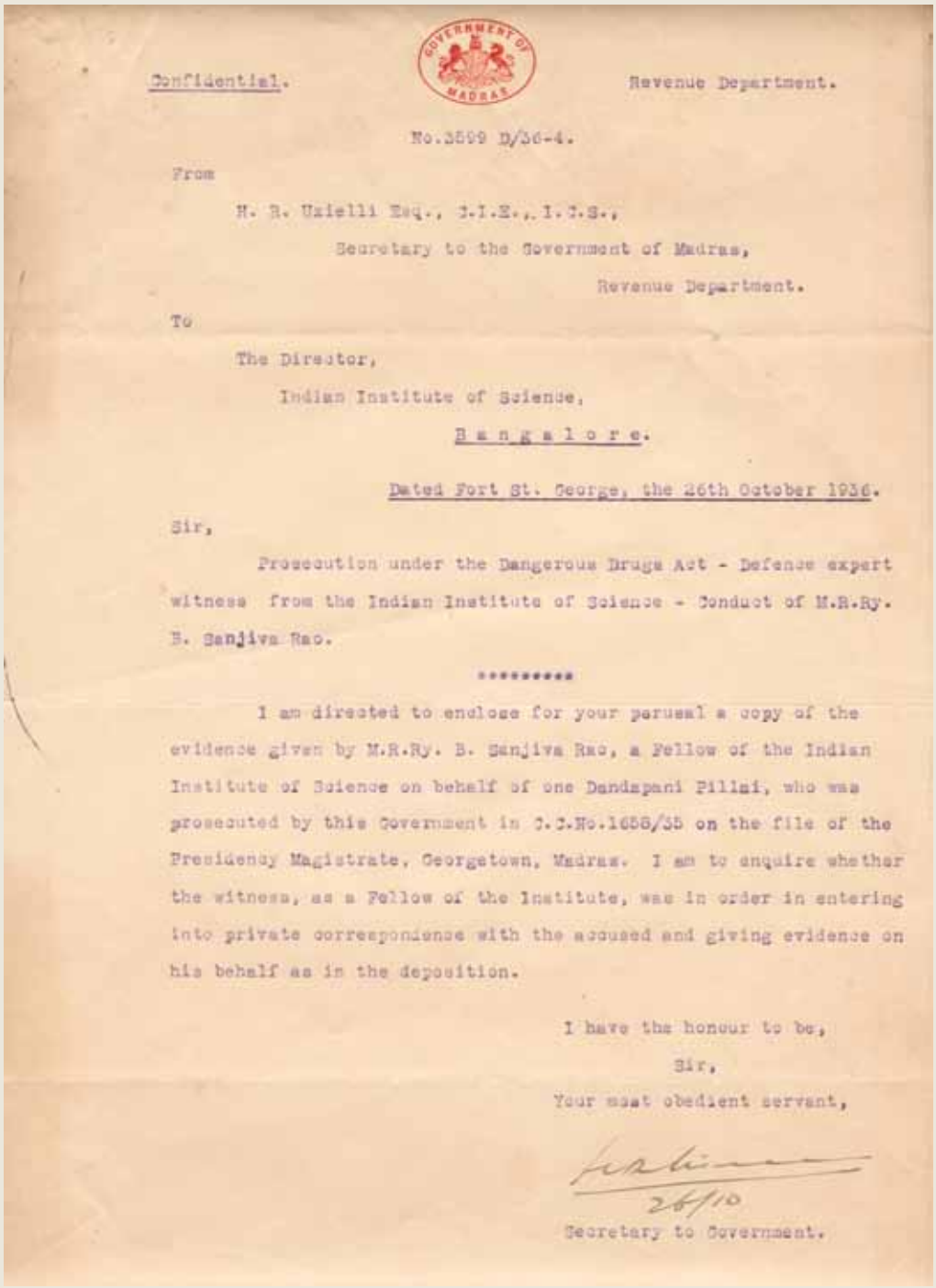
What was your work in the Metallurgy department like?

It was all very informal. There were regular Saturday talks in the department and occasionally when my time came I would give a talk on some aspect of crystallography. I had no official responsibilities at all – just do something interesting and publish it to justify my existence. Sinha first, and then Rangu later, kept funding me as a Visiting Scientist. I couldn't be a faculty member because I wasn't an Indian citizen – I am now. (I probably have set a record for the longest 'visit' to IISc!) But that was okay – my only responsibilities were to get on with my research work and help the students with theirs. Rangu's students, of course, had practical work whereas I was totally theoretical. They'd be involved with preparing alloy samples, studying them under the electron microscope and obtaining diffraction patterns. The theory involved geometry, understanding how the molecules are arranged in crystals and quasicrystals – I could help with that.

The students were great fun. Being with them kept me youthful. We would go out into town together to have dinner and drinks. For me, it was like being a student again!

NOT YOUR AVERAGE SCIENTIFIC INVESTIGATION

"I have had no occasion to analyse ganja for the purpose of giving evidence in court"



Confidential. Revenue Department.

No.3599 D/36-4.

From

M. R. Uzielli Esq., I.C.S.,
Secretary to the Government of Madras,
Revenue Department.

To

The Director,
Indian Institute of Science,
Bangalore.

Dated Fort St. George, the 26th October 1936.

Sir,

Prosecution under the Dangerous Drugs Act - Defence expert witness from the Indian Institute of Science - Conduct of M.R.Ry. B. Sanjiva Rao.

****

I am directed to enclose for your perusal a copy of the evidence given by M.R.Ry. B. Sanjiva Rao, a Fellow of the Indian Institute of Science on behalf of one Dandapani Pillai, who was prosecuted by this Government in C.C.No.1658/35 on the file of the Presidency Magistrate, Georgetown, Madras. I am to enquire whether the witness, as a Fellow of the Institute, was in order in entering into private correspondence with the accused and giving evidence on his behalf as in the deposition.

I have the honour to be,
Sir,
Your most obedient servant,

26/10

Secretary to Government.

On 26 October 1936, HR Uzielli, Secretary to the Government of Madras, Revenue Department, wrote IISc's Director a letter about a drug investigation in which an Institute faculty member had been involved.

A man named Dandapani Pillai had been prosecuted by the Government of Madras under the Dangerous Drugs Act over ganja, and B Sanjiva Rao, head of the Department of Organic Chemistry, had given testimony on Pillai's behalf, saying that he had tested samples of the substance and found no trace of ganja. In his letter to the Director (who happened to be CV Raman), Uzielli wrote: "I am to enquire whether the witness, as a Fellow of the Institute, was in order in entering into private correspondence with the accused and giving evidence on his behalf as in the deposition."

Rao's rather amusing deposition on 10 June 1936 is as follows:

IN THE PRESIDENCY MAGISTRATE'S COURT, GEORGE TOWN, MADRAS

Before M.R.Ry.N. Koil Pillai Avl., B.A., B.L.
Second Presidency Magistrate

D.W.3 Mr. B. Sanjiva Rao age 41 years sworn. I am employed in the Indian Institute of Science, Bangalore for the last 15 years. I am a Fellow of the Indian Institute of Science. I am a graduate of the Madras University and M.Sc. The fellowship of the Indian Institute of Science is equivalent to D.Sc. of any Indian University. I am now in charge of the department of organic chemistry. The Institute is under the portfolio of the education member of the Viceroy's Executive Council. Sir C.V. Raman is the Director of the Institute. I have been doing a lot of Research work. I have published more than 35 original Memoirs in the course of my research work. I am acquainted with the work of detecting ganja and other drugs. Exhibit 1 was received in the Indian Institute of Science with a sealed packet complainant's lagiyam* (M.O.5) from Dandapani Pillai. I tested a sample of the lagiyam in M.O.5 and returned M.O.5 to Dandapani Pillai with a covering letter exhibit 11 and a report exhibit 111. I have opined in exhibit 111 that the presence of ganja in the sample examined is very doubtful even the minimum of 200:1 (Amirtham:Ganja) was not present in the sample. I have now examined the contents of a tin in M.O.1 in court. Ganja is not present in it even in the proportion of 200:1. As the quantity decreases the test is not reliable. I cannot say whether ganja is present or not present. I applied Beam's test** in court. I took about an hour. I have applied the best test. Microscopic test alone is not very reliable as there are plants similar to ganja plants. Ganja loses its activity by efflux of time.

Cross examination: I am not paid by Government but by the Institute. The post is not pensionable – Our services are available to the public. 50% of the fees received goes to the Institute. There is no printed form of certificates and opinions issued by us. The correspondence between me and the accused was of a private nature. A fee of Rs. 28/ was charged for analysing M.O.5. I took 3 days for analysing and for sending the opinion. I was the senior Assistant to the acting Professor till 2nd May 1936. The professor does no analysis work. He does not supervise the work. I obtained the Director's permission to come here and give evidence. I have had no occasion to analyse ganja for the purpose of giving evidence in court. I have not given expert evidence in any case till now. I took the degree in 1929 and my treatise was on plant products. Usually other tests are also made, but I made only one test today for want of instruments. I brought only all the instruments for making Beam's test. I brought instruments with reference to Advocate's letter to me. For Beam's test weights and minimum glass measures are not necessary. No weighment was made by me here. I brought ganja weighed and Amirtham weighed from Bangalore. I took a similar quantity of lagiyam from M.O.1. I applied the modified Beam's test. I brought Mysore ganja. Madras ganja also will respond to the Beam's test. I had no occasion to test Madras ganja. I was not aware of any difference between Mysore Ganja and Madras Ganja. The active principle of ganjas of different provinces is the same but their proportion may differ. I have tested only Mysore ganja. I do not know that the active principle of ganja varies according to the soil where it is grown.

I did not measure or weigh the contents to-day. I gave equal amount of time for the various processes. There is no quantitative test for ganja. I have not brought any microscope to day. I did not apply any such test. There are 4 or 5 tests in all but all are not of the same value.

Re-Examination: The modified Beam's test is the best test. The microscopic test was found to be not satisfactory. Weighment is not necessary to apply Beam's test.

** Editor's note: Tamil word for a concoction of herbs and spices meant to serve as a digestive aid*

*** Editor's note: The Beam test is a simple forensic test to detect the presence of marijuana, based on the fact that when hemp tissue is treated with bases, it gives off a purple colour*

ABSTRACTS

IISc Photography Club

The bark of a eucalyptus tree
near the swimming pool