IWSA NEWSLETTER

THE OFFICIAL PUBLICATION OF THE INDIAN WOMEN SCIENTISTS' ASSOCIATION

Volume 42 | Issue No. 3 | ISSN 0972-6195 | Sep-Dec. 2015

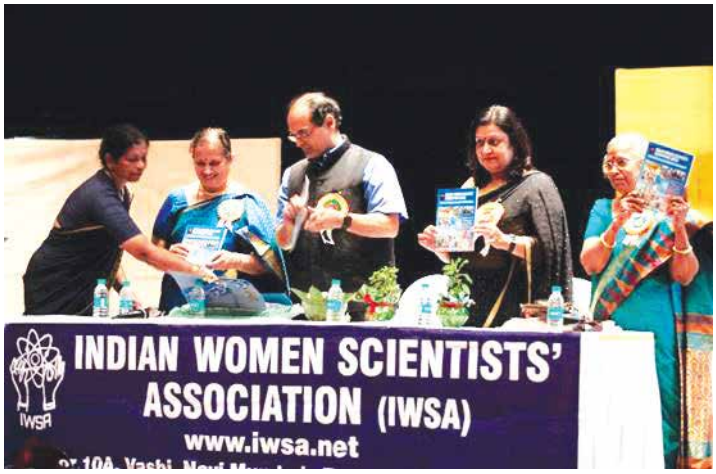
From Edison's Incandescent Lamp to the LED of today

2015

INTERNATIONAL YEAR OF LIGHT

&

THE IWSA FUND RAISING DRIVE



Shri. Sanjay Bhatia, releasing the Souvenir in the presence of Chief Guest Smt. Anuradha Bhatia IRS, Dr. Devaki Ramanathan Dr. Susan Eapen and Dr. Lalitha Dhareshwar.

Padmashri Shekhar Sen felicitated by Founder Member Dr. Sudha Padhye.

BRANCHES

ROORKIE 1979 ▪ HYDERABAD 1979 ▪ PUNE 1980 ▪ NAGPUR 1982 ▪ KOLHAPUR 1982
DELHI 1987 ▪ KALPAKKAM 1987 ▪ BARODA 1988 ▪ LUCKNOW 1997 ▪ AMRAVATI 2010

« **Dr. A. P. Jayaraman**
Delivering Lecture at
Sophia College.

Audience at the Lecture at »
Sophia College.

« **Dr. Sunil Keswani's**
Lecture at
SIES College, Sion.

ISRAPS-IWSA »
Lecture at
Ramnarain Ruia College.

From the Editor's Desk

Dear IWSA Members,

Wish you all a very Happy and Prosperous New Year 2016. From this issue onwards, the New Editorial Board is taking over the responsibility of IWSA Newsletter for the next two years.

The United Nations General Assembly on 20th December 2013, passed a resolution declaring 2015 to be the Year of Light and Light based Technologies. In this issue, we have two articles on this topic. The first article by Dr. Dhanya Suresh discusses light based technologies in our everyday life, such as lighting, communication, medicine and other uses. This article also discusses light based technologies for probing some deep phenomena, to observe chemical processes in living organisms, for understanding ultrafast natural processes etc. Another article by Dr. Dimple Dutta discusses the chronicles of lighting technology, starting from the 18th century incandescent lamps to the modern LEDs. Both these articles are very informative and I am sure that all of you will enjoy reading them.

The articles on Nobel Prizes of 2015 in Physiology and Medicine, Chemistry and Physics give the readers glimpses of the research carried out in these areas that have led to these highest scientific awards of this year.

The fund raising event, "Vivekanand" organised by IWSA was a great success as were the various popular science lectures held at several colleges in Mumbai. We have included reports on these events along with relevant photographs. There are also reports on the various important activities of IWSA that have taken place during the last quarter of 2015.

I appeal to IWSA Members in particular those from our Branches across the country, to come forward and contribute interesting scientific articles to the Newsletter. This Newsletter is not just for reporting the events and achievements of IWSA, but to keep the scientific curiosity of our members alive. I also welcome suggestions from members to improve the quality of the Newsletter and seek your support to maintain the high standard of this publication.

With Best Wishes

Dr. Shyamala Bharadwaj
shyamala.bharadwaj@gmail.com

CONTENTS

PRESIDENT'S **MESSAGE**

My Dear Members,

I am very happy to announce that our Fund Raising Event "Vivekanand" on Nov. 28, 2015, was a grand success. We thank all of you for your encouragement. I hope many of you attended the event and enjoyed the mono act play, a detailed report of which is given by Dr. Susan Eapen, Convener of the Fund Raising Drive 2015 in this issue.

As I had specified in my address at the Event, fund raising drive for IWSA is an on-going process, so it has to go on and on ..... More the number of new programmes, more the requirement for funds ..... We have already done the spade-work and planning to set up a virtual class room and e-learning and distant teaching programmes at IWSA for which we need fresh infrastructure, extra space and augmented facilities. I appeal to all members to help us meet our goals so that your association can gear up to match with state of the art technology in all our endeavours.

We are on the threshold of the New Year 2016. I wish all our members a very Happy New Year and entreat you to make it another landmark year for IWSA. This is the year for our triennial conference/seminar. The last one was in 2013 at Pune University, hosted by our Pune Branch Convener, Prof. Nilima Rajurkar, who very ably conducted the conference on Current trends in Science & Technology" (CTST).

The HQ at Navi Mumbai will be the host for the 2016 conference.

What will be theme for this conference? Keeping with the need of the hour, we would like to discuss topics under 'sustainability'. Mother Earth is in dire need of this. We have begun brain storming meetings to zero-in on the details. I request all members to send in suggestions that could be considered and consolidated. But please act fast, fast, fast,.....as the ball has to be set rolling early.

Your President's Best Wishes to all of you.

Dr. Devaki Ramanathan
devakir66@yahoo.com

OBITUARY

TRIBUTE TO
Miss VIDYA K. KHUBCHANDANI

(24-01-1929 to 10-10-2015)

IWSA lost an important founder member, Ms. Vidya Khubchandani on 10th October, 2015.

Vidya was born in a family which highly valued education and honesty. Her father was a doctor and took part in the freedom movement and strongly supported education and independence, both for girls and boys. After partition, the family migrated from Karachi to Mumbai, and faced extreme difficult circumstances, like several others after partition. Vidya took up a job to help support the family of 11 members. She continued her studies and completed her B.Sc from Bombay University.

Further, she also undertook a Diploma in journalism. She was a voracious reader and joined many activities, especially different music groups. She was with Rabindra Sangeet group for 30 years and had mastered Bengali, besides several other languages, like Russian, Marathi, Tamil and, Kannada in later years.

Vidya stood for high principles and justice wherever needed-- at her official workplace or at IWSA. This often brought her into conflict with people, who later would appreciate her bold and honest stand. Needless to say, her conduct was highly ethical at all levels. In other words, her zest for standing for everything that was "right", thirst for knowledge, and her interest in music made her life hectic and extremely interesting.

Vidya's association with IWSA was strong, as she was one of the founder members. In fact, the first shoots of IWSA sprouted in her house in Chembur, Mumbai, in various meetings that took place with other founder members. She took active part in most of IWSA activities, and was the first Editor of IWSA NEWSLETTER for several years.

In her late seventies, Vidya expressed her wish that she would not like to be dependent on any one. Nature fulfilled her wishes and till the last minute, she could do her own chores herself, with music always in the background, newspapers on her table side and in contact with her friends and loved ones.

Her voice against injustice and for integrity will be the guiding force at IWSA.

Dr. B.S. Mahajan and Dr. N. Bhattacharyya
Secretary and Chairperson respectively,
Board of Trustees, IWSA
With inputs from Dr. Kamlesh Suleebka (Sister of Ms. Khubchandani)

REPORTS FROM **HEADQUARTERS**

IWSA Fund Raising Drive 2015

The previous Fund Raising Drive of IWSA took place in 2008. After seven years, it was noted that there was urgent need for funds to support the varied activities of IWSA. Maintenance of the hostel, the IWSA auditorium, the science awareness activities etc. needed funds to the tune of more than Rs. 1 crore. It was therefore decided to have a Fund Raising Drive spanning the whole year with the grand finale event in November 2015.

After a series of deliberations and discussions regarding the ways and means to raise funds, it was decided to approach the challenge in four ways-

- Direct donations from well-wishers.
- Sponsorship of the program.
- Through advertisements in the souvenir to be released during the final event.
- Through Donor Passes for the event.

Appeal letters giving details about IWSA infrastructure and the activities were sent to many of our old and regular donors as well as others.

The final event selection was done after considering different artistes and programs. Padmashri Shekhar Sen's musical mono-act play "VIVEKANAND" was the finally selected. The character of Swami Vivekananda as a supporter of women's education and emancipation perfectly resonated with IWSA's philosophy. The venue for the event was the new auditorium of CIDCO Exhibition Center, at Vashi, Navi Mumbai.

Sponsorship folders were designed carefully and various sponsors from corporate sector were approached. LIC, Tata Capital, Kisna Jewellers and Fair & Lovely were the four Bronze sponsors, with a sponsorship of Rs.1 Lakh each. Publicity mileage for the sponsors as well as IWSA as an organizer was carefully planned. The program was advertised in Hindustan Times. Several types of banners were displayed almost a month before the event at various locations in Vashi. IWSA WhatsApp group also circulated the banners to encourage members to collect Donor Passes.

A commemorative souvenir with a beautiful cover was designed with about 35 advertisements from very prominent government as well as private organizations such as- Atomic Energy Regulatory Board, Board of Radiation and Isotope Technology, LIC, Franklin Templeton etc.

The souvenir contains the messages from IWSA President, Convener of the Fund Raising Drive and Dr. R. Chidambaram, Principal Scientific Advisor to Government of India. A lucid description of IWSA history and its founding members along with present activities is covered in the souvenir. The write up by Co-Convener of the program- Looking forward.... The Mission and Vision of IWSA visualizes the dreams shared by the members

of IWSA in envisaging challenging future projects such as a Virtual class and an advanced Lab. IWSA's commitment to social welfare is reflected in its endeavour to enhance the scholarship fund to support the education of girl students from economically backward families, even up to PhD level. The several health camps planned in the near future speak volumes about IWSA's concern for the holistic health of women and children.

The approach of the final day of the event showed the meticulous planning and seamless working of the several committees to make it a huge success. The program was formally inaugurated by Smt. Anuradha Bhatia IRS, Principal Commissioner, Income Tax and Director (Finance), MSEB Holding Co. Ltd. The commemorative souvenir made for the occasion was released at the hands of Shri. Sanjay Bhatia IAS, Vice Chairman and Managing Director, CIDCO. In her Presidential Address, Dr. Devaki Ramanathan spoke about the various activities of IWSA and the need to start new activities like Virtual Lab to reach out to school and college children in remote areas. Dr. Susan Eapen welcomed the gathering and Dr. Lalitha Dhareshwar proposed vote of thanks. Dr. R. Chidambaram, Principal Scientific Adviser to Government of India was present as Guest of Honour. The inaugural program was compered by Dr. Anjali Bhagwat.

The musical mono act play which soon followed was thoroughly captivating as Padmashri Shekhar Sen enacted the life and mission of Swami Vivekananda through 32 melodious songs all by himself in a span of 2 hours. Several of the audience later called IWSA members to thank and express their gratitude for arranging such a fantastic program which they had never seen before! Some even requested that we organize more of such plays in future! Dr. Sudha Padhye felicitated the artiste at the conclusion of the play amidst thunderous applause by the audience. The concluding session was compered by Dr. Shubhada Naik.

In all, we can only say that this Fund Raising Drive has not only been monetarily highly gainful, but also an enriching experience of team work from the concept to making it a reality!

Thanks are due to all members, for making this Fund Raising Drive a huge success!

Dr. Susan Eapen
Convener, Fund Raising Drive 2015

Swami Vivekananda's Quotes on Women
(Abridged from: www.swamivivekanandaquotes.org)

- The best thermometer to the progress of a nation is its treatment of its women. In ancient Greece there was absolutely no difference in the status of man and woman. The idea of perfect equality existed. No Hindu can be a priest until he is married, the idea being that a single man is only half a man, and imperfect. The idea of perfect womanhood is perfect independence.

- The great Aryans, Buddha among the rest, have always put woman in an equal position with man. For them sex in religion did not exist. In the Vedas and Upanishads, women taught the highest truths and received the same veneration as men.

ISRAPS-IWSA Popular Science Lecture at Ramnarain Ruia College, Mumbai on 19th Sep. 2015.

The year 2015 has been declared as the "Year of Light" by United Nations and in 2014, Isamu Akasaki, Hiroshi Amano and Suji Nakamura won the Nobel prize for Physics for invention of efficient blue light emitting diodes which has enabled bright and energy saving white light sources. Indian Society for Radiation and Photochemical Sciences (ISRAPS) in collaboration with IWSA organized two lectures on Saturday, the 19th September, 2015 at 11.00 hrs. at Ramnarain Ruia College, Matunga, Mumbai.

The first speaker Dr. R. K. Vatsa, Chemistry Division, BARC delivered a lecture on "Light and its Interaction with Matter". In this lecture few basic aspects of light as well as its interaction with matter was reviewed and application in the form of rotational, vibrational and Raman spectroscopy too was briefly discussed. Light, more generally radiation, interacts with matter in a complex manner, behaving sometimes as wave and other times as particle. This duality has been accepted by scientists ever since Einstein explained photoelectric effect based on particle nature of light, Dr. Vatsa explained. However, he said it is difficult to predict a priori how light will behave (as wave or particle) in a totally unknown new situation. Different sources such as laser, LED and synchrotron radiation were also dealt with briefly. A very unusual interaction of visible laser light (532 nm) with $(CH_3I)n$ nanocluster (size= 10 nm) was discussed wherein the nano-system appears to see both forms of light i.e. particle as well as wave nature.

The second speaker, our IWSA member Dr. S. Dhanya of Radiation and Photochemistry Division, BARC, spoke on "Light: A Source of Ever-growing Applications and Enlightenment". Light in the UV-Visible region of electromagnetic spectrum is the most fundamental for our life on earth. In the recent times, Dr. Dhanya said the progress in the science of light and the light based technologies have visibly revolutionized our lives. This has also improvised our probing techniques, thereby contributing significantly to our understanding of natural systems, she explained. The talk covered these aspects, starting with the basics of interaction of UV - visible light with molecules, absorption and fluorescence spectroscopy techniques and some representative examples of the wide variety of light-based applications. The lecture also briefly touched upon the most ancient, but the most efficient light based technologies existing in nature: energy fixation by photosynthesis and maintenance of a chemically stable atmosphere by cleansing and recycling.

Both the lectures enthused the audience mainly comprising of about 100 students and few Lecturers. There was active interaction and discussion with both the speakers. Prof. Rajendra Rathi, HOD, Physics Department, Ruia College welcomed and introduced the speakers and Prof. Pratap Patil proposed vote of thanks. Tea and snacks were served at the end of the session.

IWSA Popular Science Lecture at Sophia College for Women on 18th Oct. 2015

Indian Women Scientists' Association (IWSA) conducted a popular science lecture for junior college students at Sophia College for Women, Bhulabhai Desai Road, Mumbai on 18th October, 2015. Dr. A. P. Jayaraman, former Senior Scientist, Department of Atomic Energy spoke on "Science 2015 and Opportunities in the next decade". Dr. Jayaraman spoke on the theory of knowledge relating it to periodic table. He covered various topics such as how to develop scientific thinking, ability to think fast and slow, how scientists can make money using information gained, quoting Thales, the first scientist who was a weather man and made money by investing in oil mills due to his knowledge to predict the weather. He also spoke on critical thinking and problem solving, creativity and innovation, communication, collaboration and leadership, cross cultural and societal fluency, career and learning self-direction, computer and digital proficiency etc. China, Korea and Japan have improved their learning skills and creativity in the recent years, he said. The present education system will soon become obsolete and the present type of jobs will vanish in the next few years and hence it is essential to develop new skills and change the direction for survival, Dr. Jayaraman emphasized. Dr. Susan Eapen spoke of the various activities of IWSA and its efforts to popularise science and develop scientific temper among college students. Dr. Ignat Mendes, HOD of Chemistry Department, Sophia College welcomed the gathering and appreciated IWSA's efforts to reach out to students in popularizing science. There was a very good interaction between Dr. Jayaraman and the students. About 150 students attended the talk.

IWSA- ISRAPS Popular Science Lecture at Sophia College for Women, Mumbai on 5th December 2015

To commemorate the 'Year of Light', Indian Society for Radiation and Photochemical Sciences (ISRAPS) in collaboration with IWSA conducted two popular science lectures at Sophia College for Women, Bhulabhai Desai Road, Mumbai on Saturday, the 5th December 2015 at 9.30 AM.

The first speaker was Dr. R. K. Vatsa, Chemistry Division, BARC who spoke on "Light Matter interaction: Fundamentals and Applications". He informed that light matter interaction is a multi-faceted field depending upon the form of matter. Intensity of light being used modifies optical properties of matter and its photo-physical/photo-chemical behaviour. Hence it is difficult to predict a priori how light will interact with matter in a totally unknown situation. The lecture covered various topics such as electromagnetic spectrum, different transitions occurring in the regions, different radiation sources such as Laser, LED and Synchrotron. Rotational, vibrational and Raman spectroscopy were also discussed. Interaction of laser light with nano-clusters in gas phase, where both particulate and wave nature can be seen, was also presented.

The second speaker Dr. Sharmistha Dutta Choudhury, Radiation and Photochemistry Division, BARC spoke on "Magic of Light". She said that light plays a vital role in our daily lives and light based technologies have revolutionized society through internet communication, advanced medical procedures and smart lighting applications. The talk covered a wide variety of light based applications including an over view of impact of light in cutting edge bio-medical research.

About 130 students attended the lecture and there was a very active discussion at the end of the lectures.

IWSA's--BRNS Popular Science Lecture at SIES College of Arts, Science and Commerce, Sion on 18th Dec. 2015

Dr. Sunil M. Keswani, Director, Research, National Burns Centre, Airoli, Navi Mumbai, gave an illuminating lecture on "Miracle of Skin Donation". He informed the audience about the need for skin donation for treating burns. He provided details of how skin is collected from those who have died within 6 hours of their demise. The exclusion and inclusion criteria from whom the skin donation could be accepted was explained. Dr. Keswani showed how the body is cleaned, skin is harvested, converted into a mesh and then stored in antibiotic containing glycerol at 4°C-6°C. The skin so acquired is tested for absence of viruses and bacteria before use. Strict standard operating procedures are followed during collection, processing and storage. The Skin Bank is audited every year to ensure that all guidelines for banking are adhered to. Acceptable skin is used to treat patients with burns by layering the skin mesh on the well cleaned area of the burn. The mesh prevents the loss of fluids and hastens healing. Dr. Keswani informed that the Skin Bank at the National Burns Centre in Airoli, provides the stored skin to other hospitals and burn centres with appropriate documentation for treatment of patients with burns. He impressed on the audience the need to educate public about skin donation after death so that many lives could be saved. He requested one and all to help in this task by informing friends and relatives about skin donation.

The lecture was attended by about 150 students and teachers of the college and there was active discussion after the lecture.

One Day Certificate Course on "Ethics in Scientific Research", 20th November, 2015

A one day certificate course on "Ethics in Scientific Research" was conducted by IWSA in collaboration with Karmaveer Bhaurao Patil College (KBPC), Vashi, Navi Mumbai on 20th November, 2015. This was attended by more than 70 delegates, many of them students (from KBP College and other Mumbai Colleges) and a few were from Research laboratories like BARC. Dr. Surekha Zingde, Vice President, IWSA and Co-Convener of the workshop welcomed the chief guest, all the participants and the faculty. The course was inaugurated by our Chief Guest, Dr. Harsha Mehta, Principal, SIES College, Sion. Dr. Mehta articulated on the connection between philosophy and ethics and the importance of ethical grooming for the students to follow good standards of conduct in their respective careers and day to day lives. Dr. Devaki Ramanathan, President, IWSA gave a short review of IWSA and its activities. Dr. Bakhtaver Mahajan, Trustee IWSA and Convener of the course, presented a preamble of the course. After the inaugural address, the KBPC students presented an Ethics song which was innovative and appropriate for the occasion. The compeering for the entire inauguration function was done by Dr. Shubhada Nayak, Vice Principal, KBP College and another Co-Convener of the course.

In total, there were seven lectures on different themes. Each of the speakers dealt with their subject impressively, conveying the pertinent messages through discussion with specific case studies. The topics covered were as follows:

1. Ethics in Scientific Research: an overview – Dr. Bakhtaver S. Mahajan, IWSA
2. Ethical Conduct and Misconduct in Science – Dr. Surekha Zingde, IWSA
3. Data Management -The Ethical Issue – Dr. Yasmin Khan, Sophia College, Mumbai

4. Science Communication: Role of Authors, Editors and Other Players – Dr. Hema Ramchandra, Sophia College, Mumbai.
5. Human Interactions in a Laboratory – Dr. Jyoti Ramchandani, University of Mumbai.
6. Funding of Science – Dr. Bakhtaver S. Mahajan, IWSA
7. Ethics and Technology – Dr. Devaki Ramanathan, IWSA

The valedictory function was chaired by Dr. V. S. Shivankar, Principal, KBP College. Dr. Shubhada Nayak announced names of all participants as the Chief Guest distributed certificates of participation. Dr. V. Sudha Rao, Immediate Past President, IWSA, felicitated Dr. Shivankar with a Tulsi Plant. There was a feedback session before closing down. The organizers would like to place on record their sincere appreciation to Dr. Shivankar for the support from their college, and to all the faculty for their efforts. Special mention should be made of the two speakers, from Sophia College, and one from Mumbai University. The idea in the choice of speakers was to spread the message of ethics among teachers first and then to students. The main objective of the course is creating awareness among the academia so that the subject of 'ethics' becomes a compulsory subject in the curriculum - at different levels - starting with schools and then culminating at graduate and post graduate levels - as in other countries. Over a period of time, ethical conduct leads to higher quality of scientific research.

Dr. Devaki Ramanathan
President, IWSA

IWSA's Merit cum means Scholarship for girl students -2015

Over the years, Indian Women Scientists' Association has been supporting less privileged and academically bright girl students pursuing science at undergraduate and post graduate levels by providing scholarships. This year, two B.Sc. students from ICLE M.J. College, three M.Sc. students from Institute of Science, one M.Sc. student each from Annasaheb Nagar College, Hadaspar and from KBP College, Navi Mumbai were selected for IWSA Scholarships. One special feature of this year was institution of Dr. Jayashree Daoo fellowship in memory of former principal of ICLE M. J. College for a girl student pursuing Ph.D. Ms. Kanaka Ghosalkar of NIRRH, Parel was selected for the award of Jayashree Daoo fellowship. Another novel feature of this year was supporting two girl students doing Ph.D- Ms. Asha Yadav, Dept. of Physics, Mumbai University and Ms. Anisha Ramsurat Kashyap of Dept. of Physics, Ramnarain Ruia College from the donation received from Mr. Aditya Dhareshwar. Two students each of computer course and TOT were also selected for award of scholarships.

A function was held on 10th October, 2015 at 4.30 p.m. for distribution of scholarship awards. Dr. Pramod Pabrekar, Principal ICLE M. J. College was the Chief Guest and Shri. Ashwin Mehta and Ms. Darshana Mehta were the guests of honour. Dr. Pabrekar spoke on the need for students taking up science and the present policies of government to reach out to the masses through education. Mr. Ashwin Mehta spoke on the importance of supporting girl students and how this will lead to development of the nation. The scholarships to M.Sc. and B.Sc. students were distributed by Mr. Ashwin Mehta and Ms. Darshana Mehta, while Jayshree Daoo Fellowship was distributed by Dr. Pabrekar. Dr. Sudha Padhye distributed the scholarships to computer and TOT students. In the same function, teachers' trainees were given certificates and prizes. Dr. Sudha Rao welcomed the guests and spoke about various activities of IWSA with special reference to nursery teachers training programme. Dr. Susan Eapen elaborated the scholarship programme. The function was attended by about 80 participants who later joined for high tea hosted by IWSA.

IWSA Teacher Trainees Present a Lively Play! – A Report (2015)

A play adapted from a folktale about giving and kindness, 'The Boy and the Drum', written by Umesh P. N. and illustrated by Rajiv Eipe, was conducted on 5th September, Saturday, 2015 from 10 am to 10.30 am at IWSA's ICICI Multipurpose Hall for Nursery & Day Care Children. The agenda was to promote Pratham Books, not-for-profit publisher, a brand of story books as Indian as the children who read them. It dreams to see a country where every child wants to read, is able to read, and has something good to read. IWSA Teacher trainees (2015), with the encouragement and guidance of their teachers presented the play as a part of the "creative drama" content of the syllabus of the Diploma in Nursery / Crèches Teacher Training Course affiliated to SNDT University at IWSA. Another show of the same play was conducted on 16th September 2015 from 4.30 pm to 5.00 pm at Sai Nath School's Main Hall, Vashi; and two shows were conducted on 24th September 2015; 1st show from 4.30 pm to 5.00 pm. and 2nd show from 5.00 pm to 5.30 pm at Fr. Agnel Multipurpose School. About 700 Pre-Primary and Primary school children & teachers enjoyed the shows.

A folktale about giving and kindness was transformed into a lively play and our Teacher Trainees with all fun and learning performed this versatile and adaptable piece on the stage. Since it was on the occasion of Teacher's Day and a holiday for school children and public, number of people gathered to see the play.

Objective Achieved:

1. IWSA actively participated and supported the cause of **'a book in every Child's hand'** started by Pratham Books.
2. IWSA went to Schools with their Teacher Trainees and there through the play based on the story of the boy and the drum imparted the value of sharing and also to value people and not things.
3. Teacher Trainees got the privilege to learn an art and to perform a play for such a noble cause.

They also learnt group and individual co ordination, voice modulation and most importantly time management. They would be using this skill as an enhanced teaching aid in further school programmes.

Archana Dube Sahu
(Trainee Teacher, Roll No. 10)
Diploma Course in Nursery/Crèche Teacher's Training,
affiliated to SNDT Women's University,
Mumbai at IWSA, Vashi, Navi Mumbai.

Report for November to December – 2015 for the Teachers Training Program.

These two months have been very busy with a number of programs. Prior to Diwali vacations the 2nd Unit Tests were held. On 16th November the trainees resumed classes. On the same day, a field trip to Kilbil, day care centre was organized. The trainees spent 3-4 hrs observing the activities in the Centre. They were addressed by Mrs. Shashi P. who explained the working, objectives and their future plans for the day-care.

During the two months the trainees completed their I.T. training which is part of their training module. They made power point presentations on various topics. Two of the groups were awarded prizes for the same. Trainees along with teachers attended Kaleidoscope 2015 (A National Conference on Child Rights – Participation and Play in the Urban context) at S.N.D.T Juhu, organized by IPA and TISS during 30th Nov-1st Dec 2015. Thereafter, a Field trip / study tour to S.O.S village Alibaug was organized for the students. This is part of their curriculum for paper IV. Reports for all the above have been made by the students and submitted to the relevant subject teachers.

Ms. Shaheena Shaikh, Supervisor, TOT.

IWSA's "Mrs. Indirabai Padhye" Nursery School: Report for December 2015

The nursery school now has 17 children. During December 2015 the children were taught painting of vegetable and flowers. They were introduced to shapes such as triangle. To improve their general knowledge the children were taught about road transport and the winter season. As a part of learning and playing together, the children from the day care and nursery school were taken for a picnic to the Nerul rock garden on 19th Dec 2015. They were all dressed in festive red and white for the Christmas season. The children and the accompanying teachers and support staff thoroughly enjoyed the morning.

IWSA's – Satish Haware Computer Education Centre

The past few months have been busy in the Computer Centre with seventeen children from grade 3 to 6 being trained for the Cyber Olympiad examination held by SOF- Science Olympiad Foundation. The training comprised of: Exploration of Hardware; Hands on practical projects;Audio Visual Training; Logical and Analytical Skills Building; Multiple Choice Questions.

The Centre is proud to announce that results were excellent for all the children with a few rank holders too.

1. Gold Medal - Grade 3, Mananjyot Soni, Avalon Heights International School.
2. Bronze Medal- Grade 4, Amrit K, North Point School,
3. Bronze Medal - Grade 6, Ishvajyot Soni, Avalon Heights International School.

Ms. Ruchi Sood
Head, IWSA's S. Haware Computer Centre
soodruchi@gmail.com

IWSA's –Jitendra Mafatlal Mehta Working Women's Hostel

The Hostel at IWSA has always been environment friendly. The hostel has solar panels, the power generated from which is used for providing hot water to the hostelites. Noting that there is need to provide an environment friendly solution for the disposal of soiled sanitary napkins, the hostel has installed an incinerator which is a simple, safe and hygienic way to dispose the napkins. The incinerator was obtained from the Ms. Swati Bhedekar of Sakhi Foundation. This incinerator consists of a bottom plate, middle body and a top lid, all made of cement/ clay materials. It has a top opening to drop the napkins and a bottom hole to introduce a match stick. Soiled napkins are to be wrapped in a paper and dropped into the incinerator from the top opening. A small piece of burning paper has to be introduced from the bottom. Within few minutes all the material inside turns into ash without any foul smell or smoke.

Many of the states especially in the North East have made it mandatory for these incinerators in schools, colleges and other institutions. We at IWSA are also contributing to the effort to protect our environment.

Ms. Vijayalakshmi Tilak
Varalakshmi55@yahoo.com

Upcoming Event:

IWSA's Triennial Conference on:
"SUSTAINABILITY: Changing Trends in Science and Technology in India"

Dates: 2nd to 4th December 2016.
Venue: IWSA Headquarters, Sector 10A Plot 20, Vashi, Navi Mumbai.

Members please block these dates on your calendar and keep track of IWSA's website for detailed information. Encourage your colleagues and friends to participate.

We look forward to meeting you at the Conference.

IWSA IS HAPPY TO ANNOUNCE THE RECOGNITION OF TWO OF OUR SENIOR MEMBERS BY THE INDIAN MERCHANTS CHAMBER, NAVI MUMBAI BRANCH.

DR. V. SUDHA RAO

DR. ASHA DAMODARAN

Dr. V. Sudha Rao, Member Board of Trustees and immediate past President of IWSA was recognized for her contributions to Food Science Technology and for popularizing Science and developing scientific temper in the Society.

Dr. Asha Damodaran, member IWSA and District in-Charge of Medical services of the Sri Sathya Sai Seva Organization (SSSO), was recognized for her dedication in rendering medical services to the poor and needy and for spreading wellbeing in many underprivileged villages through SSSO.

Dr. Sudha Rao and Dr. Asha Damodaran were felicitated by Indian Merchants' Chamber, Navi Mumbai, at a function organized to honour Women achievers from Navi Mumbai who have outshone in the area of business, industries, professions such as Doctors, Chartered Accountants, Lawyers, Actors, Sports persons etc. The function was held at the Hotel Fortune Select Exotica, Navi Mumbai on 23rd Dec 2015. The function was attended by lady entrepreneurs and the ladies wing members of IMC. Mrs Shalini Piramal, President IMC Ladies Wing was the Chief Guest and Mrs. Netra Shirke, Chairperson, Navi Mumbai Municipal Corporation was the Guest of Honour on the occasion.

IWSA's MERIT CUM MEANS SCHOLARSHIPS/AWARDS

These are given to meritorious students every year.

The scholarships/awards have been made possible through the generous donations from well wishers of IWSA.

Applications will be invited for the scholarships/awards through an advertisement in Vashi Times / Times Navi Mumbai at the end of June 2016.

Members are requested to bring this information to the attention of deserving students.

2015 - International Year of Light (IYL)

The International Year of Light and Light-Based Technologies (IYL 2015) is a global initiative that will highlight to the citizens of the world the importance of light and optical technologies in their lives, for their future, and for the development of society. A resolution regarding this was passed by the United Nations General Assembly on 20th December 2013. The importance of light as the source of energy and life in earth is well established and applauded from ancient times. All ancient civilizations considered light as divine, and worshipped in the form of gods and goddesses. So, why has this special celebration of 2015 as the year of light been taken up?

The answer lies in the fact that humankind has progressed so much from just being the passive beneficiaries of light - or nature itself for that matter-, as food, energy and life provider. In the last few years, the progress in the light based technologies have revolutionised our lives, be it the field of communication, medicine, energy, entertainment, art and what not! Photonics, which is the technology of generating, controlling and detecting light, is considered to be the technology of 21st century, as electronics was in 20th century. 2015 marks the anniversary year of many significant scientific milestones in the understanding of light and development of light based technologies. It marks the 1000th anniversary of launching of a book on optics by Ibn Al-Haytham (1015). It was 200 years back that wave theory of light was proposed by Fresnel and 150 years back that the electromagnetic theory of light propagation was proposed by Maxwell (1865). Exactly hundred years back, Einstein used the theory of the photoelectric effect proposed in 1905 and brought out the embedding of light in cosmology through general relativity (1915). It is the 50th year of discovery of the cosmic microwave background by Penzias and Wilson (1965). 2015 also marks the 50th anniversary of Charles Kao's achievements concerning the transmission of light in fibers for optical communication. Thus, 2015, a conglomeration of anniversaries of breakthroughs in the field of light, is an apt choice for celebrating the year of light. The aim of this celebration is "to raise the global awareness of how light-based technologies promote sustainable development and provide solutions to global challenges in energy, education, agriculture, and health". The International Year of Light will consist of coordinated activities at national, regional and international levels. The text of the resolution, which was adopted as part of a more general agenda item on science and technology for development, stated: "Applications of light science and technology are vital for existing and future advances in medicine, energy, information and communications, fiber-optics, astronomy, architecture, archaeology, entertainment and culture."

Light consists of electromagnetic radiation waves, i.e., oscillations in electric and magnetic field, which can carry energy from one location to another. In our everyday language, light is treated as the part of electromagnetic waves which can be perceived by human eyes. But there is a whole range of electromagnetic radiation that is dark or invisible. The electromagnetic radiation has an intriguing dual nature, behaving as a wave as well as a particle. The particle is a wave packet, called a photon. Consequently the electromagnetic radiation is described in terms of wavelength (λ) or frequency of the wave, and energy of the photon is given by hc/λ, where 'h' is the Planck's constant and 'c' is the velocity of light. The visible light is a combination of radiation with wavelength in the range of 400 – 700 nm (nanometer), but the radiation with higher and lower wavelengths is no different from this, and the technology harnesses the advantages of this part of the electromagnetic spectrum as well. The whole range of electromagnetic radiation is shown in Fig. 1.

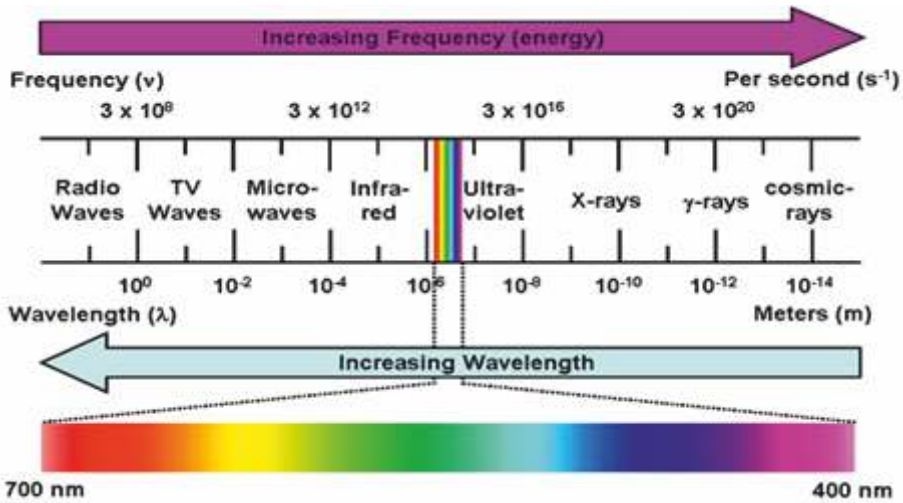


Fig. 1 *Different regions in the electromagnetic spectra*

Advance in the light based technologies in the whole range of wavelengths have become part of our everyday life, and also they continue to "enlighten" us more and more about matter and the universe where we exist. A few important aspects will be covered here.

Light Based Technologies in Everyday Life

Lighting: This is the most obvious or direct application of light, which has evolved through centuries, from oil lamps, electric incandescent bulbs, metal halide lamps, compact fluorescent lamps (CFLs) to energy efficient LEDs (Light Emitting Diodes) and lasers. A detailed description of the lighting technology is given by Dr. Dimple Dutta in the next article in this issue. In addition to the light sources, the utilization of natural daylight also has seen the technological advances, which allow its penetration far into a building's interior, both across the space and through ceilings and floors to provide natural lighting within the building. Solar tracking systems on rooftops follow the sun throughout the day, which maximize the sunlight used within a building. Solar concentrators also can boost the natural sunlight levels to generate more available light inside. Indoor and outdoor lighting for entertainment industry and for other commercial applications has become a big business, with improved energy efficiency, light quality, ability to direct precisely and control using occupancy or vacancy sensors etc. Reduction of "light pollution" that affects the observation of night sky is also a recent area of interest.

Communication: One part of our life that is totally revolutionised by the light based technology is telecommunication through fibre optics, which actually facilitated the advent of the Information Age. Optical signal transmission has advantages over electrical transmission and is widely used for transmitting cable television signals and also in internet communication. Although Alexander Graham Bell was the first one to use light for transmitting information in 1880, this could be of practical use only after the advances in lasers and fiber optic technology. An optical fiber is a single, hair-fine filament drawn from molten silica and its chemical purity and composition decides the degree of attenuation and the range of wavelengths that can be transmitted. In a fiber optic cable, many individual optical fibers are bound together around a central steel cable or high-strength plastic carrier for support. This core is then covered with protective layers of materials such as aluminum, kevlar, and

polyethylene, which is called the cladding. Due to the difference in the refractive indices of the core and cladding, light gets constantly bent from the cladding back to the core and does not get attenuated at the surface. Thus the optical information travels efficiently in the fiber at the speed of light. Lasers or LEDs are used as light sources and photodetectors based on indium gallium arsenide are used as receivers. At present the whole world is physically wired and connected, with thousands of km long fiber optic cables, mostly running undersea, divided into many segments and with many landing points.

Medicine: Light always had some therapeutic applications as in the case of irradiating babies with jaundice, which causes a photochemical change that allows the jaundice pigment to become water soluble and to be excreted. After the advent of lasers (light amplification by stimulated emission radiation) in 1960s there are many more areas of applications of light based technologies, in diagnostics as well as in treatment. Due to the precision that can be achieved, the laser beam has replaced conventional scalpels in intricate surgeries like eye surgery. Leon Goldman, known as the "father of laser medicine" was the first researcher to use a laser to treat a human skin disease, in 1961, just a year after laser was invented. The technique he used paved the way for later developments in laser dermatology. His research also led to the application of the ruby laser in retinal surgery in 1961 itself and to discoveries such as lasers being able to simultaneously cut skin and seal blood vessels to restrict bleeding. Now the lasers are used in many areas of medical fields, to remove cataract and to reshape corneas (LASIK) so that patients no longer need to wear glasses, in cosmetic surgery to remove spots and wrinkles from the face, in dentistry for surgery and drilling holes, to name a few. Laser based endoscopy and imaging techniques are widely used in early diagnostics of diseases, such as cancer. In photodynamic therapy (PDT) light activating drug called photosensitizer is injected, which is preferably retained in the cancer cells. These molecules absorb the laser light directed towards the cells and initiate the destruction process.

Energy: The primary energy provider for earth is sun and the secondary sources such as firewood, oils, animal fats, coal, petroleum, natural gas etc are derived basically by photosynthesis, and hence derivatives of solar energy. Due to the decrease in the fossil fuel reserves, one of the greatest challenges of modern science is conversion of solar light energy directly to electricity. The sun shine incident on earth delivers about 3×10^{24} J of green energy per year, which is about 10000 times of the global energy consumption and hence this is a very active and promising area of research and innovations. Silicon based photovoltaic solar cells have good efficiency, but they are costly. They are mainly used as the energy source in satellites. Single p–n junction crystalline silicon devices are now approaching the theoretical limiting power efficiency of 33.7%. The solar cell achieved a new laboratory record with 46 percent efficiency in a French-German collaboration in December 2014. The other option for solar energy conversion is dye sensitized solar cell (DSSC), which mimics the process of photosynthesis. They are cheaper and more environment friendly. The most performing DSSCs (of 13%) use organic solvents, but efforts for making aqueous based DSSCs are ongoing. Apart from solar energy, nuclear fusion is another future prospect, where light in the form of powerful lasers plays an important role for confinement.

Other Uses: High power lasers (kW) are used for welding, soldering, drilling, cutting, material processing, surface modification, ablation etc. in industry. They are extremely useful for precision jobs such as engraving, etching and micromachining in the manufacture of very small devices. Light is used for inspecting crime scenes and materials and for identifying fake currencies. Uses of lasers in optical data storage, DVD players, bar code readers, pointers etc have become very common in our everyday life.

Light Based Techniques – for "Enlightenment"

The nature of interaction of each region of electromagnetic radiation with matter is unique and has been put to use for various spectroscopic applications, which are enhancing our knowledge about nature, materials and the whole universe. Electromagnetic radiation is reflected, refracted, transported or absorbed by a medium. Depending on this, materials appear shiny, transparent or coloured. Absorption depends on the resonance or matching of the energy of the radiation with the quantized energy levels in the materials. UV-VIS spectroscopy probes electronic excitation, infra-red region probes vibrational excitations whereas microwave region interacts with rotational motion of the molecules. These spectroscopic techniques can be used for characterization, quantification, studying the surroundings etc. Some of these excited states emit efficiently, and the nature, intensity and lifetimes of this fluorescence have been shown to be very sensitive and powerful probing techniques. Microwaves and radio waves are also used in NMR and EPR (Nuclear Magnetic Resonance and Electron Paramagnetic Resonance). X-ray emission spectroscopy and photoelectron spectroscopy are very useful for understanding crystal structure and elemental compositions. Mossbauer spectroscopy which is based on the interaction of γ-rays with nuclei is very sensitive and useful to determine composition and phase transitions. Recent advances in technology has opened up innumerable modifications and variations of the basic spectroscopy techniques, so that we are able to probe deep into any phenomena, go smaller as well as wider in space and time and obtain the kind of information that challenges or testifies our accepted theories. Fourier Transform Infra Red Spectroscopy (FTIR), Laser Induced Fluorescence Spectroscopy (LIF), Laser Induced Breakdown Spectroscopy (LIBS), Cavity Ring Down Spectroscopy (CRDS), Coherent Anti-Stokes Raman Spectroscopy (CARS), Surface Enhance Raman Spectroscopy (SERS), Circular Dichroism Spectroscopy (CDS), Sum Frequency Generation (SFG) and Terrahertz spectroscopy are few of them. The techniques and other developments in the field of light have been effective in deeper understanding of materials and life. Few such examples are discussed here.

Probing Live: The discovery of intensely fluorescing green fluorescent protein (GFP) in jelly fish has led to the development of a tagging tool in biosciences to observe the important chemical processes in living organism (Fig.2), for which Shimomura, Chalfie and Tsein received Nobel prize in 2008. The advantage is that fusion of GFP to a protein does not alter its location or function. Hence it is widely used in labeling, tracking, studying interactions, in super resolution spectroscopy, drug development etc. As a spin off, this has also entered the entertainment industry, with fluorescent fish being available in the pet stores in some parts of world.

Fig.2. *Engineered frog expressing green fluorescent protein in its muscle cells.*

Probing Fast: With the advent of lasers of very short lifetimes (upto femtoseconds, 10^{-15} s), it is possible now to directly probe very fast natural processes. Vision and photosynthesis are two such natural processes. Ahmed H. Zewail got Nobel Prize in Chemistry in 1999 for developing the femtosecond spectroscopy which enables to take snapshots of the fast chemical reactions through the transition states. Using this technique, Prof. Mathies and his group demonstrated that the first step in vision, the cis-trans isomerisation of retinal, occurs in 200 fs. Similarly, the complex process of photosynthesis which involves more than one sensitizers, two photosystems followed by dark reactions, is also completely understood now with the help of different light based probing techniques, and the knowledge is efficiently translated to many light harvesting techniques. This understanding is also used for developing self cleaning glass and other materials, which use photocatalytic surfaces for removing stains and dirt by oxidizing radicals such as OH.

Probing Small: The Nobel prize in Chemistry for the year 2014 was shared between Eric Betzig, S. S. W. Hell and W. E. Moerner for the development of super resolved microscopy. The resolution of optical microscopy was limited by the wavelength of the visible light, known as Abbe's diffraction limit, making it impossible to follow interaction between molecules in the cell. Study of such interactions is required in understanding the details of how diseases develop. Two different methodologies are used by them, one by using stimulated emission as a nanosized flashlight and the other by looking with different wavelengths to physically separate the excitation processes. Spectroscopic techniques can also quantify extremely small amounts. e.g., ambient concentration of OH radicals in the atmosphere, which is only about 10^5 cm^{-3} (10^{-15} M), can be monitored by Fluorescence Assay by Gas Expansion (FAGE) or Differential Optical Absorption Spectroscopy (DOAS).

Fig. 3. *Telescopes (as of February 2013) operating at wavelengths across the electromagnetic spectrum. Observatories are placed above or below the portion of the electromagnetic spectrum that their primary instrument(s) observe.*

Probing Far: Modern spectroscopic techniques, distributed in the observatories across our earth and in the space stations surrounding the earth's outer space (see Fig. 3), are breaking the barriers of distance and time. These data help us to measure distances to stars and galaxies, determine their chemical composition, to understand the nature of the stellar and interstellar media. The information leads us to understand the age of the stars, evolution of galaxies, expanding universe and its present chemically diversified structure. In addition to the existing ground based telescopes in Pune and Ladakh, Indian Space Research Organisation has launched. ASTROSAT telescope in Sep 2015 (Fig.4). This can make use of a wider variety of wavelengths – from visible to X-ray region by its 5 instruments (payloads), unlike many other telescopes which operate in a narrow range.

Fig. 4. *Astrostat mission before launch in the clean room*
http://www.isro.gov.in/pslv-c30-astrosat-mission/astrosat-mission

As light based technologies are helping us to reach out and unravel the mysteries of the universe, the mystery of light itself, its dual nature and quantum interactions are being pursued by scientists. Using a pulsed femtosecond laser, the scientists from École Polytechnique Fédérale de Lausanne (EFPL) induced surface plasmon polaritons in the nanowire, which is an electromagnetic wave pattern within the electrons of the material. Because of the size of the nanowire, the plasmon polaritons form a standing wave within the wire and also radiate light, which in a quantum sense means that photons are emanating from this standing wave (Fig.5). The team then used the ultrafast energy-filtered transmission electron microscope and aimed a beam of electrons at the set up. Some of the electrons collided with the emanating photons, and thus gained some specific quantized amounts of energy from the induced photons. Basically the team found a way to induce particle-like interactions while maintaining the overall wave aspect of the system at the same time.

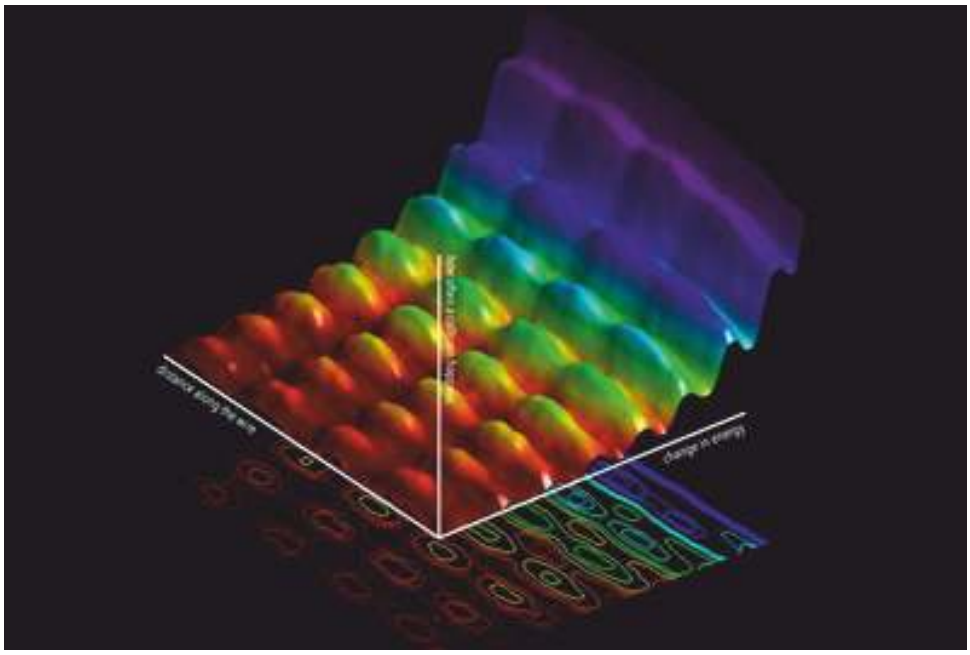


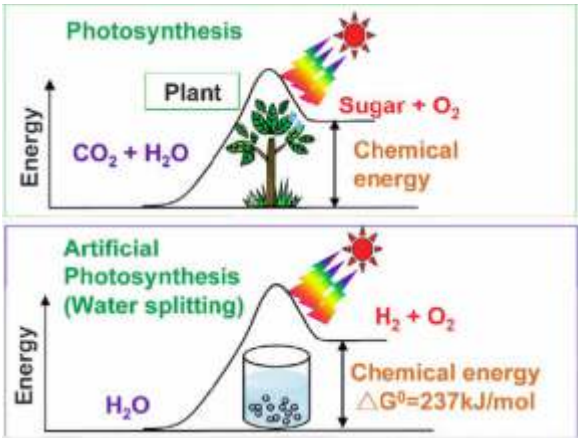
Fig. 5. *Standing wave of* ***surface polaritons*** *induced in a nanowire, and their particle nature seen by the collisions of their interaction with electrons, which lead to quantized change in energy, imaged by high resolution electron microscopy. (Nature Communications, 2015). The axes are distance in the nanowire, change in energy and frequency of collision.*

The above experiment is a clever and pioneering way to interact with and control quantum systems, and is very useful for the development of photonics and quantum computing. These experiments will probably pave the way for many more exciting applications of light based technologies. Let us wait for the future and meanwhile celebrate the present excitement and enlightenment using light!

References:

1. http://www.unesco.org/new/en/unesco/events/prizes-and-celebrations/celebrations/international-years/international-year-of-light/
2. Lasers in Medicine, Sian Harris, SPIE Professional 2011, January.
3. Reviews in Modern Astronomy, Deciphering the Universe through Spectroscopy, Ed. Regina von Berlepsch, Wiley-VCH Publications.
4. F. Dimroth et al., Wafer bonded four-junction GaInP/GaAs//GaInAsP/GaInAs concentrator solar cells with 44.7% efficiency. Progress in Photovoltaics: Research and Applications, 2014. **22**, 277-282.
5. A. MacLachlan, How a Jellyfish Protein Transformed Science, National Institutes of Health, http://www.livescience.com/
6. F. Bella,C. Gerbaldi, C. Barolo, and M. Grätzel, Aqueous dye-sensitized solar cells, Chem.Soc.Rev.,2015,**44**,3431—3473.
7. D. M. Chudakov, M. V. Matz, S. Lukyanov, K. A. Lukyanov, Fluorescent Proteins and Their Applications in Imaging Living Cells and Tissues, Physiol. Reviews 2010 , **90**, 1103-1163.
8. www. nobelprize.org
9. D. Stone, L. K. Whalley and D. E. Heard ,Tropospheric OH and HO2 radicals: field measurements and model comparisons, Chem. Soc. Rev., 2012,**41**, 6348-6404
10. http://www.isro.gov.in/pslv-c30-astrosat-mission/astrosat-mission
11. L Piazza, T.T.A. Lummen, E Quiñonez, Y Murooka, B.W. Reed, B Barwick, Simultaneous observation of the quantization and the interference pattern of a plasmonic near-field, Nature Communications, 2015

Dr. S. Dhanya
Radiation and Photochemistry Division
BARC
sdhanya@barc.gov.in



Sunlight plays important role in photosynthesis, where plants convert atmospheric CO_2 and water to various forms of food that are essential for sustenance of life in our planet.

In artificial photosynthesis, photocatalysts can split water to hydrogen and oxygen. Hydrogen is considered to be the clean energy carrier for the future.

The Chronicles of Lighting Technology

Our planet Earth has been bathed with light since the birth of the Sun and the solar system about 4.5 billion years ago. The Sun has been the primary source of energy for all living things on our planet ever since. It is also the only source of natural light. With the passage of time, mankind discovered wood fire as the first source of artificial light. The endless quest for efficient, reliable and affordable lighting sources led to the transformation from the use of fire as a lighting source to oil lamps. Though wooden torches and spirit lamps are still used in remote areas, it is electricity which is the major power source of artificial light in the modern world today.

The invention of the incandescent light bulb has been stated as one of the top ten inventions that changed the world. According to historians, nearly two dozen people were instrumental in inventing incandescent lamps throughout the 18th century. However, the pioneering experiment was done in 1802 by Sir Humphry Davy. He connected a thin strip of platinum to wires that were connected to a powerful electric battery. The passage of current through the platinum strip heated it to such an extent that it started to glow. Platinum was used since it has a very high melting point. Though it did not last long and was not too bright but it was a beginning. However, Thomas Alva Edison is regarded as the primary inventor because he created a completely functional lighting system, including a generator and wiring as well as a carbon-filament bulb that lasted for 13 hours way back in 1879 (Figure 1). After the patent was filed and granted, Edison and his team discovered that a carbonized bamboo filament could last over 1200 hours. A year later, Edison started manufacturing commercial lamps using carbonized Japanese bamboo as filaments. However, it was much later in 1904 that Sandor Just and Franjo Hanaman were granted a patent for light bulb with tungsten filament that gave brighter light and lasted much longer.

Figure 1: *Original carbon filament bulb developed by Thomas Alva Edison*

In ordinary incandescent lamps, tungsten evaporates under the influence of heat and gradually deposits on the inner surface of the glass bulb darkening its surface. The solution to this problem was provided by application of some basic chemistry which led to the development of the halogen lamps. Halogen lamps have a tungsten filament with a small amount of iodine or bromine vapors encased in a quartz or aluminosilicate glass bulb (Figure 2). The tungsten evaporates on heating and forms tungsten halide, which does not deposit on the glass. When this halide gets close to the tungsten filament which is at a high temperature, it dissociates into tungsten and halogen and react again setting up a cyclical process. Thus the glass stays clear and the tungsten filament lasts longer. The first commercial halogen lamp that used iodine as a halogen gas was patented in 1959 by General Electric. It was developed by Elmer Fridrich and Emmet Wiley who worked at General Electric, in 1955. The halogen lamps are small in size to allow faster reaction between the evaporated tungsten and halogen gas. However, the small size leads to heated surface since it is much closer to the hot filament. That way they present danger and can cause explosion and also second and third degree burns if they

are touched when the lamp is hot. However, the major drawback of such incandescent lamps lies in its energy inefficiency. Approximately 5-10% of the energy used in an incandescent lamp goes to creating light whereas the rest is lost to heat.

To overcome this problem, researchers developed the compact fluorescent lamps (CFL). In 1895, Daniel Moore conducted an experiment that demonstrated emission of white and pink light from carbon dioxide and nitrogen infused bulbs. Thereafter, in 1934, Arthur Compton from General Electric reported successful experiments conducted with fluorescent bulbs which were later pursued further by the company. In a modern day CFL, an electric current is driven through a tube containing argon, krypton, neon or xenon and low pressure mercury vapor. This generates ultraviolet light that excites a fluorescent coating made of either metallic or rare earth salts (called phosphor) on the inside of the tube, which then emits visible light (Figure 3). CFLs use about 70% less energy than incandescent bulbs, emit lesser heat and distribute light evenly without putting a strain on the eyes. However, the CFLs contain toxic chemicals like mercury which pose an environmental threat during their disposal. The low luminous efficacy of incandescent (15 lumen/watt) as well as fluorescent lamps (80 lumen/watt) leads to considerable wastage of electricity in the form of heat. Consequently, researchers around the world realized that significant improvement in lighting efficiency through energy savings technology and procedure would have a major impact on the global energy consumption and economy.

Figure 2: *Tungsten halogen lamp*

Figure 3: *Compact fluorescent lamp*

Solid State lighting using light emitting diode (SSL-LED) is a new energy efficient option in the lighting industry. This technology promises superior attributes such as longer lifespan, and higher energy conversion efficiency of 95% (including driver losses) compared to incandescent and fluorescent lamps [1-5]. Furthermore, SSL-LED is a very low pollution source; it is compact, rugged and has a higher color rendition index (CRI). Light Emitting diode (LED) is a semiconductor device that can be used to emit either visible or infrared light depending on the material used by the process of electroluminescence or injection luminescence. Under this process and for a forward biased LED junction, electrons occupying finite number of higher energy states in the conduction band jump to lower energy states (valence band) recombining with holes to produce light (photon). The emitted light has an energy which represents the difference between the higher and lower energy state of the electron's transition (i.e. the energy bandgap). The peak wavelength of emitted light depends on the type of semiconductor material (direct or indirect band gap) used in the manufacture of LED. In direct band-gap materials the minimum of conduction band and maximum of valence band occur at the same wave vector k, whereas in indirect band gap materials they occur at different k-values. The emitted light is at a specific wavelength and it appears coloured since it is a narrowband emission. Hence, to obtain white light the narrowband emission must be converted into semi-broadband emission that fills the entire visible spectrum. The journey of white LEDs from lab to commercial light holders has been long and arduous. Nick Holonyak Jr., employed in General Electric, developed the first light-emitting diode that emitted light in the

visible part of the frequency range in 1962. It was a red LED. In 1972, M. George Craford, who was a graduate student of Holonyak, invented the first yellow LED and a brighter red LED. Thomas P. Pearsall developed high brightness light-emitting diode in 1976, for use with fiber optics in telecommunications. Shuji Nakamura of Nichia Corporation made the first blue LED in 1979 but it was too expensive for commercial use until 1994.

The luminous efficiency (ηL) of the first white LEDs was only 5 lm/W at a forward-bias current of 20 mA. However, now the efficiency of white light LEDs has already surpassed that of incandescent lamps and is competitive with fluorescent lamps. The luminous efficacy (lumen per watt) of an LED is determined by three physical parameters: internal quantum efficiency, the extraction efficiency and white light conversion efficiency. The internal quantum efficiency is a measure of how many injected electrons and holes are converted to photons (light) and depends on the radiative and non-radiative carriers' lifetime. The luminous efficacy and hence the brightness of a LED can be low in spite of high internal quantum efficiencies if light is not extracted efficiently. The extraction efficiency is a measure of how efficiently internally generated photons are extracted from the device. There are various approaches to get efficient solid state sources for white light generation (Figure 4) [6]. We can directly mix light from three (or more) monochromatic sources, red, green and blue (RGB), to produce a white source matching with the RGB sensors in the human eye. Another method is to use a blue LED to pump one or more visible light-emitting phosphors that has been integrated into the phosphor-converted LED (pc-LED) package. The pc-LED is designed to leak some of the blue light beyond the phosphor to generate the blue portion of the spectrum, while the phosphor converts the remainder of the blue light into the red and green portions of the spectrum. We can also use an ultraviolet LED to pump a combination of red, green and blue phosphors in such a way that none of the pump LED light is allowed to escape. Each of these approaches has potential advantages and clear technical challenges. Mixing the emission from red, blue and green colored LEDs is the most straightforward technique since there is no quantum deficit arising from Stokes shift and hence offers infinitely graduated color and white point control. However, this form requires independent output power control on each LEDs, and moreover there is a gap in the operating voltage between them making the operation quite cumbersome. Phosphor-converted LEDs are the most common LED based white light source and in 1996, the white LEDs fabricated from blue LED chips combined with yellow phosphors Ce3+(YAG) were commercialized [7]. This phosphor-conversion white LED represented an innovation in solid-state lighting, because they were small, lightweight, had a long lifetime and was easy to operate. However, they were inherently less efficient than an RGB source because of the unavoidable energy loss concomitant with the wavelength-conversion of a photon from wavelength λ_1 to λ_2 with $\lambda_2 > \lambda_1$. The energy loss is particularly large for wavelength-conversion processes from the UV (400 nm) to the red (625 nm) where the loss is 36%. Losses in extracted light efficiency in this approach is due to the physical shape of the phosphor, position of the phosphor, the refractive index mismatch which may lead to scattering of light back into the LED and the photoluminescence efficiency of the phosphors. The third approach is to have UV-LEDs. In this case the UV light is completely absorbed by the phosphors and the mixed RGB output appears white. The quantum deficit between the UV pump and the phosphors, especially the low-energy red phosphor, dissipates significant energy and makes this approach inherently less efficient than either the RGB or the pc-LED schemes for generating white light. However, the UV-LED approach has the advantage that color can be controlled by the phosphor mix at least at one point in time and at one temperature and hence the color rendering should be excellent.

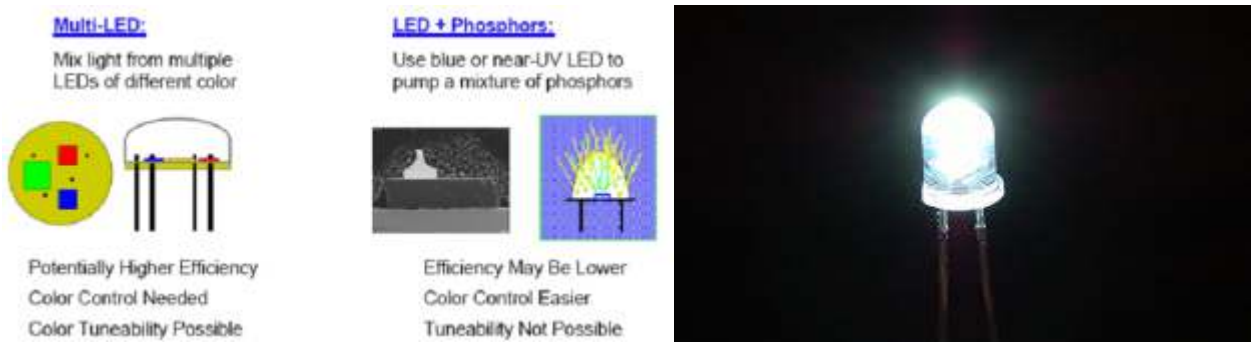


Figure 4: *Solid State Sources for LED*

High-brightness light emitting diodes are LEDs that combine the properties of high internal quantum efficiency, high extraction efficiency and high phosphor conversion efficiency to produce high luminous efficacy. Recently, a novel nano-crystalline sonochemically synthesized Gd_2O_3:RE (RE = Dy, Tb) phosphor, on excitation at 247 nm resulted in a very impressive CIE chromaticity coordinates of x = 0.315 and y = 0.316, and correlated color temperature of 6508 K which is very close to standard daylight [8]. At present the commercial high-brightness white LEDs have efficacy above 150 lm/watt [9]. Recently there have been reports of fabrication of three types of white LED with super-high luminous efficacy (η_L) and luminous flux (ϕ_V) [10]. The first type of white LED with a correlated colour temperature of 4600 K, had ηL of 249 lmW^{-1}, ϕ_V of 14.4 lm at a forward bias current of 20 mA. It was a phosphor conversion white LED lamp consisting of a blue LED die and a yellow phosphor of YAG (yttrium aluminum garnet). ηL for this white LED reached a maximum 265 lmW^{-1} at 5 mA and then decreased slightly with increasing injection current. However, the white LED was found to be deficient in red light component. To enhance the red component, a red phosphor, SrCaSiN:Eu was added to the YAG white LED.

With the efficacy of SSL now at 208 lm/watt at 350 mA and 4579 K colour temperature (under laboratory test condition) and the commercial availability of cool white 160 lm/W (Cree XM-LED) or 132 lm/W (Cree XP-G LED) (Figure 5), over 50% of global electrical energy used for general lighting purposes could be saved per year. Such energy could be channelled to improve electricity supply to avert the current trend whereby regular power outages are experienced in most developing countries. The importance of development of the white LED was acknowledged by the scientific community and the Nobel Prize in Physics for the year 2014 was given to Shuji Nakamura, Isamu Akasaki and Hiroshi Amano for their pioneering work on the development of blue LEDs. Though the red and green LEDs were developed in the 1960's, it is the lack of proper semiconductor material and technology that hindered the production of energy efficient blue LEDs for almost 27 years. Without blue LEDs, it was difficult to produce white LEDs which could compete with the other commercially-available white incandescent lights. White LEDs used for lighting are often based on efficient blue LEDs that excite a phosphor so that the blue light is converted to white light. These high-quality LEDs with their very long lifetime (100000 hours) are getting cheaper, and the market is currently exploding.

A little further on in the future, three-color LEDs may replace the combination of blue LED and phosphor for efficient lighting. This technology will allow for dynamic control of color composition. Replacing light bulbs and fluorescent tubes with LEDs will lead to a drastic reduction of electricity requirements for lighting. Since 20-30% of the electricity consumed in industrial economies is used for lighting, considerable efforts are presently being devoted to replacing old lighting technologies with LEDs. Future application may include the use of UV-emitting

AlGaN/GaN LEDs for water purification, as UV light destroys the DNA of bacteria, viruses and microorganisms. In countries with insufficient or non-existent electricity grids, the electricity from solar panels stored in batteries during daylight, can power white LEDs at night. There is a possibility to witness a direct transition from oil lamps to white LEDs in remote areas.One very exciting, new technology is OLED technology or Organic Light Emitting Diodes. This will allow LEDs to be manufactured on flexible surfaces. This has the potential to revolutionize the way that we think about and design lighting and electronics. A few manufacturers have already started using OLEDs in their products. Our curved television screens and smartphone screens utilize OLED technology. This technology is new and the costs are still high but we can safely assume that we will see more applications and lowers costs in the very near future.

Glossary

Color Rendering Index (CRI)
A color rendering index (CRI) is a quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.

Lumen
The lumen (symbol: lm) is the SI derived unit of luminous flux, a measure of the total "amount" of visible light emitted by a source.

Luminous Efficacy
Luminous efficacy is a measure of how well a light source produces visible light. It is the ratio of luminous flux to power. Depending on context, the power can be either the radiant flux of the source's output, or it can be the total power (electric power, chemical energy, or others) consumed by the source.

Luminous flux
Luminous Flux (Φ_v) is energy per unit time that is radiated from a source over visible wavelengths. More specifically, it is energy radiated over wavelengths sensitive to the human eye, from about 330 nm to 780 nm.

Correlated Color Temperature
The correlated color temperature (CCT) is a specification of the color appearance of the light emitted by a lamp, relating its **color** to the **color** of light from a reference source when heated to a particular temperature, measured in degrees Kelvin (K).

Stokes Shift
Stokes shift is the difference (in wavelength or frequency units) between positions of the band maxima of the absorption and emission spectra of the same electronic transition.

References:

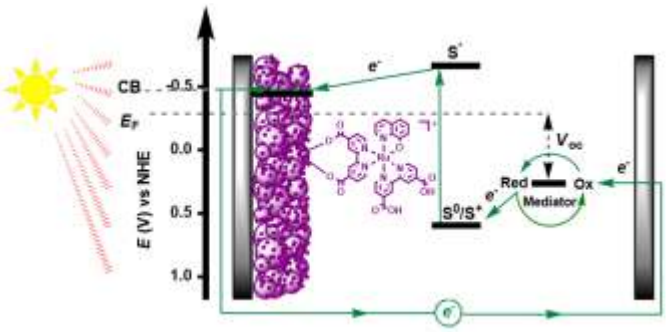
1. S. Nakamura: *Appl. Phys. Lett.* 64 (1994) 1687.
2. S. Aanegola, J. Petroski, E. Radkov: *SPIE* 10 (2003) 16.
3. Y. Narukawa: *Optics & Photonics News 4* (2004) 25.
4. L. S. Rohwer, A. M. Srivastava: *Electrochem. Soc. Interface* 12 (2003) 36.
5. J. Y. Taso: Ed. L*ight Emitting Diodes (LEDs) for General Illumination Update 2002;* Optoelectronics Industry Development Association: Washington, DC, (2002).
6. D. P. Dutta and A. K. Tyagi, "Inorganic phosphor materials for Solid State white light generation," Solid State Phenomena, Trans Tech Publishers, 155 (2009) 113-144.
7. K. Bando, K. Sakano, Y. Noguchi, and Y. Shimizu, *J. Light Vis. Environ.* 22 (1998) 2.
8. V. Bedekar, D. P. Dutta, M. Mohapatra, S. V. Godbole, R. Ghildiyaland A. K. Tyagi, *Nanotechnology*20 (2009) 125707 (9pp).
9. N. C. Durham, (2010) Cree Breaks 200 Lumen Per Watt Efficacy Barrier. Retrieved from http://www.cree.com/News-and-Events/Cree-News/PressReleases/2010/February/100203-200-Lumen-Per-Watt
10. Y. Narukawa, M. Ichikawa, D. Sanga, M. Sano, T. Mukai, White light emitting diodes with super-high luminous efficacy. *J. Phys. D: Appl. Phys.,* 43(25) (2010) 354002.

Dimple P. Dutta
Chemistry Division,
Bhabha Atomic Research Centre,
Mumbai 400 085
dimpled@barc.gov.in

Solar Cells are Devices that take Light as Input and Convert it into Electrical Energy.

There are two main types of Solar Cells. Silicon based solar cells that are widely used, but expensive to manufacture. Dye sensitized Solar Cells, which are newer, less proven, but inexpensive to manufacture. World wide several researchers are working on Dye Sensitized Solar Cells.

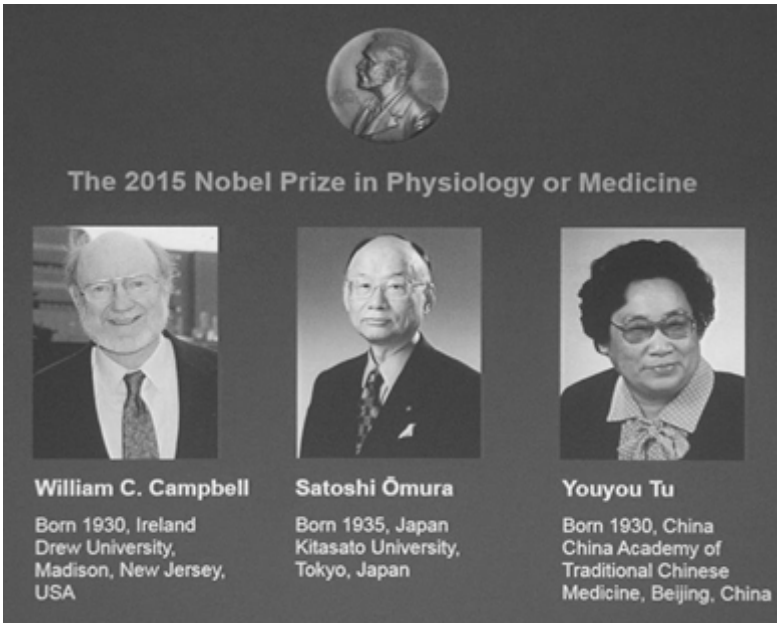
Mechanism of working of Dye Sensitized Solar Cells



THE NOBEL PRIZE IN **PHYSIOLOGY OR MEDICINE 2015**

[Abridged from: http://www.nobelprize.org/nobel_prizes/medicine/laureates/2015/press.html]

On October 5th 2015, The Nobel Assembly at the Karolinska Institute in Stockholm, Sweden, through a press release announced the award of the 2015 Nobel Prize in Physiology or Medicine, to the following: one half jointly to **William C. Campbell and Satoshi Ōmura** for their discoveries concerning a novel therapy against infections caused by roundworm parasites, and the other half to **Youyou Tu** for her discoveries concerning a novel therapy against Malaria.



The Background: Parasite Borne Devastating Diseases

Our world is biologically complex and is populated by a plethora of organisms including parasites that cause disease and even death in humans. Parasite borne diseases have plagued humankind since long, and constitute a major global health problem even today. Parasitic worms (helminths) afflict almost a third of the world's population across sub-Saharan Africa, south Asia, and central and south America. Parasitic worms cause river blindness (onchocerciasis) due to chronic inflammation in the cornea, and lymphatic filariasis (elephantiasis/ scrotal hydrocele) that leads to gross, chronic lymphedema induced swelling - a life-long stigmatizing condition (Fig.1). Malaria is mosquito-borne, and caused by single-cell parasites that invade red blood cells, causing fever and, in severe cases, brain damage and death (Fig.1).

Figure 1

Novel Anti-Parasite Therapies

The therapies developed by this year's Laureates have revolutionized the treatment of some of the most devastating parasitic diseases. William C. Campbell and Satoshi Ōmura discovered Avermectin, a drug whose derivatives have radically reduced the incidence of river blindness and lymphatic filariasis, and are also effective against many other parasitic diseases. Youyou Tu discovered Artemisinin, a drug that has significantly reduced the mortality rates for patients suffering from malaria. These two discoveries are a powerful new means to combat these debilitating diseases affect hundreds of millions of people annually, with immeasurable consequences toward improved health and reduced suffering.

Satoshi Ōmura, a Japanese microbiologist and expert in isolating natural products, focused on the soil bacteria, Streptomyces, known to produce bioactive chemicals (including Streptomycin). Equipped with extraordinary skills in developing unique methods for large-scale culturing and characterization of these bacteria, Ōmura isolated new strains of Streptomyces from soil samples and successfully cultured them in the laboratory. He characterized thousands of cultures and selected ~50 of the most promising for study of their activity against harmful microorganisms. One of these cultures later turned out to be Streptomyces avermitilis (inset to right), the source of Avermectin (Fig.2).

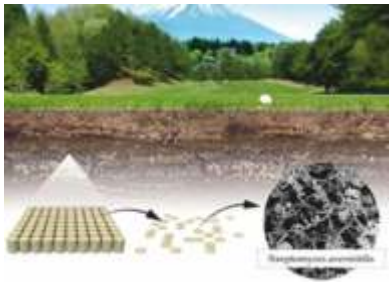


Figure 2

William C. Campbell, an expert in parasite biology working in the USA, acquired Ōmura's Streptomyces cultures and examined their efficacy. Campbell showed that a component from one of the cultures was remarkably efficient against parasites in domestic and farm animals. The purified bioactive agent Avermectin was subsequently chemically modified to a more effective compound called Ivermectin, which on tests in humans with parasitic infections effectively killed parasite larvae (microfilaria) (Fig.3). Collectively, Ōmura and Campbell's contributions led to the discovery of a new class of drugs with extraordinary efficacy against parasites including those causing river blindness and lymphatic filariasis.

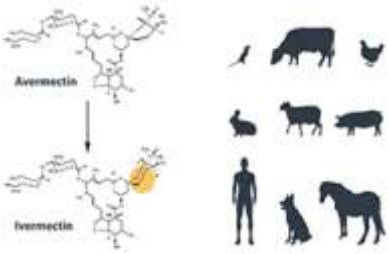


Figure 3

Youyou Tu of China turned to traditional herbal medicine in a bid to develop novel malaria therapies, in the late 1960s. From a large-scale screen of herbal remedies in malaria-infected animals, an extract from the plant *Artemisia annua* emerged as an interesting candidate. It was a search of ancient literature that provided her clues to successfully extract its active component. Tu was the first to show that Artemisinin was highly effective against the malaria parasite in infected animals and humans (Fig.4). Artemisinin represents a new class of anti-malarial agents that rapidly kill the malaria parasites at an early stage of development, which explains its unprecedented potency in treating severe malaria.

Figure 4

Effect of these Discoveries on Global Health

Today the Avermectin-derivative Ivermectin is used in all parts of the world that are plagued by parasitic diseases, and it is highly effective against a range of parasites and has limited side effects. Treatment is so successful that these diseases are on the verge of eradication, which would be a major feat in the medical history of humankind. Malaria infects close to 200 million individuals yearly. Artemisinin is used in all malaria-ridden parts of the world. When used in combination therapy, it reduces mortality by >20% overall and by over 30% in children. In Africa alone, over 100000 lives are saved each year. The discoveries of Avermectin and Artemisinin have revolutionized therapy for patients suffering from devastating parasitic diseases. The global impact of the discoveries of Campbell, Ōmura and Tu, and the resulting benefit to mankind are immeasurable.

- **William C. Campbell** was born in 1930 in Ramelton, Ireland. After receiving a BA from Trinity College, University of Dublin, Ireland in 1952, he was awarded a PhD from University of Wisconsin, Madison, USA in 1957. From 1957 to 1990 he was with the Merck Institute for Therapeutic Research, from 1984-1990 as Senior Scientist and Director for Assay Research and Development. Campbell is currently a Research Fellow Emeritus at Drew University, Madison, New Jersey, USA.

- **Satoshi Ōmura** was born in 1935 in the Yamanashi Prefecture, Japan and is a Japanese Citizen. He was awarded a PhD in Pharmaceutical Sciences in 1968 from University of Tokyo, Japan and a PhD in Chemistry in 1970 from Tokyo University of Science. He was a researcher at the Kitasato Institute, Japan from 1965-1971 and Professor at Kitasato University, Japan from 1975-2007. Ōmura is Professor Emeritus at Kitasato University since 2007.

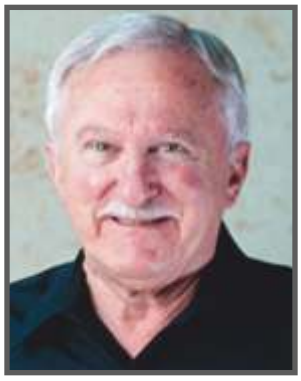
- **Youyou Tu** was born in 1930 in China and is a Chinese citizen. She graduated from the Pharmacy Department at Beijing Medical University in 1955. She was Assistant Professor at the China Academy of Traditional Chinese Medicine from 1965-1978, Associate Professor from 1979-1984, and Professor from 1985. Tu is Chief Professor at the Academy since 2000.

Dr. Aparna Bagwe
Officer-in-Charge
Science Communication and Professional Education,
ACTREC, Navi Mumbai
abagwe@actrec.gov.in

THE NOBEL PRIZE IN **CHEMISTRY 2015**

[Abridged from: http://www.nobelprize.org/nobel_prizes/chemistry/laureates/2015/press.html]

TOMAS LINDAHL



PAUL MODRICH

AZIZ SANCAR

Tomas Lindahl, 77, is an emeritus group leader at Francis Crick Institute and Emeritus director of Cancer Research UK at Clare Hall Laboratory in Britain.

Aziz Sancar, 69, is a professor at the University of North Carolina School of Medicine at Chapel Hill, North Carolina, USA.

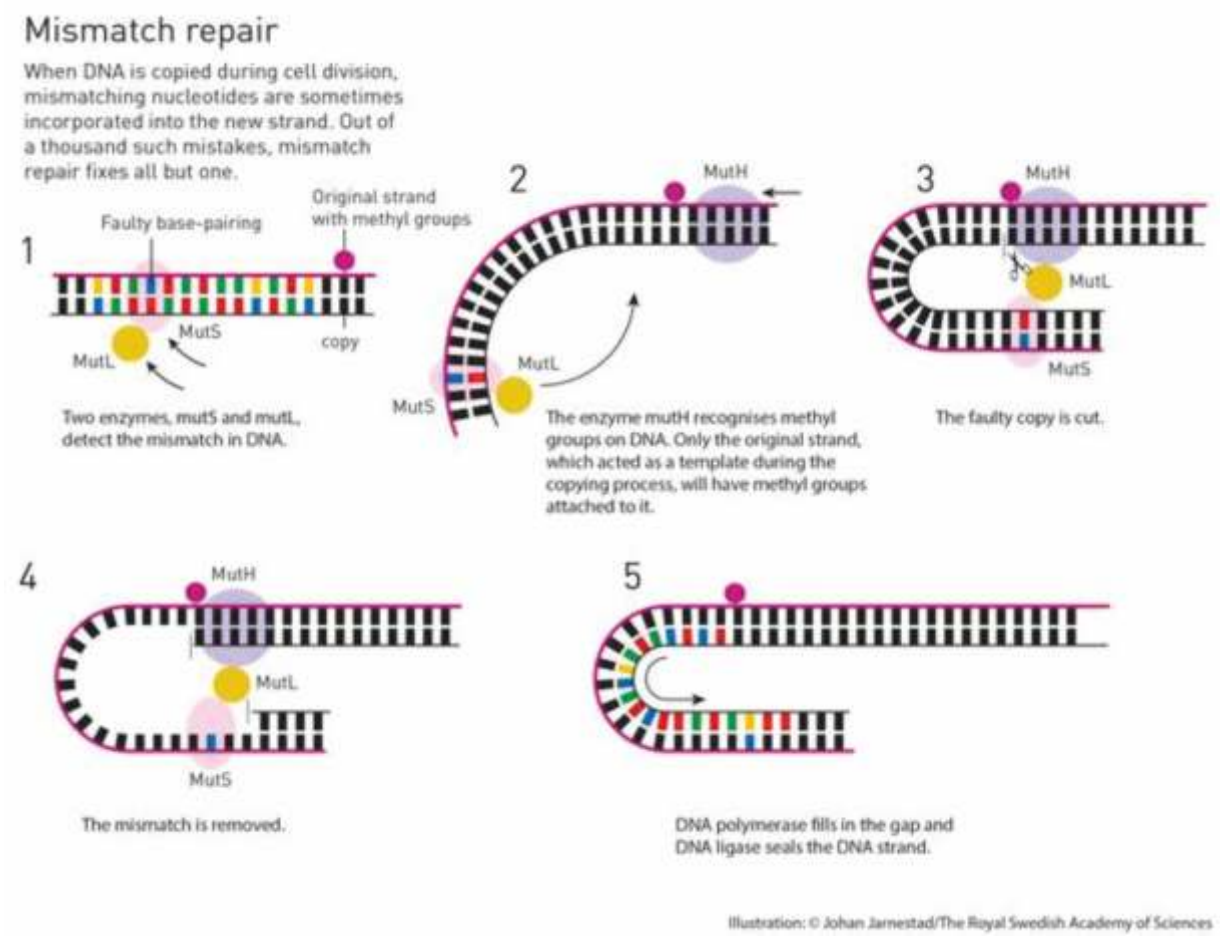
Paul Modrich, 69, is an investigator at Howard Hughes Medical Institute and professor at Duke University School of Medicine at Durham, North Carolina.

All chemical processes are prone to random errors, and so should be the molecule called DNA, the basic unit of most life on earth. The DNA present in a fertilized egg is the first molecular entity of any human that is 'photocopied' every time the cell multiplies. Such a copy of DNA is present in practically every cell of the several billion in our body. Astonishingly, the DNA molecule in every cell is remarkably similar to that first template in the zygote. How is it that this process is not subjected to random errors? Is DNA indestructible?

DNA has limited chemical stability is what Tomas Lindahl found. He found that DNA undergoes slow decay. Even when the DNA molecule is in a cell's protective environment, it does undergo damage. That could only mean that there is a mechanism in place for repairing/reverting a damage / change in DNA as the case may be.

In pursuit of these mechanisms, Tomas Lindahl found enzymes involved in removing damaged DNA and repairing it by a pathway called, Base Excision Repair. He single-handedly identified the first DNA-repair protein, uracil-DNA glycosylase. Another such mechanism which operated on UV induced damage to DNA was mapped by Aziz Sancar. He showed for the first time that UV-induced damage could be repaired by an enzyme, photolyase.

He could demonstrate in a test tube that three enzymes were enough to identify UV damage in a DNA molecule and remove the damaged portion by a mechanism called nucleotide excision repair. Paul Mordich discovered the Mismatch Repair that corrects mismatches that occur when DNA is copied, recognizing the defect strand by a lack of a specific modification called methylation in bacteria. He also showed that mismatch repair mechanism is operational in mammalian cells but does not involve methylation.



Besides these three mechanisms, several others operate in cells to preserve DNA.

If DNA repair mechanisms falter, it results in diseases including cancer. Often, in cancer cells, one or more pathways is/are partially or entirely switched off. DNA of cancer cells are unstable but in need of repair pathways, which can keep them alive. Certain cancer drugs target the remaining repair pathways, which kills the cancer cells altogether selectively. The work of these three scientists not only provided basic understanding of processes involved in DNA repair but also provided insights into how this information could lead to development of life-saving drugs.

Dr. Chitra Seetharam Misra (MBD)
and **Dr. Poulomi Mukherjee** (NABTD), BARC.
chitras@barc.gov.in and poulomi@barc.gov.in

THE NOBEL PRIZE IN **PHYSICS 2015**

[Abridged from: http://www.nobelprize.org/nobel_prizes/physics/laureates/2015/press.html]

The Nobel Prize in Physics 2015 recognizes ***Takaaki Kajita of Japan and Arthur B. McDonald of Canada***, for their contributions to the experiments which demonstrated that ***neutrinos flip and change their identities***. The major findings behind the award were reported in papers published in Physical Review Letters between 1998 and 2002.

TAKAAKI KAJITA

ARTHUR B. McDONALD

Named after the Italian for ***"little neutral one", neutrinos*** have no electric charge and were long thought to have zero mass, but Kajita at the University of Tokyo and McDonald at Queen's University in Kingston, Canada, showed otherwise. Neutrinos are the second most abundant particle known, in the Universe after photons and are essential for understanding the nuclear reactions involved in fusion and in radioactive beta decay. Neutrinos have the smallest mass of any known particle, and are created in several ways, including during the radioactive decay in the Sun's core, and when cosmic rays from the Sun hit the Earth's atmosphere.

Neutrinos are very weakly interacting particles. They penetrate through the Sun and reach the Earth. If these neutrinos can be detected on Earth, we can get direct evidence of nuclear reactions that take place inside the Sun. The first solar neutrino detector was proposed in 1964 by Raymond Davis Jr. and John Bahcall and consisted basically of a tank containing 615 tons of a chlorine-based fluid, which can interact with neutrinos via reaction

$$^{37}Cl + \upsilon_e = {}^{37}Ar + e^-$$

The argon atoms produced in this reaction can be detected. The first results showed that the experiment detected very few neutrinos than were predicted by the theories of solar structure and nuclear reactions. This discrepancy is known as the ***solar neutrino problem***.

Two possible reasons for the solar neutrino problem were postulated: either that the standard model of the Sun is wrong or the standard model of particle physics is wrong. The first reason implies that the fewer neutrinos are detected because fewer are actually produced in the Sun and the calculated values are wrong. The second option implies that the Sun produces the predicted number of neutrinos but the electron type neutrinos change into some other type and hence cannot be detected by the solar neutrino experiment.

It has been proved by Helioseismology that the current solar models are very close to the real sun. Hence, this is not a solution to the solar neutrino problem. The second reason i.e. the ***neutrinos change flavor*** is considered more reasonable because with that assumption it is possible to get neutrino fluxes in all experiment close to observed values.

The standard model, which describes all of the particles currently known, assumes that neutrinos do not have any mass. It also says that there are ***three types ("flavors") of neutrino, called electron, muon, and tau neutrinos.*** The neutrino masses and flavors do not exactly overlap each other, and indicates that different flavors of neutrinos can spontaneously change into each other as they travel and this is neutrino oscillation.

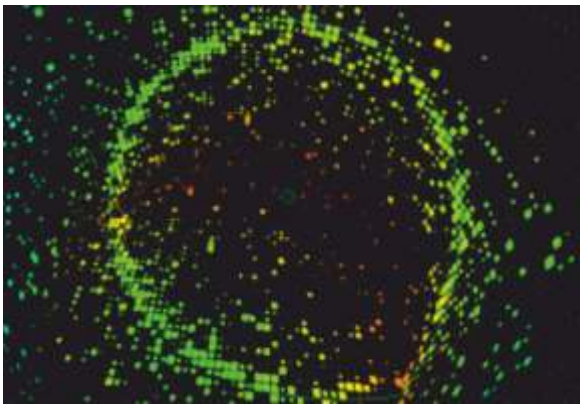
Around the turn of the millennium, this long decade puzzle was solved. Prof. Kajita, working with his team at the Super-Kamiokande detector in Japan, discovered that ***neutrinos from the atmosphere switch between two identities*** as they make their way to Earth. Meanwhile, McDonald's research group at the Sudbury Neutrino Observatory in Canada concluded that the neutrinos from the Sun do not disappear on their way to Earth. Instead, they are captured with a different flavor on reaching the Earth's surface.

Super-Kamiokande is a gigantic detector built 1,000 metres below the Earth's surface. It consists of a tank, 40 metres high and as wide, filled with 50,000 tonnes of water. More than 11,000 light detectors are located in the tank's top, sides and bottom. These detectors amplify and measure very weak light flashes in the ultra-pure water.

Layout of the Super-Kamiokandedetector
http://www-sk.icrr.u-tokyo.ac.jp/sk/index-e.html

Sudbury Neutrino Observatory (SNO) is inside a mine in Sudbury, Canada, containing 1000 tons of heavy water. In this case there were two types of collisions between neutrinos and heavy hydrogen (Deuterium) atoms, one involving only electron neutrinos and the other involving all three flavors. So the relative amounts of the different flavors could be compared.

These discoveries have proved that ***neutrinos are not massless in addition to explaining the solar neutrino deficit.*** These discoveries have raised many new queries and new theories are required to explain why neutrinos have mass.



This picture is the event display of a muon neutrino detected by the Super-Kamiokande. The colored points indicate the quantity of the detected light by each PMT. The Cherenkov ring emitted by a muon is displayed.
http://www-sk.icrr.u-tokyo.ac.jp/sk/index-e.html

Argala Srivastava and Umasankari Kannan
Reactor Physics Design Division
Bhabha Atomic Research Centre
argala@barc.gov.in and uma_k@barc.gov.in

INDIA BASED NEUTRINO OBSERVATORY
(abridged from www.ino.tifr.res.in)

The India-based Neutrino Observatory (INO) Project is a multi-institutional effort aimed at building a world-class underground laboratory with a rock cover of approx.1200 m for non-accelerator based high energy and nuclear physics research in India.

The Project Includes

a) construction of an underground laboratory and associated surface facilities at Pottipuram in Bodi West hills of Theni District of Tamil Nadu,
b) construction of a Iron Calorimeter (ICAL) detector for studying neutrinos, consisting of 50000 tons of magnetized iron plates arranged in stacks with gaps in between where Resistive Plate Chambers (RPCs) would be inserted as active detectors, the total number of 2 m X 2 m RPCs being around 29000, and
c) setting up of National Centre for High Energy Physics at Madurai, for the operation and maintenance of the underground laboratory, human resource development and detector R&D along with its applications. The underground laboratory, consisting of a large cavern of size 132 m X 26 m X 20 m and several smaller caverns, will be accessed by a 2100 m long and 7.5 m wide tunnel.

Development of detector technology and its varied applications is an important aspect of the project. On a smaller scale the development of human resource has already started in the form of the INO Graduate Training Programme (GTP) under the umbrella of Homi Bhabha National Institute (HBNI), a deemed-to-be University within DAE.

WE THANK OUR WELL WISHERS WHO HAVE DONATED FOR OUR VARIOUS ACTIVITIES

During the Fund Raising Drive, we were unable to include their names in the Souvenir due to printing deadlines.

M/s. Shirodkar Precision Comp. Pvt. Ltd.

M/s. Sanjay Tools & Accessories

Mr. Sunil Metkar

Mr. Ashish Shevate

M/s. Pioneer Dyc. Chem. Corporation

M/s. Atharva Enterprises

Mr. Aurobindo Sahu

Dr. Mahrukh Joshi

Ms. Priya Anantaraman

Dr. Pragnya Doshi

Mr. P. Vijendran

Mr. Gordhandas Goyal

Dr. Aban Samuel

Dr. Wijaya Altekar

Mr. Sandeep Tibrewal

With Best Compliments From

IED Communications Ltd.

64, Empire Building, D. N. Road, Fort,
Mumbai – 400001.

(For Instruments and Electronics)

Developments
Central Automation Technology

Email: jyothi@iedcommunications.com
Phone: 2207 9567, 2207 3370

« **IWSA** Members with Chief Guest at the Fund Raising Event.

IWSA Staff » at the Fund Raising Event.

« Fund Raising Event at the Auditorium, CIDCO Exhibition Centre, Vashi.

Fund Raising » Event at the Auditorium, CIDCO Exhibition Centre, Vashi.

BOOK POST

Regd. No. N.R.24208/74
ISSN 09726195

Dr. Pabrekar giving away Dr. Jayashree Daoo Award to Ms. Kanaka Ghosalkar.

Nursery and Day Care Children at the Nerul Rock Garden Picnic.

Nursery and Day Care Children with the Trainee Teachers.

To.:

From:

IWSA Head Office
Plot No. 20, Sector 10A
Dr. Mar Theophilus Road, Vashi
Navi Mumbai: 400703
Tel: 27661806, Fax: 27653391
Email: iwsahq@gmail.com
Website: www.iwsa.net

Published by: Dr. Devaki Ramamnathan, President, IWSA, Plot No. 20, Sector 10A, Vashi, Navi Mumbai 400703.
Editor: Dr Shyamala Bharadwaj.
Printed by: Prudent Arts & Fab Pvt. Ltd., A-221, TTC Industrial Area, M.I.D.C., Mahape, Navi Mumbai 400701. Tel.: 61119001/02