SCHOOL OF LIFE SCIENCES
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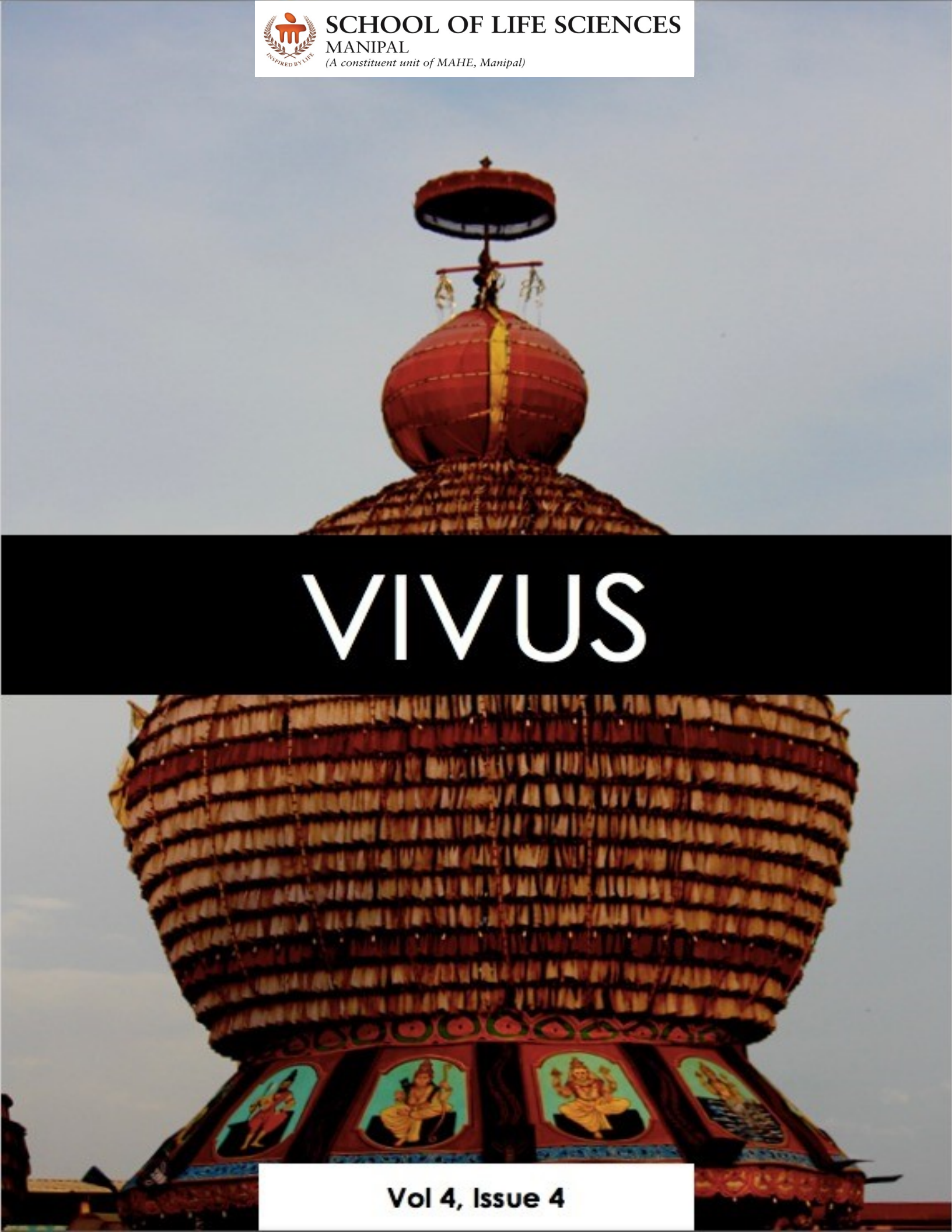

VIVUS

Vol 4, Issue 4

EDITORS' NOTE

Hello!

We are excited to present to you the fourth edition of VIVUS for the academic year 2017- 2018.

The cover of this issue is dedicated to the **Paryaya at Krishna Mutt** in 2018. The chariot seen in the picture is one of the main attractions of this ritual - standing approximately 50 feet in height, these chariots are the seat of the idol of Shri Krishna for this celebration.

This edition includes a variety of scientific articles in the areas of Neuroscience, Epigenetics, Physics and Nanotechnology. We have also had the pleasure to interview eminent personalities who visited SLS and are excited to present them to you. The 'Know Your Labs' segment in this edition covers the **Department of Radiation Biology and Toxicology** and the **Department of Plant Sciences.**

As we welcome the next editorial heads, we are proud to announce that with this volume, the newsletter layout has been revamped for better readability and its reach has increased to the readers with a student-run website (www.sites.google.com/site/everythingatsls). This website hosts all student activities, podcasts of interviews and media from various events and is updated regularly. We are proud to announce that the new segment 'Know Your Labs' has covered all departments within SLS across the four editions, as of September 2018.

We thank the authors and photographers for their contributions and making this volume a great success. We extend our sincere gratitude to **Dr. K. Satyamoorthy** for his encouragement and guidance, **Dr. T. G. Vasudevan, Dr. Saadi Abdul Vahab** and **Dr. Vidhu Sankar Babu** for their supervision and advice and the **Student Council** for their support.

Lastly, we thank you, for having taken out the time to read through this issue and welcome more participation, feedback and suggestions for the newsletter.

Wishing all the very best to the incoming Student Council and the new editorial board!

For any queries and suggestions, please contact us at sls.edboard@gmail.com

Thank You!

- **Harsh Ranawat and Tanaaz M Khan**

Alumnus BSc Biotechnology, III Year BSc Biotechnology

Co-Editors

The Editorial Board

School of Life Sciences, MAHE

2017-2018

CONTENTS

SCIENCE

From Epigenetics to Neuroscience, we’re sure to give you an interesting read!

THE IMPLICATIONS OF GENETIC AND EPIGENETIC RESEARCH

Mayukha Bathini (II Year, BSc Biotechnology)

The past saw geneticists and social scientists striking odds at the long-standing Nature vs Nurture debate. But, with the development of Environmental epigenetics as a discipline, a **"biosocial"** perception of the human body is fast approaching.

Gene-centric models failed to explain complex relationship between the human body and social circumstances as life sciences tended to reduce the unequal distribution of health in society to a linear curve of genetic bases. Environmental epigenetics now should stand a chance to explain these phenomena in terms of concrete molecularity. The convergence of the biomedical and the social sciences is viewed with enthusiasm. However, the biosocial model of the body comes with social, ethical and political challenges.

Genetic research like association studies and the development of genetic testing has raised ethical questions about the responsibilities that are tied to an individual who now has knowledge of his/her genetic risk to a particular condition. While it creates possibilities for prevention, most genetic disorders that are tested for have no prevention or cure. Are the identified individuals obligated to deal with their risk for the greater good? What defines their responsibilities? What if their family members would rather not want to know about their potential genetic risk? In addition to these moral dilemmas, studies show that people living with the knowledge of their genetic risk worry about being denied insurance or equal opportunities in jobs.

Epigenetic risk however has the possibility to lead to social segregation based on life circumstances. A consequence of **biosocial plasticity** was to claim European superiority and justify colonisation of inferior populations that have drastic negatively impacting epigenetic changes due to the environmental conditions they live in. The concept deemed that the degeneration suffered was hardly reversible. Biosocial plasticity was thus used to create racial inferiority leading to racism and negative eugenics.

Today's epigenetic research and more importantly transgenerational epigenetic inheritance comes with similar risks. The question we need to ask is if this research could be used for the benefit of the society rather than its segregation. Epigenetic research pertaining to how life experiences affect the body's physiology has the potential to mark groups and individuals who have been in traumatising situations as either harmed and damaged for life or harmed but can have a hope of reparation. Should greater responsibility be placed on pregnant women since most epigenetic effects are decided during development? Which groups in particular have to be monitored for hereditary effects?

It is thus a priority for researchers in environmental epigenetics to consider the social and political implications of their work, even more so when the concept of an interplay between the human body and the environmental conditions its put in, has a history that is better off being history. The molecular explanations of these phenomena in particular are thought of as more concrete 'proof' and add more weight. Will research that associates deprivation with physical and mental effects in later life lead to the recognition of the importance of better living conditions and contribute to closing the gap or will it increase the stigma that already surrounds the disadvantaged groups? Research funders and institutions play a huge role in making such inter-dimensional research possible.

Epigenetic and genetic research calls for a collaborative effort between scholars of life sciences and social sciences to reflect on the possible implications of their work and to interpret them in a socially responsible manner during and after the research process.

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NANOTECHNOLOGY IS ANCIENT HISTORY

Puja Kalita (II Year, MSc MBHG)

The ancient empires of the world are remembered for their impressive large-scale feats of engineering: Machu Picchu in Peru, the pyramids in Egypt, and the Parthenon in Greece to name a few. However, the artisans of those eras were also skilled at engineering at the opposite end of the spectrum i.e, at the nanoscale.

The manipulation of material at the atomic and molecular scale to create new functions and properties sounds like it should be a profoundly modern concept. By modern-day standards, they were working in a branch of nanotechnology called **nanocomposites**. These are bulk materials in which nanoscale particles are mixed to improve the properties of the overall or composite material.

There are a number of relatively famous examples of ancient artefacts which were created using nanocomposites. **The Lycurgus cup**, is a stunning decorative Roman treasure from about AD400; it is made of a glass that changes colour when the light is shone through it. The glass contains gold-silver alloyed nanoparticles, which are distributed in such a way to make the glass look green in reflected light but, when light passes through the cup, it reveals a brilliant red.

https://www.thevintagenews.com

A corrosion resistant azure pigment known as **Maya Blue**, first produced in AD800, was discovered in the pre-Columbian Mayan city of Chichen Itza. It is a complex material containing clay with nanopores into which indigo dye was combined chemically to create an environmentally-stable pigment.

Damascus steel swords from the Middle East were made between AD300 and AD1700 and known for their impressive strength, shatter resistance and exceptionally sharp cutting edge. The steel blades contain oriented nanoscale wire-and-tube-like structures, which almost certainly enhanced the material's properties.

https://www.tigeredge.com

Pottery from across the Renaissance Mediterranean world was often decorated with an iridescent metallic glaze called **lustre**, the colour and sheen of which is a down to nanoparticles of copper or silver.

So can we call the artisan who made these materials nanotechnologists? Ian Freestone at the Institute of Archaeology at University College London, who studied the Lycurgus cup, thinks not. "They were highly skilled but they were not nanotechnologists. They did not know that they were working on the nanoscale," he says. Peter Paufler from TU Dresden, who led the research on the Damascus sword agrees. "They developed materials by trial and error similar to evolution in biology. They didn't know the processes going on inside the solids."

The high-resolution microscopic analysis is used to reveal the nanostructure of these artefacts, but such analysis cannot tell us how they were made. "How did they dissolve these metals into the glass?" says Freestone of

the Roman glassmakers who made the Lycurgus cup. "And how did they get such a homogenous distribution of nanoparticles?"

A disadvantage of using high-resolution microscopy is that samples must be milled down to a fraction of their original thickness, destroying part of the artefact. When the material is abundant, such as for weather-resistant Maya Blue, taking a little for analysis is not a big deal. However, when these artefacts are rare, it is more difficult to justify. "There's no way it would have been acceptable to remove a sample of the Lycurgus cup," says Freestone. "It's too unique, too valuable. Fortunately for us, some fragments of the glass were found in its metal base several decades ago and were saved."

In the case of the steel sword, the curators at the Historical Museum Berne, who donated the sword, weighed up the potential benefits against the loss of one of their collection pieces. "Workers obviously felt that sufficient original blades were available to sacrifice some for research," says Paufler.

Such sacrifices are worth it. Some of these studies are providing pointers for new nanotechnology research. Understanding the nanoscale mechanism underlying how Maya Blue works has generated a new direction for scientists to investigate stable hybrid nanostructured pigments. Researchers from the French National Centre for Scientific Research have investigated a variety of nanoporous materials in which they insert and stabilise organic dyes.

These historic structures are the results of hundreds of years of trial and error experimentation with artisans passing their skills and knowledge down through generations. Nanotechnologists can also now build on this ancient wisdom. But, they benefit from a modern understanding of the behaviour of atoms and molecules along with state-of-the-art fabrication tools and analytical instruments to achieve exciting new products and devices in a fraction of the time.

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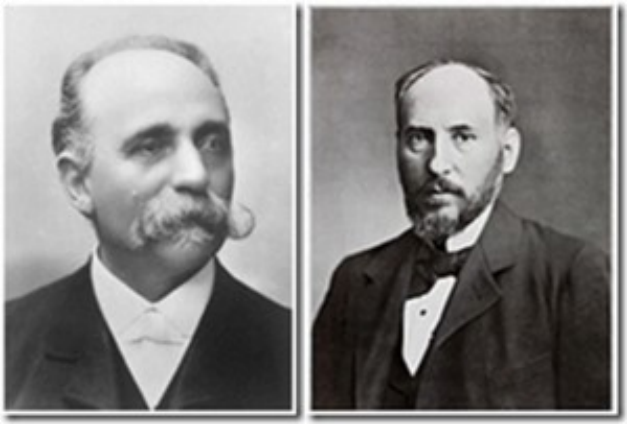
NOBEL PRIZES IN NEUROSCIENCE

Yash Goel (II Year, BSc Biotechnology)

One of the core concepts about neuroscience that fascinates me is that the "**brain is the body's most complex organ**" and has enabled many Nobel prizes. This article aims to bring together the important works which changed the face of how we look at our brains. Neuroscience has contributed to a large number of Nobel prizes, all of which haven't been mentioned in this article, especially the discoveries concerning the vestibular apparatus, audition and vision have been included. In a certain manner our ever hunting eyes and ears move along with the movement of our thought. For each new object can elicit a new thought, a new memory or rather a reflex. And it is after perceiving do we only establish a response to it. These topics are rather concerned with modern neuroscience. In this article, we shall discuss classical discoveries which set the roots for our reasoning into higher cognitive functions and their understanding.

It's quite ironic how an organ can study itself and one of such studies enrooted in history is something called **"The Black Reaction"** by **Camillo Golg**i. This reaction involves the staining of the neuron with silver nitrate salts. This method allows the staining of dendrites and axons and thus can help in identification of nerve pathway and its connection to other neurons. Further studies and experimentation with staining lead to the formation of the **"The Neural Doctrine"** by **Santiago Cajal**. It is established that each nerve cell is an independent entity and that nerve impulse transmissions occur via synapses. These discoveries were awarded the **1906 Nobel Prize** and have been the basis of the establishment of neurophysiology.

Stained neurons



Camillo Golgi *(left)* **and Santiago Ramón y Cajal** *(right)*

To this day, we are on the roll to discover new neurons such as one discovered recently known as the **"Rose Hip "** neuron **(**named so for its bushy appearance), at the Allen Institute of Brain Science , Seattle by using single RNA sequencing (Transcriptomics) and at the University of Szeged in Hungary who used a morphological approach to study these neurons. These neurons are GABAergic (inhibitory in nature) and are absent in the cortex of rodent models- raising implication for differences in the human and rodent mind.

After the establishment and an understanding of the basic structure of a neuron, another core concept in this field was established and that was that **"Neural transmission occurs through both electrical and chemical signals"**. This idea was proposed by **Sir Henry Hewitt Dale** and **Otto Loewi** who discovered the importance of acetylcholine as a neurotransmitter and refined its function in the nervous system. This discovery was awarded the **Nobel Prize in 1936.** Acetylcholine is an excitatory neurotransmitter and mediates the biochemical basis of the moment of our muscle, emotions and mental health. Several toxins which have been greatly used in warfare in Syria and were used during the WWII. This texin is widely known as the Nerve Gas which consists of blockers of neuronal channels which absorb this neurotransmitter leading to a prolonged contraction of muscles. This leads to a point where a person finally loses physical control. These neurotransmitters share similar receptors to that of nicotine and hence their function and the withdrawal effects of smoking can be an interesting topic to further read about.

Sir Henry Hallett Dale *(left)*, **Otta Loewi** *(right)*

These synapses and chemical signalling inpart a sense of individualism and behavioural identity by their virtue of plasticity. **Synaptic Plasticity** is a property which turns our brains into constantly changing dynamic structures allowing a neuron to produce a different response to a stimulus by moderating the release of neurotransmitters. One could again relate the tolerance of various psychoactive substances to the phenomenon of synaptic plasticity and a constant need for higher dosage to elicit a similar response. These changes may be short term or may be long term which are expressed by changes in the gene expression of an organism and the growth of synaptic connections. The property of synaptic plasticity hence plays an important role in being the neurochemical founders of change in memory and learning. This research was awarded the **2000 Nobel Prize** which went to **Eric Kandel** who demonstrated this phenomenon on an *Aplysia* (Sea Snail).

Eric Kandel

Another important aspect that changed the face and understanding of neuroscience was the **1963 Nobel Prize** which was shared by **Alan Lloyd Hodgkin** (Ionic Basis of Nervous Conduction) and **Andrew Fielding Huxley** (Quantitative Analysis of Excitation and conduction in nerves). Hodgkin and Huxley worked together on nerve impulse transmission in squid neurons. **Sir John Carew Eccles** was awarded the Nobel Prize for Ionic Mechanism of Postsynaptic Inhibition in the same year. This discovery established the whole concept of an action potential and how a nerve impulse travels throughout the whole nervous system.

Sir John Carew Eccles, Alan Lloyd Hodgkin, Andrew Fielding Huxley (left to right)

After the establishment of Ionic Basis of Nerve Impulse soon followed the **1970 Nobel Prize** for establishing the biochemical and anatomical basis of nerve impulse. The work concerned the storage, release and inactivation of humoral transmitters in nerve terminals. This discovery conferred a sense of specificity of different neurotransmitters with their physiological function. This prize was awarded to **Sir Bernard Katz**, who studied the muscle activity along with role of acetylcholine in neuromuscular junction, **Ulf Von Euler**, who discovered epinephrine and showed how it's packed, released and absorbed and **Julius Axelrod**, who studied noradrenaline which plays an important role in activation during fight and flight.

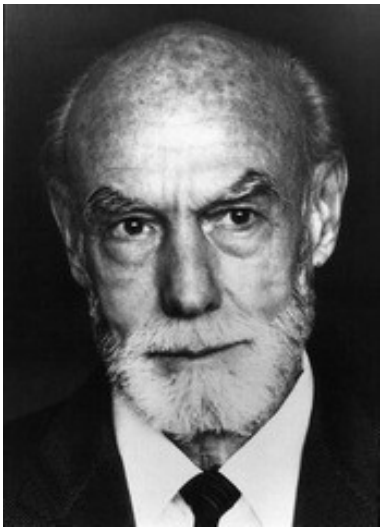
Neurotransmitters form an integral part of neuroscience and it is their modulated release that allows us to render a control on our muscular control. They also play an important understanding into the biochemistry of addiction and how certain substances elicit the feeling of pleasure and reward. Another neurotransmitter which

Sir Bernard Kutz, Ulf von Euler, Julius Axelrod *(left to right)*

has formed the basis of understanding Parkinson's is dopamine. Dopamine is a neurotransmitter which is released by the substantia nigra in the pons and leads to the activation or suppresses our circuitry in basal ganglia which modulate voluntary movement. This circuitry is majorly involved in initiation and termination of voluntary movement by two antiparallel pathways. In Parkinson's, there is a loss of these dopaminergic neurons leading a depression in signal. The affected individual faces problems with initiation of a moment and then it's suppression to a point where they have to be physically guided and may lead to a repeated action. This study was awarded the **2000 Nobel Prize** to **Arvid Carlsson**, who passed away on 29 June 2018.

Sir Arvid Carlsson

One of the major interesting experiments was the splitting of the brain. **Roger Sperry** was awarded the **1981 Nobel Prize** for the establishing the functional differences of the two cerebral hemispheres of the brain. He established this by studying patients with epileptic seizures where the corpus callosum (a bundle of white matter connecting the left and the right hemisphere) was rendered non functional to prevent the seizure from spreading. He termed it as the **split brain** as the two hemispheres seemed to function independently of each other.

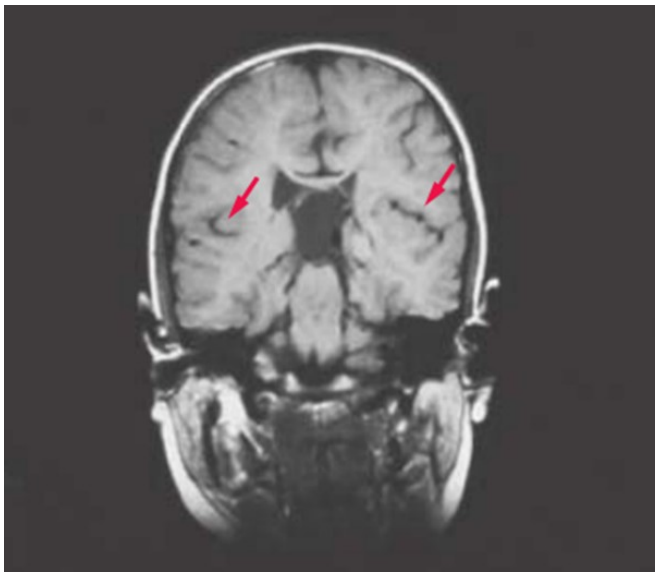


Roger W Sperry

From this the concept of split brain gained dominance where each brain was seen to be working as an individual hemisphere and did not remember the action witnessed by the other half. The work done by him established the concept of a dominant left hemisphere over the right hemisphere of the brain. He discovered that the left hemisphere of the brain was responsible for language understanding and articulation, while the right hemisphere could recognize a word, but could not articulate it.

Further investigation in this field concern with the Wernicke's area which lies adjacent to the sylvian sulcus towards the superior temporal gyrus. This area is essential for the understanding of language in any form may it be speech, written or even sign language. This region has played a special role in understanding the development and learning of a language along with age. So, every time we learn a new language we are establishing new synaptic connections in this region and surprisingly different languages can be marked specifically to a cer-

tain and a unique region. Thus, a surgeon should be careful from people speaking different nationalities for these languages could be marked separately.



Wernicke's Area *(red arrows)*

The region surrounding the Wernicke's area is the planum temporale present on both the left and right hemisphere. This region is rather larger in the left hemisphere and smaller in the right hemisphere where it is important in encoding for understanding the emotional gain in speech and writing. So, if a person suffered a damage to the right temporal planum he will understand the signs and speech but lose the ability to be emotionally moved by the language. It is quite evident how each discovery has unraveled the complex nature of this beautiful bundle of fibres until to a point where we can describe physiological and anatomical significant cells constituting a central positioning system in our hippocampus. This was the subject of the **2014 Nobel Prize** shared by **John O'Keefe**, **May Britt Moser** and **Edvard Moser**. And so, we are constantly updating our sense of self or sense of space through these massive dynamic neurons.

I shall end this article again by appreciating the complex nature of our brains which endows us with the wonderful curiosity to understand and interact what's around us. So, do ponder over your daily actions along with an emotional sense of self and try to identify connections as to why it may be so. Keep Looking!

John O' Keefe, May-Britt Moser, Edvard L. Moser *(left to right)*

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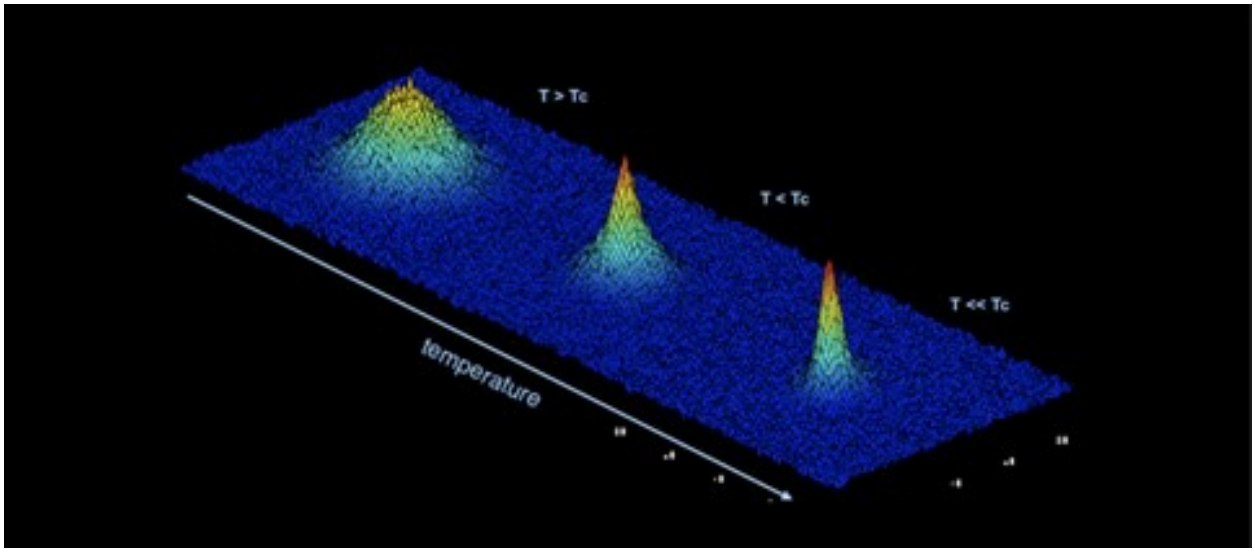
EXOTIC PHYSICS

Harsh Ranawat (Alumnus, BSc Biotechnology)



False-colour density plots of atomic distribution with reducing temperatures towards absolute zero. Photo Courtesy: Jet Propulsion Lab (JPL), 2018.

The Coolest Experiment in Space.

Scientists at the **Cold Atom Laboratory (CAL)** confirmed in the second week of July 2018 that temperatures as low as 100 nanoKelvin (10^{-7}K) have been achieved at the International Space Station (ISS), under microgravity. (1Kelvin is equal to -273°C). The CAL produces **Bose - Einstein Condensates (BEC)** in atom traps or frictionless containers to enable studying fundamental quantum properties of matter in its fifth state, different from solids, liquids, gases and plasma.

Let us break it down.

The first laboratory scale BECs were produced in 1995, but the phenomenon was predicted much earlier by **S. C. Bose and Albert Einstein**. Atoms exhibit the wave-particle duality which depends on the energy of the atoms. Under normal conditions, atoms in a gas move freely and discretely as particles with highly concentrated waveforms. On lowering their temperature i.e. by reducing their energy considerably, the wave-nature of atoms becomes more extended. At near absolute zero temperatures, the size of waves of these atoms exceed the inter-atomic distance, and atoms of the group take on same energies, behaving as a single cloud - the **'super atom'**. This super atom expresses as a single quantum wave and behaves as a relatively macroscopic quantum particle (Figure)

Now, such BEC had been achieved earlier on Earth. Infact, the record for the coldest place known to man is at 100 picoKelvin (10^{-10}K) at MIT, USA in 2003. The concern with such experiments on Earth is that when the traps are shut off to make the actual measurements, the gravitational force pulls the ultra-cold atoms and hence they can only be studied for fractions of a second. The persistence of microgravity at the ISS enables observation of BECs for five to 10 seconds at a time, with the ability to repeat the experiments for up to six hours each day.

In the CAL, rubidium (Rb) atoms are laser-cooled by interaction with directional photons of frequency just lower than the electronic transition of the atom, leading to consequent loss of momentum of the atom and hence reduction in temperature. Then, the atoms are magnetically trapped by creating local maxima and minima in an external magnetic field, causing atoms to be confined to the areas where their magnetic moment align with the external magnetic field. These trapped atoms are transported to an *atom chip trap* and then evaporatively cooled. Evaporative cooling refers not to the conven-

tional process (as you might have guessed) but to the use of a radio frequency (RF) knife to decrease the depth of the magnetic trap and hence 'cut off' of the hottest atoms from the trap, causing a drastic reduction in the average kinetic energy of the ensemble of atoms. In the final stage, this cloud of atoms is allowed to expand adiabatically causing a still greater reduction in temperature. At this stage, the cloud of atoms enters the Bose-Einstein condensate.

The BEC enables hyper-precise measurements of gravitational and inertial forces at the atomic level. It is so 'cool' that even light can be slowed down drastically, down to 17 m/s in one experiment. Compared to this, the speed of light in vacuum and all around us is 30,00,00,000 m/s.

The CAL was launched to the ISS on May 21, 2018 aboard a Cygnus spacecraft from NASA's Wallops Flight Facility in Virginia, the USA.

"There is a globe-spanning team of scientists ready and excited to use this facility" - said Kamal Oudrhiri, the mission manager for CAL.

This, undoubtedly is exotic Physics.

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INTERVIEWS

Of those who know better.

Dr. FU JEN KAO

Yash Goel (II Year, BSc Biotechnology), Thyagarajan S (III Year, BSc Biotechnology)

Dr. Fu Jen Kao visited SLS to deliver a talk about *"Conceiving the future of Optical Microscopy"* at the One Day Symposium on Biomedical Optics and its Applications conducted by the Manipal OSA Chapter, School of Life Sciences. Dr. Kao is currently a Professor at the **Institute of Biophotonics, National Yang-Ming University, Taiwan.** He is also the head of the **Modern Optics Laboratory** at National Yang-Ming University. His main research areas are Microscope technology and Biophotonics sensing. He did his MA in Physics and his PhD in Physics from Cornell University, USA. The Manipal OSA chapter organising members had the opportunity to interview Dr. Kao. Here are excerpts from the interview.

Student Chapter (SC): Sir, could you start by introducing yourself and a bit about your academic history?
Dr. Fu Jen Kao (FJK): Basically, I grew up in Taiwan and did my undergraduate there. I went to the United States for my graduate studies in advanced degrees (Masters and PhD). My alma mater is Cornell University in NY. After I completed my PhD, I returned to Taiwan to start my academic career. I think many young Indians have a similar experience. They return to establish their career.

SC: Sir, why did this field fascinate you in particular?
FJK: You mean, what was the reason. I have to go back thirty years ago. Taiwan was still developing. Most of the technology and science, Taiwan was lagging behind. We knew that and saw that if we stayed in Taiwan we would not learn the better way and cutting edge technology. That was the biggest motivation for us to go abroad. To see how the world was like and to see how other people are doing these things. It was the scientific culture and even economic interest.

SC: Sir, is there any advice you'd like to give the youngsters?
FJK: You need to have the persistence to get answers. Students in India and especially Manipal University are very prospective themselves.

SC: Sir, how do you see the field of Optics progressing?
FJK: The field of photonics is evolving. One very successful and renowned examples of optical communication is the optical fibres because mobile phone networks are enabled by optical fibres. Various touchscreen technologies are also enabled due to optical technologies. Even illumination, we need light to light up our world. That is an important aspect of our world. The coming aspect is power. How do we power our mobile phones? The source of glowing technology is light. Whether it comes biotechnology, solar panels, we need light. It's also an enabling tool for technology and science as well.

SC: Sir, lastly, I would like to ask a questions regarding Optogenetics. Optogenetics is a very recent development. How do you think we can make it more efficient considering it is a very complex field as well?
FJK: Honestly, I have never heard of Optogenetics as such. Whoever started this field would get the Nobel Prize. It's too early to say what the impact of this field would be. Using light to fix or to treat or cure whatever ailment a person is affected by.

Dr. ANTIGONE MARINO

Yash Goel, Mayukha Bathini (II Year, BSc Biotechnology)

On the August 30, 2018 the School of Life Sciences had the pleasure of receiving Dr. Antigone Marino, an OSA ambassador and researcher at the Institute of Applied Sciences and Intelligent Systems (ISASI) of the Italian National Research Council (CNR). Dr. Marino gave a talk titled **"Skill Bill"** for the benefit of young scientists, PhD and postdoc candidates. She began with very relatable words on the pressures and frustrations of a PhD candidate. Moving further, Dr. Marino presented a five-fold skill list that includes - networking, teamwork, communication, decision making and career building. She shared valuable advice on choosing the right research problem, picking the right journal for the publication and creating your digital footprint while tracking your digital shadow. The talk ended with a few laughs and many wise words. The Student Council had an opportunity to interview Ms. Antigone after the talk. Here are the excerpts from the interview that was conducted.

Student Council (SC): Could you give us background on your education and the major turns that made a difference in your scientific life?
Dr. Antigone Marino (AM): I was really in love with everything close to physics at the end of high school. My masters degree and PhD are from University of Frederico II, Naples, Italy. I did my PhD on soft matter optics and mainly liquid crystal technologies. I was going around doing postdoctoral fellowships for 8 years in Naples, Spain, Germany. I had to work hard to get a position. Finally in 2010 I won a national competition that let me become a research fellow. I believe that you cannot live in a small reality as was the case with the city of Naples and our university. Working with the Optical Society, the Physical Society helped in networking and improved my career a lot. It gave opportunities like being an editor of the Journal of Optics, being an OSA ambassador, starting outreach programmes.

SC: What was the moment when you realised you wanted to study physics?
AM: I had my first camera when I was 8 yrs old. The love for physics grew from photography. At 12 yrs old, I got a (reflex) camera which made me feel that light was something amazing. When I was a child, I tried to dismantle and rebuild everything. In my last year of high school I had a wonderful physics teacher. When she explained relativity to us, it changed everything and was the moment when I decided to study physics.

SC: How does the environment or the way we think influence the way our research goes?
AM: Scientists and researchers have the responsibility to use their resources for something that helps benefit humanity. This is a common responsibility. Your institution is trying to use their studies to improve quality of life of people. This is a decision that everybody should make - to use their research to solve a certain problem like disease, energy crisis, agriculture etc.

SC: Could you tell us about your current work?
AM: I work in SMOL (Soft Matter Optics Lab). We mainly do the characterisation of the optical properties of liquid crystals using ellipsometry. They have a very strong optical anisotropy and their optical properties can be controlled with a small thermal or electrical field. Their refractive index can so be tuned.

SC: We hear about women facing barriers when trying to make a career in STEM subjects. What do you say to this?
AM: Honestly, I have worked with good people throughout and have not felt uncomfortable for being a minori-

ty, which I am. The percent of women in my institution and of those in STEM is very low. But, things are changing. Women want to be treated as scientists. We want to receive awards for being researchers, not for being women and I personally would not accept any so called "pink" awards. However, the initiatives running to promote equality are really important to overcome an inertial issue.

SC: Are there any times in your lab that leave you in awe and glad to be doing what you are doing?
AM: Such incidents happen almost every week on my optical bench. One special incident was when I was working in Zurich with materials called perovskites, which become superconductors under a particular value of temperature. A small piece of perovskite was in a huge cryostat and we were waiting for the temperature to become low enough. The monitor was blank at that moment. After a while, all these domains started to appear that looked like abstract paintings and I realised that all this was happening because we were freezing that material. That was a very nice moment.

SC: Any advice for us students?
AM: Whatever you do, do it with passion. Sometimes students just follow the research line of their group or professor and while this is important and has to be done, if you have cool idea, which may not be a success, still follow it. Study and also bring new ideas.

SC: What were the challenges you faced when establishing your chapter?
AM: I started it 10 years ago because it felt like a great opportunity to be in contact with other people. The people you meet usually as a PhD student are those who work on the same things as you do. This was also something made by ourselves while under supervision. The chapter is now much bigger.
Some institutions don't make it very easy for students to run something on their own because seniors always want to help. While this is good, these activities are done to give space to young people to work on their own legs. This was a difficulty I saw in the past. I suspect that this is problem of ages and not of academia or science.

SC: How do you think we should deal with such problems?
AM: OSA chapters are meant to make students more independent. It is not easy for a student to tell a senior scientist that they want to do something a certain way. But it is possible with practice.

SC: What future do you see for the field of photonics?
AM: Biophotonics seems to be very important for the strong applications it has. The world of imaging is also going through a strong growth. These two fields would be promising in the next decade. In a longer run, I don't know what we can expect but there can be another revolution of telecommunication. We have waited a long time since the field is already saturated.

SC: What would be your message to students?
AM: Study. Technical skills are very important and they make you a scientist. After you finish your study you will be working for a long one time. So find the work you really want to do. Something that makes it easy to wake up in the morning and which makes you happy. It will change your life. We live in a society where work takes, I would say more than 60% of your time. So you have to find a way to make this your happy time.
And be professional. It is not easy to change from being a student to being a professional. But when they are paying you a salary, it expected from you to be on time, to be efficient, to be able to communicate science.

KNOW YOUR LABS

An attempt to inform you of the history, research and people here at the School of Life Sciences, MAHE, Manipal

DEPARTMENT OF RADIOBIOLOGY AND TOXICOLOGY

Dr. BS Satish Rao
Professor, HOD & Associate Director-Research
Radiobiology, Experimental Oncology, Toxicology

Dr. Kamalesh D Mumbrekar
Assistant Professor
Radiogenomics, DNA repair, Toxicology

Dr. Herman D'Souza
Professor
Metal Toxicology, Biochemistry, Molecular Biology

Subhankar Das
PhD Scholar

Rekha K N
Research Scholar

Manasa Hegde
Research Scholar

Laxmi U
Associate

Jayasheela Poojary
Senior General Duty

Sandhya S Prabhu
Scientific Assistant

Monica S. M.
PhD Scholar

Geethanjali UK
Scientific Assistant

Suresh M
Lab Assistant

Kumar K
Senior Housekeeping Staff

Sudhakara K Kotian
Senior Lab Assistant

The Department of Radiation Biology & Toxicology was formerly known as Department of Radiobiology, which was established in 1986 as one of the constituent departments of Kasturba Medical College, Manipal. The department aimed to study the fundamental mechanisms of radiation response of normal and cancer cells and to find a strategy to modulate radiation response aiming greater therapeutic effect. With the inclusion of environmental toxicology component, it was renamed as "Department of Radiation Biology and Toxicology" and is one of the active research departments of School of Life Sciences, MAHE. The department has three faculty members, Dr. B S Satish Rao, Professor & HOD, Dr. Herman D'Souza, Professor and Dr. Kamalesh Mumbrekar, Assistant Professor, undertaking both undergraduate and post graduate teaching (Biotechnology, BNMT, Medical Physics, MD Radiotherapy) and interdisciplinary research activities with a goal of developing comprehensive translational research programs integrating investigations in basic cellular and molecular biology.

The multi-disciplinary research program of the department include experimental oncology, genotoxicity, DNA damage and repair, radiation biodosimetry, radiosesensitization and radioprotection, environmental toxicology, and targeted anticancer drug delivery using liposomes as well as nanomaterials. Considering the importance of genetic basis for radiobiological phenomenon and cellular response, the conventional radiobiological research questions are also addressed with the molecular tools. Over the years the research activities have been sponsored by various government funding agencies such as ICMR, CSIR, DAE, LSRB, DST, SERB, AERB, DBT and BRNS in addition to private funding agencies. Presently, the department is undertaking national and international collaborative research projects.

In addition to the routine laboratory instrumentation, the department is equipped with image analyses system, access to radiation facilities such as X-rays, tissue culture facility and animal house with breeding and rearing facility for mouse strains such as BALB/c, C57BL mice as well as nude mice. Further, department has facilities and expertise for routine anticancer drug screening (using human cancerous cells growing in vitro & transplantable animal tumor models in vivo), toxicological screening activities and over the years extended these services to industry, university and institutional requirements.

On going Research Projects:

- A preclinical study aimed to target temozolamide anticancer drug specifically to the brain tumor (gliobastoma) using a liposomal nano platform and making the tumor sensitive to radiation to enhance the cancer drug release at the site of the target –Dr. BS Satish Rao.

- Elucidating the mitochondrial dynamics in response to genotoxic agents like radiation heavy metals. - Dr. BS Satish Rao, (Research Scholar: Mr. Shubhankar Das)

- Investigations on the prenatal and postnatal EMF Radiation exposure in a Mouse Model - Dr. BS Satish Rao, (Research Scholar: Ms. Hannah Christina)

- Cellular and Molecular Mechanisms Involved in Variations to Lead Toxicity – Dr. Herman Dsouza, (Research Scholar: Ms. *Monica Shirley Mani)*

- A structural and behavioral Study on neurological changes in adult mice co exposed to low-dose Radiation and organophosphate pesticides during Neonatal and Postnatal Stages of development –Dr. Kamalesh D. Mumbrekar, (Research Scholar: Ms. Rekha KN)

"Be honest, committed and have clear cut goals with appropriate strategies to achieve scientific contributions of human and environmental impact."

-Dr. BS Satish Rao

(Head, Department of Radiobiology and Toxicology, SLS)

DEPARTMENT OF PLANT SCIENCES

Dr. Annamalai Muthusamy
Professor & HOD
Metabolomics, Stress biology, In-vitro breeding and DNA barcoding

Dr. Vidhu Sankar Babu
Associate Professor
Plant physiology, conservation and herbal drugs

Mr. Bhaskar Ballal
Senior Lecturer
Plant Sciences, genetic diversity and cytology

Soundaryaa Bargunam
PhD Scholar

Ipsita Pujari
PhD Scholar

Kiran K. R.
PhD Scholar

Swathi PS
PhD Scholar

Ariya K.
PhD Scholar

Bhagyashree Pai
Junior Research Fellow

Shashikala Tantry
Technical Staff

The Department of Plant Sciences was established in the School of Life Sciences, MAHE in the year 2005. Currently, the department is headed by **Dr. A Muthusamy**, Professor, SLS. The department has contributed immensely through active research in plants. Some of the main research areas are: (a) biodiversity assessment and conservation of rare, endangered and threatened (RET) plant species, (b) devise micropropagation strategies, relative efficiency of plants in CO_2 sequestration, (c) chemoprofiling, (d) plant DNA fingerprinting, (e) natural products scale up, (f) eco-restoration, (g) biochemical and molecular characterization of fruits and (h) identification and diagnosis of plant diseases. The department is funded by the School of Life Sciences, MAHE; Department of Science and Technology, Government of India and Indian Council for Medical Research, Government of India.

Dr. A Muthusamy, who is a Professor, carries out research on in vitro breeding of crop plants. His work is based on Brinjal: *Solanum melongena* (Local name: Mattu Gulla), *Phyllanthus amarus*, *Phyllanthus urinaria* and *Withania Somnifera*. He is currently working on irradiating GI tagged Mattu Gulla with laser to produce varieties with improved agronomic traits as these plants are susceptible to various microbial pathogens. Dr. Muthusamy plans to carry out further work on the rapid identification of plant diseases using molecular methods. The likely outcome of this would be to identify pathogenic organism and help farmers to selectively choose pesticides for disease management programs. These projects are funded by Manipal Academy of Higher Education, Indian Council of Medical research (ICMR) and Department of Science and Technology (DST), Government of India.

The department consists of two other faculty members, Dr. Vidhu Sankar Babu and Mr. Bhaskar Ballal. **Dr. Vidhu Sankar Babu**, is an Associate Professor carrying out research in a wild orchid (Dendrobium). Her work mainly involves analysing the cytogenetics, phytochemistry (compounds like Moscatilin and Resveratrol and making their cybrids), Physiology and real time monitoring of the photosynthetic efficiency, phylogenetic analysis, studying the medical efficacy of phytochemical compounds on mammalian cell lines. Dr. Vidhu's projects are mainly funded by Science and Engineering Board (SERB), Government of India through the Fast Track program for Young Scientists and extramural research funding as well. Her plans are to study the metabolic engineering mechanisms of plant cells further.

Mr. Bhaskar Ballal is a Senior Grade Lecturer and has recently begun a project involving the characterisation of Jasmine cultivars from the region of coastal Karnataka. His work is unique is in the sense that no prior work has been done in this area so this would lead to assimilation of information regarding endemic species in this region. As these are grown commercially, they tend to provide good revenue to rural women in the region. Mr. Ballal's plans are to study these cultivars and develop elite varieties of the same. This would contribute to improved varieties being brought into the market which would result in more revenue and would help the livelihood of rural women.

The department also consists of five PhD research scholars and one Junior Research Fellow (JRF). Ms. PS Swathy is working alongside Dr. Muthusamy on Laser irradiation of Mattu Gulla to characterise its bioactive molecules. Ms. Ipsita Pujari (PhD scholar) is working alongside Dr. Vidhu Sankar Babu on a potent anti cancer compound "Moscatilin" in *Dendrobium ovatum* and its conservation, which leads to stable yield of bioactive compounds. Mr. Kiran K. R (PhD Scholar) is working on the microbial interactions during salinity stress in *Solanum melongena* and screening these organisms for their insecticidal properties. Ms. Bhagyashree Pai (JRF) is working on the characterisation of Withanolides biosynthetic pathways genes in *Withania somnifera* and study its anti cancer activity. Ms. Soundaryaa Bargunam (PhD Scholar) is working on determining the function of Melatonin on designated dicot and monocot species when they are administered exogenously.

On-going research projects:

- Biochemical and molecular characterization of bioactive molecules from He-Ne laser irradiated Brinjal (*Solanum melongena L.*) var. Mattu Gulla (MAHE funded): Dr. A. Muthusamy, Dr. K.K. Mahato and Ms. P.S. Swathy

- Implications of plant-microbe interactions on salinity stress responses in Brinjal (*Solanum melongena L.*) (MAHE & CSIR funded): Dr. A. Muthusamy, Dr. T.S. Murali and Mr. K.R. Kiran

- Characterization of withanolides biosynthetic pathway genes and withanolide contents in vegetative and reproductive phase of *Withania somnifera* (L) dunal under salinity stress (DST funded, Indo-South African JCP): Dr. A. Muthusamy, Dr. S. Padmalatha Rai and Ms. P. Bhagyashree

- Studying anti-cancer activity of Moscatilin derived from *Dendrobium ovatum*: Dr. Vidhu Sankar Babu, Ms. Ipsita Pujari (MAHE and SERB EMR funded)

- Characterisation and conservation of *Dendrobium ovatum*: Dr. Vidhu Sankar Babu (SERB Fast track funded)

- Characterisation of indigenous Jasmine cultivars: Dr. Bhaskar Ballal (MAHE funded)

- Decrypting the multifaceted function of exogenously supplemented melatonin designated dicot and monocot species: Dr. Vidhu Sankar Babu, Ms. Soundaryaa Bargunam (MAHE funded)

"The academic profession comprises of a sequence of grades within a legitimately anticipated timeframe, so they should take appropriate steps to make sure that this progress goes as scheduled with a visible outcome."

-Dr. A Muthusamy

(Head, Department of Plant Sciences, SLS)

COMPILED BY:

Harsh Ranawat (Alumnus, BSc Biotechnology)

Tanaaz M Khan (III Year, BSc Biotechnology)

CREATIVE CORNER

Straight out of the right cerebrum.

PHOTOS

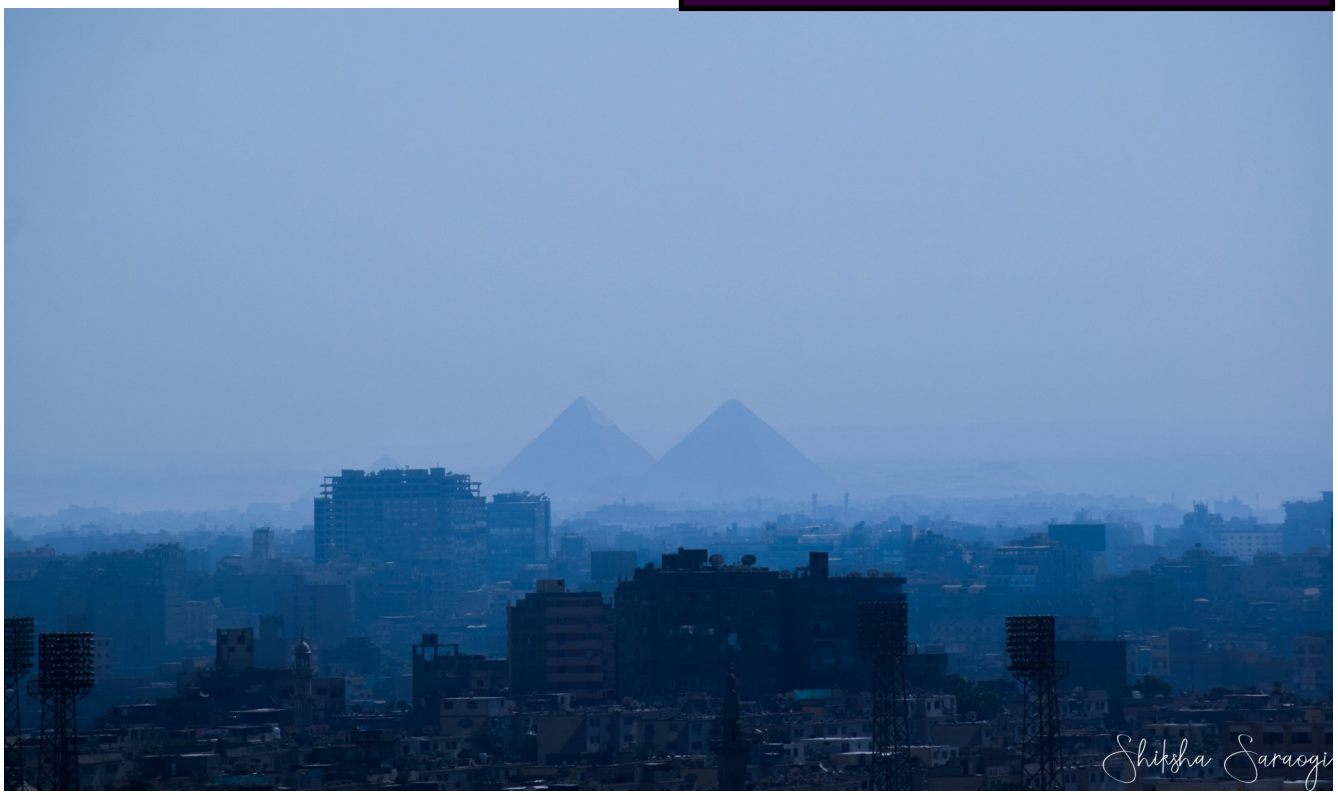
Shiksha Saraogi
(II Year, BSc Biotechnology)

"Rays of hope in a City of Dreams"

-Ovee Kalyankar
(I Year, BSc Biotechnology)

Swarnadeep Ghosh
(I Year, BSc Biotechnology)

Shiksha Saraogi
(II Year, BSc Biotechnology)



STUDENT EXPERIENCES

What goes around comes around.

IONS SCANDINAVIA 2018

Yash Goel (II Year, BSc Biotechnology)

IONS Scandinavia, a conference conducted in association with the Optical Society of America (OSA) was held from 5-9 June, 2018 at the **Technical University of Denmark (DTU), Lyngby, Denmark**. The conference entailed talks from various speakers in the field of Photonics. One on the chapter members from our very own Optical Society of America Student Chapter, Yash Goel who is in the second year of his Bacherlors had the opportunity to attend the conference on our behalf.

There were a total of eight esteemed speakers who spoke about the various aspects of the fielf of Photonics and its applications. **Dr. Ursula Gibson,** Norwegian University of Science and Technology, Norway spoke about her research on Optical Materials and Novel core fibres. **Dr. Nir Rotenberg,** Niels Bohr Institute, University of Copenhagen spoke about Coherent quantum nanophotonics and the chiral and non-chiral interactions with quantum dots. **Dr. Jes Broeng,** Technical University of Denmark, who is also an entrepreneur, spoke about the journey of the introduction of crystal fibres into the market by his company. **Dr. Siddharth Ramachandran**, Boston University spoke about fibre optics and communication along with its non-linear interactions. **Dr. Katarina Svanberg,** Lund University, Sweden spoke about the biological applications of Laser spectroscopy and her experience while treating patients in China. **Dr. Sune Svanberg**, Lund University, Sweden spoke about the environmental and medical applications of laser spectroscopy. **Dr. Anne L'Hullier**, Lund University, Sweden spoke about the aspects of high harmonic generation and attosecond science.

The conference included visits to various labs around the university that are carrying out cutting edge scientific research such as the Laser lab, MAX PEEM, Balder and NanoMAX, COsaxs and BioMAX, as well as FemtoMAX. The attendees were also taken on a leisure trip to the world's oldest amusement park, Dyrehavsbakken as well as a tour of the Copenhagen canals. All in all, the conference was a good blend of education and fun leaving an impression on all of its delegates providing them with knowledge on Photonics and also made lasting memories for years to come!

ALUMNI SEGMENT

Yash Goel (II Year, BSc Biotechnology) with inputs from Mrs. Kranthi Kumari (Alumnus, SLS, MAHE)

Our lives are a constant search about who we are and **Mrs. Kranthi Kumari** who completed her degrees at Manipal Life Sciences Centre (Now called SOLS) in 2009, vividly remembers her days of self discovery and transformation amidst the trials of Manipal. She came to study here from Kenya and served as the **Vice President** for the **first student council** at MLSC. Even though 8 years have gone by, she fondly remembers her fresher's day, the UTSAVs and various other college fests she organised and was a part of. Howver, she reserves the dearest memories to the many friendships formed here, which she still carries on. She believes that Manipal is a mini globe in itself where anyone and everyone can find a place whether it be academics, adventure or something as simple as doing what you love. Even though sometimes we may not see a point in things, she suggests that we hold on to our perception. Seeing the rut of career and profession in life outside, where one has to constantly deal with people, Mrs. Kranthi advises us to participate more and interact with more people from across different disciplines.

After completing her MSc degree at MLSC, Mrs. Kranthi worked in **Biocon (P) Ltd.**, where she was concerned with the development of HPLC techniques for qualitative and quantitative assessment of monoclonal antibodies (mAbs). The mAbs were mostly targeted towards head and neck cancers among other things. She then went to USA, where she completed an MS in Molecular Microbiology and Immunology at the **Johns Hopkins Bloomberg School of Public Health**. Over a period of time she studied **International Health Epidemiology** and worked in the Toxicology Lab on alternatives to animal testing along with working on whole blood assay and its applications dealing with various microbiological stimuli and air pollution as well.

Later she took up the position of Lab Manager/ Research Assistant in **HIV/AIDS Research Unit** at **UT SouthWestern, Dallas** where they conducted observational and interventional studies. One of the global studies is the **REPRIEVE study** which enrolled 7500 HIV positive individuals and observed them for cardiac events for over 5 years. This is a study that can change the way ASCVD (Atherosclerotic Cardiovascular Diseases) scores are calculated. She primarily played a role in maintaining documents, SOPs, participate in study meetings along with coordinating with research studies, identify candidates for research studies and discuss the science behind the study with them.

This job has given her the scope to grow with 2 promotions in 4 years to Senior Research Associate. She finds a very strong satisfaction with the job along with the drive to learn more. Being a mother of two, she feels this job allows her to have the her to have the best of both her equal priorities - her professional and family life.

As of October 2018, Mrs. Kranthi has quit her job in the USA and returned to Bengaluru, India to carry out her future endeavours, probably in her preferred areas of public health and clinical research. She can be contacted at: **vkranthikumari@gmail.com** to know more about her work and experience!

FAREWELL!

Ramya Gupta (II Year, MSc MBHG)

Top row: Rudranath, Saswata, Vallabha, Ramya, Kanaya, Namita, Sourav. Nevin, Harsh, Harshit
Bottom row: Soumyabrata, Shiksha, Inaas, Yesha, Nidhi, Niharika, Bhargavi, Rajat, Tanaaz *(left to right)*

As the tenure for the Student Council 2018-19 ended, the new Student Council took charge with more enthusiasm than I could have ever foreseen. When they first announced their plan to screen the Asia Cup final in college, a wise person summarized my feelings with this quote from Naruto:

The next generation will always surpass the previous one. It's one of the never-ending cycles in life.

I believe I can speak for the whole council when I say that our tenure was an absolute rollercoaster ride. I personally believe that we are now equipped with a skill set comparable to that of a management executive in a small firm. There is however, one key difference: being part of the council at SLS is also like being part of a family. There are feelings to be managed a feeling of inclusivity that needs to be addressed. On the bright side, the rewards are many more. You make friends in the unlikeliest of places and discover talents you never knew you had (I can remix music! Who knew?).

We had a year that saw record participation for Utsav that was at par with that of many bigger colleges. We saw several new clubs and associations form. We contributed to society in newer and in more ways than ever before, with enthusiastic participation from students. We started a brand new student-run website and revamped our newsletter and social media presence. As a team, we came up with countless ideas. To see some of them materialize to have a real impact on student welfare was more than I could have ever asked for. Most importantly, we saw the SLS family evolve.

As the outgoing President, I was asked to pen down any advice I may have for the new council and the student body. As someone who is in her fifth consecutive year at this institution, my only piece of advice to any student would be to *be involved.* Be an active and contributing member of the SLS family. The reason is simple: being part of a research community scientifically and non-academically teaches you how to build interpersonal skills. Join one of the hundred clubs and make friends from other batches or social circles. Participate in a conference and discover new research ideas. Discuss your seminar paper with a faculty member and discover a mentor. endless. It is easy to day-

dream through classes from 9 to 5 and leave at the first possible opportunity, but that won't help you personally or academically. Even if you have no intention of building a career in science, the opportunities to develop a personali- Ask a research scholar about their work and see what scientific passion looks like in real life. Volunteer for an intra-college event or with the social committee and discover a new love for art, craft, music, social work and much more. The possibilities are truly limitless. Your SLS experience is what you make it to be.

When I first saw this institution back in 2014, it was mostly academic-oriented. There were no student-run clubs and after-college activities meant drinking coffee at the canteen. The picture is entirely different today and I attribute that almost entirely to the student body. They are a living example of 'be the change you want to see.' I hope and pray that this spirit will live on through our new students.

I wish our new council all the very best for their tenure. I am certain that they will add the new-age factor that's been missing from the old-school soul of SLS!

STUDENT COUNCIL AND COMMITTEE HEADS (2017-2018)

STUDENT COUNCIL	**Ramya Gupta** (I Year, MSc MBHG) **(PRESIDENT)**	**Namita Bhyravbhatla** (I Year, MSc MBHG) **(VICE PRESIDENT)**	**Vallabha Mohta** (III Year, BSc Biotechnology) **(GENERAL SECRETARY)**
	Niharika Jhawar (II Year, BSc Biotechnology) **(TREASURER)**	**Sourav Patege** (II Year, BSc Biotechnology) **(JOINT SECRETARY –1)**	**Nidhi Singh** (I Year, BSc Biotechnology) **(JOINT SECRETARY-2)**
EDITORIAL BOARD	**Harsh Ranawat** (III Year, BSc Biotechnology)	**Tanaaz M Khan** (II Year, BSc Biotechnology)	
CULTURAL COMMITTEE	**Kanaya Bhattacharya** (II Year, BSc Biotechnology)	**Nevin Kuriakose** (I Year, MSc MBHG)	
SOCIAL COMMITTEE	**Bhargavi Karna** (II Year, BSc Biotechnology)	**Syeda Inaas** (II Year, BSc Biotechnology)	
SPORTS COMMITTEE	**Rudranath Ghosh** (I Year, MSc MBHG)	**Saswata Hore** (III Year, BSc Biotechnology)	
FINANCE COMMITTEE	**Rajat Agarwal** (II Year, BSc Biotechnology)	**Yesha Ramani** (III Year, BSc Biotechnology)	
PHOTOGRAPHY COMMITTEE	**Harshit Joshi** (I Year, MSc MBHG)	**Shiksha Saraogi** (I Year, BSc Biotechnology)	**Soumyabrata Banik** (II Year, BSc Biotechnology)
STUDENT RESEARCH FORUM	**Sagnik Pal** I Year, MSc MBHG)		

STUDENT COUNCIL 2018-2019

STUDENT COUNCIL: Laxman, Talitha, Shiksha, Archica, Shiksha, Vishnu, Shannen *(clockwise)*

STUDENT COUNCIL	Vishnu K Khandige (I Year, MSc Bioinformatics) **(PRESIDENT)**	Shannen Fortes (I Year, MSc Bioinformatics) **(VICE PRESIDENT)**	Archica Gupta (III Year, BSc Biotechnology) **(GENERAL SECRETARY)**
	Talitha Keren Kurian (III Year, BSc Biotechnology) **(TREASURER)**	Shiksha Saraogi (II Year, BSc Biotechnology) **(JOINT SECRETARY –1)**	Laxman Kamath (I Year, BSc Biotechnology) **(JOINT SECRETARY-2)**
EDITORIAL BOARD	Swetha Stanley (I Year, MSc MBT)	Mayukha Bathini (II Year, BSc Biotechnology)	Nicole Mary Swer (I Year, BSc Biotechnology)
CULTURAL COMMITTEE	Danielle Paige Anthony (I Year, MSc MBT)	Kanaya Bhattacharya (III Year, BSc Biotechnology)	Praneeth T Sai (II Year, BSc Biotechnology)
SPORTS COMMITTEE	Arbaaz (II Year, BSc Biotechnology)	Dharti (I year, BSc Biotechnology)	
SOCIAL COMMITTEE	Shreya Gudi (III Year, BSc Biotechnology)	Rithika Bekal (I Year, BSc Biotechnology)	
FINANCE	Christabelle R (I Year, MSc MBHG)	Malavika M Jayaram (III Year, BSc Biotechnology)	
PHOTOGRAPHY COMMITTEE	Soumyabrata Banik (III Year, BSc Biotechnology)	Swarnadeep Ghosh (I Year, BSc Biotechnology)	Sahana Dhasharatha (I Year, BSc Biotechnology)
STUDENT RESEARCH FORUM	Sree Harshitha K (I Year, MSc by Research)	Malavika S Rajeev (II Year, BSc Biotechnology)	

"The greatest enemy of knowledge is not ignorance, but the illusion of knowledge"

-Stephen Hawking