

Editor-in-chief

Prof. Binny J. Cherayil

Editorial Board



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FROM THE CHAIRMAN'S DESK

A warm welcome to the readers of The Elixir! For the last few years, The Elixir, IPC's in-house magazine, has been brought out by an enthusiastic team of student volunteers, with assistance from my colleague Prof. Binny Cherayil. It had an earlier avatar some decades ago. I hope we continue to bring out this magazine to stay in touch with everyone interested in the Department's activities.

I took over as the Chairman of IPC on the 16th October 2018. Prof. Umapathy, who served as our Chairman since 2015, accepted the position of Director, Indian Institute of Science Education and Research, Bhopal, and assumed office there in September, 2018. Prof. S. Vasudevan served as Chairman of IPC in the interim. I thank them both and all our previous Chairmen, among them the founding Director of the IISc and a Director who led the first Indian Institute of Technology of independent India in Kharagpur, Sir J. C. Ghosh.

IPC and our Institute started their journey together in 1909. The first Director of our Institute was Prof. Morris Travers, a chemist and the co-discoverer, along with Sir William Ramsay, of a number of rare gases, including neon, xenon and krypton. Sir Ramsay was awarded the Nobel Prize in Chemistry in 1904 for this work. Asked to help found the new research institute envisioned by J. N. Tata, he laid the ground work for its establishment, and recommended Travers as its first Director. When the Institute finally started, it had just two departments, Electrotechnics, and General and Applied Chemistry, which became IPC a few decades later.

Today, the IISc can arguably be considered the mother of all academic institutions in India, and our department has played a significant role in its achieving this status. Sir Jan Chandra Ghosh became a Professor in our Department and the Director of the Institute in 1939 after Sir C. V. Raman's tenure as its first Indian Director. Sir J. C. Ghosh made enormous contributions to the Department and the Institute, and it was during his time that the IISc introduced programmes in aeronautical engineering, internal combustion engineering, metallurgy, and power and high voltage engineering. After serving as a member of India's first Planning Commission, he was invited by Pandit Nehru to establish an Indian Institute of Technology in Kharagpur, the first of its kind, and the start of an academic revolution. The IITs today have become a global brand. The IISc, in the meantime continued to excel, but it has remained below the radar of the general public, though well known in the academic world. It is the number one Institute in India, and has remained so for more than a century. The contributions of Institute chemists towards this achievement are quite significant.

The recent announcement by the Government of India of the 'Institute of Eminence' tag to the IISc has made it much more widely known. If there was one Institute about which there was unanimous agreement with the Government's decision, it is IISc. Clearly our Institute and Department have sustained excellence for 11 decades now, and I am confident they will continue to do so in the future. I invite everyone to go through our website for more details (ipc.iisc.ac.in). Let me end by wishing everyone a happy, healthy, peaceful and prosperous 2019.

E. Arunan



Sir J. C. Ghosh's son Debabrata Ghosh and his family visited IPC and IISc on 1st June 2018. They donated some vintage photograpahs of Sir Ghosh to the Department, which have been handed over to the Archives and Publication Cell. The photograph above shows of some of our faculty members with the Ghosh family during their visit.

Photo courtesy Sharath Ahuja, formerly of the Archives and Publications Cell, IISc



WHAT THRILLERS CAN TEACH US ABOUT SCIENTIFIC WRITING Prof. Binny J Cheravil



Sometimes the hardest part about doing science is writing about it. Especially when you're a nonnative user of English. Then the task of translating the details of a research project into clear coherent prose can be a challenge. As it often is for Indians, whose scientific papers are written in language that tends to be at best merely serviceable or at worst painfully incomprehensible. It's the rare Indian scientist whose writing commands immediate interest and sustains it over pages of technical minutiae.

So even when we write without doing lasting damage to the Queen's English, we're not always successful in keeping our readers glued to the written page. In fact, we probably lose them in first few paragraphs of the Introduction the itself, which I regard as possibly the most important part of a scientific paper. The Introduction is the place where a reader decides to stick with the material or to move on to something more gripping.What I've observed over the years is that when we write Introductions we almost invariably begin by saying something like this: "Lithium-ion batteries (substitute your own favourite topic here) have recently received a great deal of experimental and theoretical interest." There then follows a string of citations to a dozen or more papers, many of them unread, that by their sheer numbers and impressive provenances are intended to reassure skeptical readers that the subject under discussion is truly at the forefront of research, and that no further justification is needed for making it the focus of the present study. And none is ever offered. What is offered

instead are the mundane details of the study, a lengthy compendium in passive voice of facts and figures that have all the appeal of a shopping list.

This is a lazy approach to writing, and it should come as no surprise if the only reaction it evokes is boredom.

Boredom, of course, would never be an issue if the research being described really were momentous. If you've just discovered roomtemperature superconductivity, for instance, you could probably write a paper on the subject in hieroglyphics and still be certain of captivating your audience; it wouldn't matter then if your syntax were fractured or your grammar atrocious or your spelling awful. But most of us will not be fortunate enough to stumble upon something of such pith and moment, so we need to do more than merely state the facts of the case to get people to sit up and take notice.

And this is where, I think, thrillers can teach us a thing or two. Thrillers may represent a despised genre to high-minded literary purists, but they usually make for compelling reading. And one of the ways in which they keep readers interested is their use of what I call the principle of confounded expectations: the rhetorical equivalent of feinting a left to the chin, and landing a haymaker with the right.

A nice example is the opening of Alistair MacLean's 1960 high seas adventure, *When 8 Bells Toll.* It's worth quoting in full:

"The Peacemaker Colt has now been in production without change in design for a century. Buy one today and it would be indistinguishable from the one Wyatt Earp wore when he was marshal of Dodge City. It is the oldest handgun in the world, without question the most famous, and if efficiency in its designated task of maiming and killing be taken as a criterion of its worth, then it is also probably the best handgun ever made. It is no light thing, it is true, to be wounded by some of the Peacemaker's more esteemed competitors, such as the Luger or Mauser; but the high volume, narrow calibre steel-cased shell from either of those just goes straight through you, leaving a small, neat hole in its wake, and expending the bulk of its energy on the distant landscape, whereas the large and unjacketed soft-nosed lead bullet from the Colt mushrooms on impact, tearing and smashing bone and muscle and tissue as it goes, and expending all its energy on you.

In short, when a Peacemaker's bullet hits you in, say. the leg, you don't curse, step into a shelter, roll and light a cigarette one-handed, then smartly shoot your assailant between the eyes. When a Peacemaker bullet hits you in the leg, you fall to the ground unconscious, and if it hits the thigh bone, and if you're lucky enough to survive the torn arteries and shock, then you'll never walk again without crutches because a totally disintegrated femur leaves a surgeon with no option but to cut your leg off.

And so I stood absolutely motionless, not breathing, for the Peacemaker that had prompted this unpleasant line of thought was pointed directly at my right thigh.

Another thing about the Peacemaker: because of the very heavy and varying trigger pressure required to operate the semi-automatic mechanism, it can be wildly inaccurate unless held in a strong and steady hand. There was no such luck here. The hand that held the Colt, the hand that lay so lightly, yet so purposefully on the radio operator's table was the steadiest hand I'd ever seen. It was literally motionless.

What I find riveting about these opening paragraphs is the way they keep you off balance, setting you up to expect one outcome but then ambushing you with another. They begin in low key, with three simple unremarkable sentences. The tone is a little dry and somewhat didactic, as though the author were imparting a lesson in history. By the fourth sentence, though, there's a shift in register, and what seemed to be shaping up as another boring afternoon lecture has evolved towards something decidedly sinister. We soon discover the reason for all this talk of guns: a particularly nasty representative of its kind is pointed at the narrator's leg, and the slightest misstep on his part will leave him without one. But this is not the only twist in the tale; there's another (which Ι haven't reproduced), and it's even more unsettling: the "hand that held the Colt" was motionless because it was the hand of a corpse, a corpse with a knife in its back that had become stiff from rigor mortis.

There's a lesson here for scientific writing: a good way to generate and sustain interest in a paper is to always keep the reader a little unsure of what's coming next. If the subject is lithiumion batteries, for instance, one way to get the reader past the first couple of paragraphs is to first offer up a few concrete and particular facts about them, and then, when he's not quite expecting it, to point out – using a strategically deployed "But" or "However" – that some of those facts are actually undermined or called into question by new information in your possession, which you now proceed to dole out in dribs and drabs, whetting his appetite for more, until finally, perhaps after a few more U-

turns if you can manage them, he's sufficiently intrigued by what he's read that he's willing to plough through the rest of the paper without much fuss. If you can afford the luxury, try this approach the next time you're preparing a submission for JACS.

A well-written Introduction is, of course, no

guarantee that your paper will meet with universal acclaim, but it's likely to at least get the paper a fair hearing. Given how often papers are dismissed simply for being unreadable, it can be worth your while to put in as much energy in writing them as you would in doing the science they describe.





During a visit to IPC earlier this year, Nusrat Sanghamitra, a former student of Prof. A. G. Samuelson, consented to answer questions from The Elixir on her life and work. Here are her answers, edited for length and clarity.

The Elixir: What are some of your earliest recollections of childhood?

Nusrat S.: I was born in a small town in Orissa called Soro, but I grew up in Koraput (till I was 4) and then in Bhadrakh. The earliest recollection I have is of a place in Koraput where small baby monkeys in tiny little red dresses sat on huge stones the shape of elephants.

TE: You were a student of IPC. What was your time here like as a student? What did you work on for your Ph.D.?

NS: I remember the first time I walked in front of the Faculty Hall – I was just awed by the grandeur and aura of that place. Everything about IISc and IPC is lovely; I liked the campus, the canopy of trees and Bangalore weather. I worked with Prof. Samuelson on the synthesis and anticancer activity of Cu (I) phosphine complexes. I take this opportunity to thank him for accepting me as a student even though I wrote his name as my second preference! He is an excellent teacher and a very

kind human being with a heart of gold. I realized and appreciated this more and more later in life. However, during my student days I was very scared of him. I owe my scientific spirit, ethics, my ability to define a problem and devise a



solution to my training in his laboratory.

TE: After your Ph.D., how did you come to be an entrepreneur?

NS: To me, entrepreneurship is not a career but a way of life. It's a mindset to make a difference in peoples' lives. After my Ph.D. and 8 years of postdoctoral research, I developed a hypothesis that I'm working on now, but I wasn't convinced about continuing research as a faculty member at a research institute. That's because I felt suffocated in the conventional academic set-up, the rat race of publishing papers, the illusive world of impact factors and citation indices, etc. I love fundamental research, but I just can't motivate myself to do research and publish papers for the sake of it unless I see its potential use in real time. I just can't accept that scientific credibility can be measured by the number of papers a scientist publishes or by the impact factor of the journal where he or she publishes them. I can't do research with the sword of 'publish in high impact journal' hanging above my head. I took a break year, volunteering in school and palliative care organizations, and then went to Jordan to do an intensive course in Arabic. During this period, the program manager, Nikhil, and the CEO, Dr. Suar, of KIIT Technology Business Incubator convinced me that if I had an innovative idea I should apply for a Biotechnology Ignition Grant, which would give me 50 lakh rupees to come up with a proof of concept in 18 months. I never believed I would get the grant, but I did, though the reviewers kept it in the high-risk category! That was the beginning ...

TE: How did you come up with the idea for your business?

NS: As a B.Sc. chemistry student, I was naïve enough to dream of synthesizing a drug that would cure cancer, and during my Ph.D., I thought copper phosphine complexes would replace cisplatin! My ideas and goals are more refined now, but my mission as an individual, as a scientist and now as an entrepreneur has not changed, and that is to improve the quality of life of cancer patients.

I did not venture into entrepreneurship in the conventional way, with a business idea. I was disheartened by the fact that the Cu(I) phosphine complexes whose anti-cancer activity I studied for my Ph.D. were extremely toxic in vivo. I felt I needed to understand the mechanism of drug action. Since most drug targets are proteins, I wanted to study protein structure and function, which I did with Prof. Mazumdar at TIFR. The following few years of work were not directly relevant to anti-cancer drug research, but I enjoyed studying the biophysical chemistry of proteins. My eureka moment came during my stay in Kyoto University with the serendipitous discovery of a novel mechanism for the entry of a protein into a cell. I was convinced at that time that we'd had enough of cytotoxic drugs, that we didn't know how to make them work, and that we needed to reduce the dosage. Based on that discovery, I developed a hypothesis, felt the need to prove it, and then translate the

TE: What challenges did you face when you started?

NS: I have just started, 1.5 yr old! For me the biggest challenge so far has been to find a cofounder and build my team. The other challenge has been managing operations in two different countries, one in Pune, India, and the other in Cork, Ireland. Expanding so early to a different continent was an extremely tough strategic decision to take as a naïve solo founder.

TE: When did you charter your business? *NS:* March 2017.

TE: What products and services do you offer?

NS: Ours is an innovation led R&D company. It is based on a patent pending technology to deliver molecular cargoes directly into cells. We are using the technology to transform drugs from poisons to remedies, and to give new life to old drugs. In our portfolio, we will have products in three differ-

ent verticals: anticancer drugs, antibiotics, and research reagents. So far, our business model is to take our formulations to the preclinical stage and then go for a co-development partnership with a big or mid-sized pharma company or licensing the technology. At this moment, we do not intend to take up manufacturing per se, but that might change.

TE: How do you advertise your services?

NS: I am not too concerned about marketing strategies at this stage. Since ours is a drug delivery technology, the new formulation of anti-cancer drugs or antibiotics will be treated as a new chemical entity, and will have a long gestation period, since it has to go through the FDA approval process, which requires huge investments. So for us, the important thing is to create a buzz, to showcase our technology, and to build relationships with prospective pharma partners, angel investors and venture capitalists. This is the reason I had to take the decision to expand into Europe so early – it was to gain access to the venture capital community. In India, we have global players in generic drugs but our ecosystem and funding mechanisms are not yet mature enough to take on the risks that innovation-led pharma companies face.

TE: What are the risks entrepreneurs face when they start?

NS: Entrepreneurs take a leap of faith when they quit their full-time jobs to invest in building a business. Raising the first fund is challenging. Then there are several valleys of death during the growth of the startup. I get butterflies in my stomach every other day: what if the technology fails, what



if there is no market for my product, what if I fail to build the right team, what if I'm not be able to raise more money? In my case, I've known all along how risky my idea is, especially given the long regulatory pathway that drugs go through. I know it can fail any time. All the same, I admit that it's deeply gratifying to feel that I'm pursuing my dream and following my conviction. I will have no regret even if it fails.

TE: How many employees do you currently have?

NS: We're four full-time members now and we will be hiring two more research scientists soon. We also have part time consultants helping us maintain accounts, patents, etc.

TE: What three adjectives best describe your start- up? *NS:* Disruptive, adaptive, patient-centric.

TE: What would you like to do to improve your startup? *NS:* Build a winning team and improve my team management skills.

TE: Where do you see your startup in the next 10 years?

NS: I am insanely fearless and a die-hard optimist. So as a CEO, I would like to lead CyCa-OncoSolutions through its growth into a globally recognized billion-dollar public pharmaceutical company, and to see it improve the quality of life of cancer patients.

TE: How do you understand the potential of a product before you choose to work on it? What are the criteria that

you have in mind when you start something new?

NS: It's vital that entrepreneurs talk to their customers early in the product development cycle. That's when one understands a product's potential. Market research is a must. The most important criteria I have in mind when starting something new is the value it creates and its impact on my customers' quality of life.

TE: What is the potential market size of your product today?

NS: Our prime focus is the anti-cancer drug market, which has a total addressable market (TAM) size of \$ 75-80 billion, and out of that the service obtainable market for us is \$ 3-4 billion. In anti-microbials, we are addressing a service obtainable market of \$ 840 million out of a TAM of \$ 60-70 billion, and in the research reagent market, it is \$ 292 million out of a TAM of \$ 9 billion.

TE: If a product fails, what do you do, and how do you convince investors to stay on board?

NS: That's a difficult and scary situation, and it's too early

for me to offer an answer. It's important to outline risk mitigation strategies very early on, with clear fallback or pivot options. That's why adaptability is important, so long as core values aren't compromised. We need to be always ready to alter the product pipeline or strategy to safeguard investors' interests.

TE: Do you think the entrepreneurial culture is taking off in India, or are we still lagging behind other countries?

NS: It's definitely taking off. The government has come up with wonderful schemes and funding mechanisms to de-risk ventures, especially biotech startups. But there's still a lot to catch up on, and the ecosystem needs to be much more adaptive, vibrant and developed. Not just entrepreneurs but society as a whole needs a shift in mindset. All stakeholders – the government, academic institutions, industry, clinicians, hospitals, and especially our investor community – have to increase their understanding of biotech/pharma startups, particularly those with long gestation periods, and signifi-

cantly increase their appetite for risk.

TE: How conducive is the present-day scenario in India for startups?

NS: I think if anyone wants to have a startup in India, this is the right time.

TE: Any advice for the current generation of students?

NS: Have the courage to do what your heart says, however insane or crazy it may sound, and pursue it relentlessly with all your heart and with single-minded devotion and laser-sharp focus. Strive for excellence, don't settle for mediocrity because complacency and mediocrity kill progress. Remember that a scientific breakthrough is not limited to its novelty aspect; its principal component is the transformative power it has on society. So be accountable to taxpayers' money; transform solution science to delivery science so that society can say that the science has impacted it; and finally, be a success story of values.



BOOK REVIEW THE DOWER OF NOW

Prof. K.C. PATIL

The Power of Now, by Eckhart Tolle; Yogi Impressions, Mumbai (2001); pp.192, Rs.395.

Website: www.eckharttolle.com

Eckhart Tolle was born in Germany and educated in the U.K., but he is now settled in Vancouver, Canada. Until

his thirtieth year he lived in a state of continuous anxiety, interrupted by periods of suicidal depression. Then one day he woke up early in the morning feeling like a new person, free from all his fears and miseries. He did not realise what had happened to him. He wandered the streets of London aimlessly for several months. Abandoning a promising career in the U.K., he moved to California, U.S.A., living there for a couple of years without a job but reading about spirituality and talking to spiritual teachers. He realised that he had suddenly become Enlightened!

What is Enlightenment or Self-Realisation? India is the birthplace of humanity's quest for spiritual enlightenment. A number of enlightened persons,

including Buddha, Mahaveera, Shankara, Ramakrishna Paramhansa and Ramana Maharshi, were born here. According to my understanding, enlightenment is a state in which you know the answer to the eternal question, Who am I? I am not my body, my mind or my intellect but my consciousness (atma). To be enlightened is to be one with the universal consciousness (paramatma). Once you are enlightened, you become calm, compassionate and serene. A peaceful mind, a mind without thoughts (no mind) is creative. Siddartha became the Buddha when he was completely relaxed and stopped

seeking the answer to his quest. Most pathbreaking discoveries, such as Kekule's elucidation of the structure of benzene, are made during periods of sleep. That is why you are told to sleep over a problem; the solution will emerge during a state of semi -consciousness.

The Power of Now is Eckhart Tolle's account of his personal life after he achieved a state of self-realization. It is written in a question and answer format and is chiefly concerned with understanding how to control one's mind when it is always immersed in the past or future but never the present. Most people have acquired the habit of procrastination, putting off for later activities that should be done now. But by being in the present, it is possible to be creative and to achieve one's

goals in life. As the author puts it, if you are not "Now Here" you will be "No Where"!

SO, HOW'S THE DATA LOOKING? UH... UH.... UH... U

The Power of Now is a must-read book for one and all.



MOVIE REVIEW

THE SHAPE OF WATER

An unparalleled concoction of fantasy and realism seasoned with a potpourri of emotions, both impressive and bizarre, Director Guillermo del Toro's brainchild, The Shape of Water stands out as a unique cinematic event. It was the rather unusual ambiguity of the name that first lured me into watching the movie. And I must say, it was an altogether out of this world experience, one that from frame to frame linked elements of the magical and the mundane, exposing the viewer to an unlikely tale of love and empathy in scenes of marvellous realism.

Set against the backdrop of Cold War America, the story revolves around Elisa (Sally Hawkins), a neglected mute woman who works as a janitor at the Occam Research Facility in Baltimore, Maryland. А voice-over introduces her as "the princess without a voice, found by the water". She shares apartment with Giles her (Richard Jenkins), а



commercial artist and a gentle, shy, closeted gay man. The homophobia of the era has turned him into a melancholy, professionally frustrated alcoholic. At work, Elisa's best friend is Zelda (Octavia Spencer). Elisa is shown to live a monotonous, routine life both at home and at work until the day she and Zelda witness the research facility's extraordinary top-secret acquisition, an amphibious creature (Doug Adams),

Jayashree Bhagabati

half-man, half-fish captured from the Amazon by Richard Strickland, the Chief of Security. Strickland, a self-proclaimed war hero, is a brutish despot who is emotionally detached from his family. The creature's multiple breathing systems are being studied in the lab for their potential military applications. Dr. Hoffstetler (Michael Stuhlbarg), the project's chief researcher, develops some empathy for the amphibian man, whom he considers a marvel, and who is subjected to inhuman and utterly barbarous treatment in the lab. Strickland, on the other hand, mocks Hoffstetler, and calls the amphibian man an

> "abomination", a filthy thing not made in the image of the Lord. If one were to represent The Shape of Water as a fairytale, Strickland would play the evil witch or "the monster who tried to destroy it all".

> A vivisection of the creature is being planned, and with the day of this procedure just round the corner, Elisa is

drawn to him, feeding him hard-boiled eggs and communicating with him through gestures, since neither of them possesses the power of speech. In no time at all, Elisa falls head over heels in love with the fish-man. What follows next is a brooding sequence of love and loss, of empathy and inhumanity, weird and awe-inspiring at the same time. I won't disclose all the details here, and I'll leave it to readers to discover the little twist that occurs in the end. My apologies if I've given away too much already!

authoritative figure, "the man of the future", but he's shown eventually to meet an untimely end.

If one examines the cinematography closely, the blue-

green frames in the movie take one to a space that looks equally uncanny and creepy. The soundtrack, on the other hand, spreads a little pixie-dust all around as it breathes life into the otherwise wordless exchange of dialogue between Elisa and the fishman. As Elisa, Sally Hawkins's silent

performance is remarkable, her elegant facial expressions creating corporeal poetry of great power. As for the amphibian man, his intricate design and characterization seem much too real to be computergenerated imagery. The gills that flap open, and the nails on his claws that click on tile and glass are as concrete as can be. I was almost compelled to wonder if the god-like creature actually existed somewhere on the earth (like the Amazon!) Unlike most other tales of love, Elisa develops an instant connection with the fish-man, the chemistry between them speaking of a pool of emotions that keep pulling them into its ripples when they 'talk', 'listen' and 'understand' each other. As the story moves on, the turn of events reveals different aspects of its characters. For instance, Elisa is initially portrayed as a duty-bound woman, but she is shown eventually to be a fighter, someone who defies convention and leaves no stone unturned to save the fish-man's life. Along the same lines, the fish-man's aggressive nature in his early interactions with Giles gives way in the end to a generosity of spirit that prompts him to heal Giles with his restorative supernatural power. There's also Strickland's initial depiction as an



the fairy-tale plot or reworked Beauty and the Beast narrative that many might see it as. After all, the movie did earn thirteen Oscar nominations and bagged four of them! Through Giles, the gay man and Zelda, an African American, the story presents a

nuanced representation of the sexism and racism widely prevalent in the America of the time as well as the oppression these marginalized members of society experienced at the hands of white men like Strickland. It sheds light on those lesser explored aspects of professional life that, at times, could suck out the core of the human heart. In fact, the title of the movie itself is more than just a string of words, it has a latent meaning to it, profound and abstract. Just like water, which has no shape, one's beloved is supposed to be omnipresent, and hence shapeless and unperceivable. Love, as they say, transcends all bodily confines and unites two souls. Carrying this sentiment forward, the movie ends with a voice-over by Giles who quotes a poem that says,

"Unable to perceive the shape of You, I find You all around me. Your presence fills my eyes with Your love, it humbles my heart, for You are everywhere."

On a personal note, The Shape of Water for me was an unusual journey, one that took me down the road less travelled. The bumps made me wince, the bends gave me goosebumps, but in the end, as I looked back, I smiled through a tear.



















VIPIN













BEINVENUE











DIPANGKALI













SURAJIT













EKTA.











IPC's most dedicated foodie, Amit Joshi, tells you where and what to eat when you're in desperate need of a decent meal.

What is that one thing that never bores you? Yes, of course, food! You must have heard this bit of advice from your parents while growing up, "Eat to live, but don't live to eat". Well, is that actually true? Most of us follow the second option. Be it delicious recipes, nutrition tips, or eateries - we tend to want more and more tasty, lip-smacking delicacies. So it's a good thing that Bangalore has some of the best restaurants in the country. They are a testament to the changing times in Karnataka's capital, which has evolved into a rich and diverse food paradise for travellers and locals alike. There's an old saying that goes, "For every job, there is a perfect weapon". The same can be said about the food scene in Bangalore. Bangalore's restaurants aren't merely the whimsical products of adventurous restaurateurs; they also reflect the different tastes and palettes of a cosmopolitan audience. Here are my impressions of some of the restaurants in Bangalore that I've enjoyed eating and socializing in.

ICONIC SOUTH INDIAN RESTAURANTS

Mavalli Tiffin Room (MTR)

14, Lal Bagh Main Road, Sampangi Rama Nagar.

An old-time favorite of the locals, Mavalli Tiffin Room (or MTR as it is more popularly known) is the oldest of all the restaurants on this list. For the perfect experience of authentic Kannada cuisine, this is the place to go. (Rs 500 for two)

Nagarjuna

44/1 Residency Road.

If you like spicy food, you'll love Nagarjuna. This restaurant was started in 1984 by a humble Andhra

man with a passion for food. The menu is basic but delectable. (Rs. 800 for two)

Oota

Above Windmills Craftworks, 331 5B Road, EPIP Zone, Basavanna Nagar, Whitefield.

Oota's name is derived from the customary Kannada greeting "Oota aita?" (Have you eaten?). It serves up Karnataka on a platter. On the vast menu, you'll find little-known and popular dishes from South Karnataka, the Canara coast, the Western Ghats, the Deccan tract of North Karnataka, and the Hyderabad-Karnataka border region. Many recipes come from local communities and have been handed down over generations. (Rs. 2500 for two)

BUDGET RESTAURANTS



Onesta 4th Block, Koramangala.

This cozy cafe with blue and white interiors may have been a bungalow once. It has a tiny alfresco area with pretty garden furniture. The menu basically comprises 6-inch pizzas (Italian or thincrust) baked in front of you in an open plan kitchen. Roast chicken, bacon, prawns, pears and mascarpone are some of the interesting toppings. Plenty of options for vegetarians too. (Rs. 600 for two)

Truffles

22, St. Marks Road.

Located in the center of St. Marks Road, Truffles offers a wide array of continental dishes, along with seafood, pastries, and frankies. They are justly famous for their burgers, of which there is a large mouth-watering selection. (Rs. 800 for two)

Treat

3047, 80 Feet Rd, HAL 2nd Stage, Indiranagar.

Restaurants serving good North Indian food are hard to find in Bangalore, but Treat bucks the trend. With a team of North Indian cooks and a knowledgeable owner, Treat offers an irresistible experience of rich and delicious North Indian cuisine. (Rs. 800 for two)

PUBS & BARS : Good Music and Craft Beer



Toit 298, 100 Feet Road, Indiranagar II Stage.

This is the king of pubs in Bangalore. The beer's freshly brewed, the music is lively, and there's a wide variety of international main courses and starters to feast on. A must-visit watering-hole. (Rs. 1500 for two)

Big Brewsky

Sarjapur Rd., Behind MK Retail.

The Big Brewsky is an open-air microbrewery and restaurant that at first sight looks like any another romantic dining destination, but don't go by its looks. It's actually quite a noisy, happening party place. (Rs. 1600 for two)

Arbor Brewing Company

Allied Grande Plaza, Brigade Road.

A mind-blowing pub-cum-microbrewery that serves exquisite American and Continental delicacies. The food is best paired with one of the house-brewed beers, which range from black ales to golden lagers. The interiors are beautifully done with fantastic woodwork and an old ale-house vibe. The crowd here knows how to party. (Rs. 2150 for two)

ULTIMATE BUFFETS

Bakasur

23, Indraprastha Equinox, Inner Ring Road, Koramangala.

For a restaurant that has a nice ambience, good food and lots of drink choices, Bakasur is just the place. It has a spacious dining area, attentive staff, and long buffet islands serving every style of cuisine, from chaats to Chinese. (Rs. 1200 for two)

BonSouth

130, 1st Cross, Jyoti Nivas College Road, Koramangala 5th Block.

Do you hate it when the food goes cold on your plate? BonSouth places a hotplate on each table to keep your food warm! The restaurant serves the cuisines of Andhra, Kerala and Chettinad. Start your meal with elaneer cocktail and move on to the freshly made piping hot appams straight from the pan with mutta kozhambu or kai kari stew. (Rs.1400 for two)

Rasovara

Level 2, The Collection, UB City, Lavelle Road.

Elegant thali meals served by well-groomed waiters on gleaming Kansa cutlery, evoking the decadent lifestyles of the Rajasthani-Gujarati havelis – that's Rasovara. There are a mind-boggling variety of delicacies to tuck into, including dhoklas, kachoris, chaats, dal bati churma, gatte ki sabzi and khoba rotis. Make sure to leave space for the delectable desserts, like malpua, rabri and halwa. (Rs. 1400 for two)

Twentieth Century Electrochemists of the IPC Department

Prof. N. Munichandraiah, Department of Inorganic and Physical Chemistry, Indian Institute of Science

Amulya K.N. Reddy (AKN), born in 1930 to an affluent family, is well known in the electrochemistry community for his 1970 textbook *Modern Electrochemistry* Vols. 1 and 2, which he coauthored with J.O.M. Bockris. Even now the two volumes enjoy global popularity among students of

electrochemistry. After receiving a master's degree from Bangalore University, AKN began his professional career with a brief stint as a lecturer in Central College, Bangalore. He then went to the U.K. in 1950 for a Ph.D., later joining Central Electrochemical Research Institute (CECRI), Karaikudi, before moving to the IPC Department in



1965. In one of his first papers, AKN used electron diffraction techniques to study, for the first time, the structure and growth of electrochemically deposited body-centered cubic metals on the crystal faces of cubic structured crystals. His research interests later shifted to the study of surface films on metallic electrodes, where he made extensive use of ellipsometry to directly measure the formation of anodic films *in situ*, while simultaneously probing the films electrochemically.

AKN's interests shifted again, this time from electrochemistry to the direct application of science for the public good. As AKN himself said, "After almost two decades in the field of electrochemistry, I felt that [...] my own work was largely irrelevant to India's poor, the majority of whom live in villages. I also felt that I should reorient my efforts towards technologies for rural development." So in 1974, AKN set up a cell in the I.I.Sc. – the Application of Science and Technology to Rural Areas (ASTRA) – that would fulfill this vision. In 1975, he also helped establish the Karnataka State Council for Science and Technology (KSCST), which now operates out of the I.I.Sc. campus.

AKN served for a time as the Chairman of I.I.Sc.'s Management Studies, but continued to be a Professor of the IPC Department until his retirement in 1991. After retirement, he collaborated with others to set up the International Energy Initiative (IEI), becoming its founder president, and editing its journal "Energy for Sustainable Development". On his 75th birthday in 2005, a website (<u>www.amulya-reddy.org.in</u>) discussing his work was created by The Prayas Energy Group, Pune. AKN passed away in 2006, at the age of 76.¹ S. Sathyanarayana (SSN), another towering figure in IPC, made extensive contributions to electrochemical kinetics, batteries, and applied electrochemistry over a two decade career in the Department. After an undergraduate degree from IISc, SSN first joined CECRI, but then moved to the Indian Institute of Technology, Bombay. There, his talent was recognized by a well-known Russian electrochemist, Antropov, who selected him as a lecturer and sent him to Russia for basic electrochemical training. SSN worked for two years with one of the top electrochemists of the time, Frumkin, who then gave him two options: to work towards a Ph.D., or to work on different problems that would help diversify his research interests. SSN chose the latter.

Eventually, SSN returned to I.I.T, Bombay, where he established an electrochemical laboratory focused on problems related to the dropping mercury electrode. He was allowed to register for a Ph.D. without a research supervisor, successfully completing the degree on his own in the first such case in the Institute's history. In 1972, he moved to the IPC Department, largely through the efforts of AKN, who was interested in developing a centre of electrochemistry there. While at IPC, SSN initiated work on fundamental electrochemical questions, switching later to more applied re-

search, chiefly in the areas of metal corrosion and batteries. In the corrosion field, he found a way to determine corrosion rates of partially reversible metallic electrodes using Faradaic rectification, a technique invented by another stalwart of Indian electrochemistry, K. S. G. Doss. In the battery field, he studied Mg-MnO₂ and Ni-Cd



systems, initiating a collaboration with Bharat Electronics Ltd. that led to the production of Mg-MnO₂ batteries in Pune. With the production of these batteries, India became only one of two countries in the world to manufacture them, the other being Israel. The development of space quality Ni-Cd batteries in association with the Vikram Sarabhai Space Center was another of SSN's notable accomplishments. Indeed, his contributions to the battery field are so extensive that he was known as Battery Sathyanarayana in some quarters.

SSN retired from the IPC Department in 1992, and died a short time later in the same year.² The Society for the

advancement of Electrochemical Science and Technology (SAEST) in Karaikudi has now instituted the Prof. S. Sathyanarayana Memorial Lecture in his honour, and it is delivered biannually in SAEST meetings.

The last of the great IPC electrochemists I shall discuss is S. K. Rangarajan (SKR). Born in 1932, SKR completed a

B.A. (Hons) in Mathematics in 1953 from Madras Christian College. But he started his professional career by writing about films for a Tamil magazine. He then became a tutor, then a worker in the postal department, and finally, in 1955, an assistant professor at Alagappa Chettiar College of Engineering and Technology, Karaikudi. While there, at the behest of K.S.G. Doss,



the then director of CECRI, he quickly developed a theory for the phenomenon of Faradaic rectification that Doss had discovered. Doss was so impressed with SKR's talent that he persuaded him to join CECRI, where he remained for the next 10 years as a scientist. He then moved to NAL, Bangalore, later joining the IPC Department in 1975 as a Professor. He stayed there till his retirement in 1993, but served on deputation as Director of CECRI during the years 1988-92.

SKR contributed extensively to diverse areas of theoretical electrochemistry. His work on Faradaic rectification was especially noteworthy as he was able to derive a formal expression for the redoxo-kinetic potential, and to show that earlier results were special cases of his more general theory. Much of his other work followed the same pattern: he aimed for a general, formal understanding of a phenomenon, and then derived approximations that illustrated their range of applicability. In an obituary by two long-time collaborators, K.L. Sebastian

and R. de Levie, SKR was described as a genius, a man of many talents, whose unique abilities in science were matched by his fine qualities as a human being. SKR was a source of inspiration for several of his associates, and he was the driving force behind the creation of The Al(l) Chemists' Club, IPC's informal cultural society.

The IPC Department has instituted a memorial lecture in SKR's name, and the India Chapter of the Electrochemical Society (USA) recently established a student award in his name as well. After his retirement from IPC in 1993, SKR was associated for some years with the Institute of Mathematical Sciences in Chennai, the Raman Research Institute in Bangalore, and again with the IPC Department. He was active in research till his death in 2008.³

To conclude, in the last century, the Department of IPC was privileged to be the home of a number of eminent electrochemists. The field of electrochemistry has since thrived in ways that have impacted our fundamental understanding of the field and have led to a wide range of applications around the world. Society has now burdened electrochemists with the responsibility of developing appropriate technologies for electrochemical energy conversion and storage that would serve its future needs. The past and present electrochemists of the department have been contributing significantly to these areas of research. The electrochemists of the last century have directly or indirectly inspired those of the present, and it is hoped that their legacy will continue to be an inspiration in the centuries ahead.

Acknowledgements: The author is thankful to P. Sridhar (student of RSS), T. Prem Kumar (student of SSN), The ECSI, and Brij Kishore for their help in providing requested information.

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[2] A. K. Shukla and T. Premkumar, A Short History of Electrochemistry in India, Ind. J. Hist. of Sci., 2015, 49.4,



SPECIAL SEMINARS

Name of the Speaker	Affiliation	Торіс	Date
Prof. Suresh K Bhargava	College of Science, Engineering and Health, RMIT University, Australia	Building with bubbles. Is it the start of a new generation of catalysts?	05-01-2018
Prof. Andrew J Orr- Erwing	School of Chemistry, University of Bristol, Bristol	Ultrafast transient absorption spec- troscopy studies of radical and photo redox reaction mechanisms	08-01-2018
Prof. Zuowei Xie	Department of Chemistry, The Chinese University of Hong Kong, Shatin NT, China	Transition metal catalyzed functionalization of carboranes	10-01-2018
Dr. Hemakesh Mohapatra	University of Chicago, USA	Mechanochemical strengthening of polymeric materials using piezo- electric nanoparticles	15-01-2018
Dr. Amol P Amrute	Institute for Chemical and Bioengineering, ETH Zurich, Switzerland	Catalyst design for halogen mediated conversion of hydrocarbons to commodities	18-01-2018
Dr. Ankita Katre	DTNM Theory Group, The LITEN Institute, France	Modelling thermal transport and machine learning for nanomaterials	05-02-2018
Dr. Subrata Chakraborty	Dept. of Organic Chemistry, Weizmann Inst. of Science, Israel	Sustainable pincer catalysts design based on metal-ligand cooperation	22-03-2018
Prof. R. Bhargava	Beckman Institute, University of Illinois, USA	Infrared spectroscopic imaging for all digital, molecular decisions in cancer pathology	27-03-2018
Dr. Debasis Das	Depts. of Biology & Chemistry, Massachusetts Inst. of Technology, USA	Mechanistic investigation of metalloenzymes with potential in therapeutics and biofuel applications	05-04-2018
Prof. Anirban Hazra	Indian Institute of Science Education and Research (IISER), Pune	Understanding photoisomerization of ortho-nitrotoluene, a model for photo-labile caged compounds	13-04-2018

Name of the Speaker	Affiliation	Торіс	Date
Dr. Ritesh Dubey	Department of Applied Chemistry & School of Engineering, University of Tokyo, Japan	Crystalline sponges – a newer way to perform chemistry in metal- coordination self-assemblies	17-04-2018
Dr. Soumya S Roy	University of York, UK	Towards next generation of magnetic resonance applications by sustainable nuclear spin hyperpolarization	19-04-2018
Prof. Pascale Delangle	Institute for Nanoscience and Cryogenics, University of Grenoble, France	Metal-binding peptides to help understanding metal regulation and detoxification as efficient chelating agents	<mark>26-04-2018</mark>
Prof. Dietmar Hueglin	Innovation Campus, Mumbai, BASF Chemicals India, Pvt. Ltd.	Innovation @ BASF in Asia Pacific	04-06-2018
Dr. Veerabhadrarao Kaliginedi	Institute of Materials, EPFL, Lausanne, Switzerland	Charge transport at the electrode/molecule interface: From molecular electronics to energy research applications	10-07-2018
Prof. Vinayak Sinha	Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research, Mohali	Quantification of atmospheric OH reactivity and chemical emissions from agricultural fires and trees in South Asia using proton transfer reaction mass spectrometry	25-07-2018
Dr. Vishal Govind Rao	University of Michigan, Department of Chemical Engineering, Michigan, USA	Conversion of solar energy to chemical energy: Understanding of interfacial charge transfer dynamics	09-08-2018
Dr. Josep M. Oliva- Enrich	Physical Chemistry Institute, Spanish National Research Council, Madrid, Spain	Boron cluster chemistry in the ground and excited states: strange case of Dr. Jekyll (syn- B ₁₈ H ₂₂) and Mr. Hyde (anti-B ₁₈ H ₂₂)	20-08-2018
Prof. T. Pradeep	Department of Chemistry, Indian Institute of Technology, Madras	Reactions between nanoparticles	13-09-2018
Prof. Ravi F. Saraf	Department of Chemical and Biomolecular Engineering, University of Nebraska, Lincoln, USA	Sub-zeptomole to single molecule electrochemistry for cancer diagnostics and single electron-like electrochemical transistor	18-09-2018

ALMOST THERE ...

For research students the departmental colloquium is the last but one milestone on their road to a Ph.D. The following students reached this milestone in the past year, and the titles of their presentations and the dates they were given can be found here.

Nikki Kuhar

Dec. 29, 2017 (Umapathy Lab)

Vibrational spectroscopic investigations of dynamics of BSA unfolding, lysozyme – ethanol interaction and tissue imaging

Noor U Din Reshi

Jan. 01, 2018 (Samuelson Lab)

Mechanistic investigations of transfer hydrogenation catalyzed by Ru halfsandwich and group-6 NHC complexes

Naiwrit Karmodak Jan. 19, 2018 (Jemmis Lab)

Structural chemistry of boron, borospherene and borophene

Kamini Mishra Mar. 09, 2018 (Das Lab)

Protein adsorption on gold nanoparticle and protein surfaces probed by second harmonic light scattering in solution

> S. Amsarajan Mar. 20, 2018 (Jagirdar Lab)

> Chemistry of carbonized metallic nanomaterials

Imtiyaz Ahmad Bhat Jun. 01, 2018 (Mukherjee Lab)

Design and application of self-assembled coordination cages for catalysis and as drug carrier

Arun Kumar

Jun. 08, 2018 (Chakravarty Lab)

Vanadium complexes for DNA crosslinking and photodynamic applications

Bedabyas Behera Jun. 15, 2018 (Das Lab)

Blue and red shifting H bonding in X-H…Y (X=C, O : Y=O, N, S) complexes : A gas phase FTIR and ab initio study

Gaurango Chakrabarty Jul. 17, 2018 (Mugesh Lab)

Cyclic dichalcogenides as redox modulators: Synthesis, structure and glutathione peroxidase activity

Geethika M. Jul. 18, 2018 (Mugesh Lab)

Modulation of endothelial nitric oxide levels by enzyme mimetic redox modulators

Prodip Howlader Jul. 20, 2018 (Mukherjee Lab)

Organic transformations in the confined cavity of self- assembled Pd(II) molecular containers

> M. Kishor Kumar Reddy Jul. 26, 2018 (Mugesh Lab)

Development of new synthetic methodologies for selenocysteine, selenopeptides and β -seleno amino acids

A Celebration of the Scientific Contributions of Prof. Akhil R. Chakravarty



Somarupa Sahoo shares her impressions of the symposium and felicitation function held at the I.I.Sc. to honour Prof. A. R. Chakravarty on the occasion of his retirement from the Institute.

Prof. A.R. Chakravarty officially retired from the I.I.Sc. on 31st July, 2018. In honour of his contributions to the scientific community, a one day symposium titled "*Recent Advances in Inorganic Chemistry*" was organized on July 27th this year by his colleagues Prof. P.S. Mukherjee, Dr. Atanu Bhattacharya and Dr. K. Geetharani. The well-attended symposium showcased the diverse range of research in both the general field of inorganic chemistry as well as in more specialized areas of biochemistry. It provided an occasion for a large number of his students and colleagues, many now placed in eminent institutes around the country, to get together and discuss details of their current research activities.

Notable talks presented at the symposium included "Structure-Activity Relationship of Mixed Ligand Copper (II) Complexes of Nalidixic Acid and Curcumin", by M.

Palaniandavar from Bharathidasan University, "Dimetal Tetracarboxylates: Synthesis, Structure and Properties", by Birinchi Das from Gauhati University, and "Progressive Ligand Design to Impart Cytotoxicity Against Cancer Through Multiple Pathways: Design of Pt and Ru Metal Complexes", by Arindam Mukherjee from IISER Kolkata, the last two speakers being some of Prof. Chakravarty's earliest students. These talks were a reflection of Prof. Chakravarty's own multiplicity of research interests. There were also

talks by I.I.Sc. faculty, one on halogen bonding in the deiodination and membrane transport of thyroid hormones, by Prof. G. Mugesh from IPC, and another on the role of coordination environment in imparting colour to transition metal oxides, by Prof. S. Natarajan from SSCU.

The last talk of the symposium, "From Coordination Chemistry to Targeted Photo-chemotherapy" was by Prof. Chakravarty himself. He described how he started off studying the core coordination chemistry of metal clusters, then gradually moved on to the study of DNA cleavage properties of copper complexes, and finally ended up exploring metalbased photodynamic therapeutic (PDT) and anti-metastasis agents, his current areas of interest. As Prof. Ramakrishnan later remarked, his talk was unusually and pleasantly informal. He vividly described some of the highlights of the work done by his students over the roughly 35 years of his professional career, and where that work was headed towards now. Seeing all his former students together again made him a little nostalgic, and he talked about how he felt like a banyan tree whose shoots have branched off far and wide, some now firmly attached to the ground, others bearing fruits and flowers of their own.

After Prof. Chakravarty's talk, several of his colleagues from IPC went on to the stage to share anecdotes about him and to reminisce about some of the good times

> they'd spent together. There were also reminiscences by current and former students, many speaking about how he had shaped their careers and instilled in them habits of discipline and dedication. They, along with Prof. Umapathy, IPC chairman at the time, then felicitated Prof. Chakravarty and his wife, and presented them with gifts and mementos.

The symposium and felicitation function culminated in a well-curated soiree at the JVH lawns where IPC's fascination with fine food and

wine was on full display. The occasion gave Prof. Chakravarty's students an opportunity to mingle with one another and to talk about how things had changed with time. When the dust finally settled on the long day, everyone wore looks of quiet satisfaction on their faces.

Prof. Chakravarty's official retirement has done nothing to dampen his enthusiasm for science or his appetite for work. He will continue to serve the department for several more years as an honorary professor, mentoring the many PhD and postdoctoral students still under his care. Here's wishing him a fruitful and productive time in the department!

IPC in the News



On Sept 5, 2018, Prof. S. Umapathy assumed the Directorship of IISER, Bhopal.

IISc team synthesises artificial enzyme

Aswathi Pacha MAY 27, 2018 00:00 IST UPDATED: MAY 27, 2018 04:23 IST

Bac 5-7, 38%

Nanozyme mimics the antioxidant enzyme glutathione peroxidase

Nanomaterials that can behave like human enzymes have now been successfully synthesized by a team of researchers from Indian Institute of Science (IISc), Bengaluru. They produced the new nanozyme - nanomaterial with enzyme-like activity - by using vanadium pentoxide nanocrystals of just 150-200 nm size.

The nanozyme was able to act like the natural antioxidant enzyme glutathione peroxidase in our body and help maintain the hydrogen peroxide levels within the threshold. They synthesised the nanozyme with four different morphologies - nanowires, nanosheets, nanoflowers and nanospheres.

Bengaluru India Nano @BloreIndiaNano · Dec 5 IG HANNAL . A moment to remember. Prof S Sampath, @iiscbangalore being honoured with the prestigious Prof CNR Rao Award during the inaugural function of



21

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COLLECTIONS - VIDE

VIDEOS JOBS

CHEMICAL BONDING

H₂S dimer forms hydrogen bonds

Experiments suggest H₂S shares bonding similarities with water

by Sam Lemonick

OCTOBER 14, 2018 | APPEARED IN VOLUME 96, ISSUE 41

ydrogen bonds are one reason for water's unique boiling and freezing behavior and other properties. But scientists have debated for decades whether dimers of hydrogen sulfide, water's smelly triatomic cousin, also sport hydrogen bonds. Now, **Elangannan Arunan** of the Indian Institute of Science and colleagues report they have found experimental evidence that hydrogen bonds do indeed hold H₂S dimers together (*Angew. Chem. Int. Ed.* 2018, **DOI: 10.1002/anie.201808162**). Water's four hydrogen bonds (via two H atoms and two lone electron pairs) are evident in ice's tetrahedral structure, but in solid H₂S, each molecule is surrounded instead by a shell of 12 others. That suggested to some that H₂S does not hydrogen bond. Using microwave spectroscopy, Arunan's group detected rotational energy barriers in the dimer below about 60 °C that they say indicate the presence of hydrogen bonds. Computational chemists have reached the same conclusion. Arunan explains that at higher temperatures, those bonds break and re-form too quickly to be detected via spectroscopy. He adds that the observation that the distance between the H and S atoms is smaller than their combined van der Waals radii and that the S-H-S angle is nearly 180° further confirms hydrogen bonding.

N

A



Answers

- 1. E. Arunan
- 2. A.R. Chakravarty
- 3. Binny J. Cherayil &
 - S. Umapathy
- 4. Nisha
- 5. Sampad

90 Years of the Raman Effect

Current Status and Future Directions



H. C. Sudeeksha reports on a recently concluded conference organized by IPC commemorating 90 years of the Raman effect.

A conference to mark the ninetieth anniversary of the discovery of the Raman effect by Sir C. V. Raman and his student K. S. Krishnan was held at the I.I.Sc. from February 27, 2018 to March 2, 2018. Titled **90 Years of the Raman Effect: Current Status and Future Directions**, the conference was organized by Prof. S. Umapathy, Prof. Upendra Harbola and Dr. Chinmoy Ranjan of the IPC Department.

Prof. S. Umapathy, the Organizing Chair of the conference, delivered the inaugural address. This was followed by a plenary lecture delivered by Prof. Hiro-o-Hamaguchi (NCTU, Taiwan). Other notable speakers at the conference included Prof. Wolfgang Kiefer (University of Wuerzberg, Germany), Prof. Ajay Sood (I.I.Sc., Bangalore), Prof. Sebastian Schluecker (University of Duisburg-Essen), Prof. Mischa Bonn (Max Planck Institute for Polymer Research, Germany), Prof. Anthony Parker (STFC, UK), Prof. Tahei Tahara (RIKEN, Japan) and Koichi Iwata (Gakushuin

University, Japan). The talks both highlighted the Raman effect's historical evolution, from laboratory curiosity to sophisticated analytical technique, as well its future prospects, particularly its role in the development of newer methods of spectroscopic investigation. Raman spectroscopy's important contributions to the current study of fundamental problems in a range of different areas, from materials physics to biological science, were also discussed in several other invited and contributed talks. Several students presented posters of their work on the Raman effect at a session held on March 1, 2018.

Prof. Hiro-o-Hamaguchi and Prof. Wolfgang Kiefer were presented Lifetime Achievement Awards for their outstanding contributions to the field and for their inspiring guidance of new generations of Raman spectroscopists. The conference was useful for students and researchers alike in providing insights into the current and future status of Raman spectroscopy.

Interesting Facts

- Palindromes: Level, Rotator, Refer, Rotor, Alula
- Fire generally travels faster up a slope than down a slope!
- A beaver's lips close behind its front teeth!
- In northern oceans water spins CLOCKWISE!
- In southern oceans, it spins COUNTERCLOCKWISE!



