Women filling the ranks

THIS WAS MADE VERY EVIDENT WHEN RESEARCHERS FROM INDIA AND FRANCE MET AND TALKED SCIENCE FOR THREE DAYS IN BENGALURU, WRITES **S ANANTHANARAYANAN**

The Science Department of the French Embassy and the Indian Institute of Science, Bengaluru, recently conducted a three-day seminar to showcase the growing part women scientists are taking in research. The Centre Franco-Indien pour la Promotion de la Recherche Avancée (Cefipra), an Indo-French centre for the promotion of advanced research, funded the project with support from the Indian Academy Panel for Women in Science. Cefipra is a collaboration supported by the Department of Science and Technology, government of India, and the French ministry of foreign affairs. It selects joint projects, provides financial grants and helps Indian and French scientists to travel and work in the two countries. It works along with the *attachés scientifiques* at the different

centres of the French Embassy in Indian cities to administer and continue a cooperation programme that has been in operation since the 1950s. The Indian Institute of Science, earlier known as the Tata Institute, is a premier 106-year-old research establishment that started work in 1911 and had Sir CV Raman as its first Indian director.

The objective of the seminar was to highlight the scientific contribution and achievements of women in collaborative research projects. It included plenary sessions addressed by women researchers from both countries, scientific presentations by women researchers from joint research projects and a poster session by young researchers. The presentations pertained to the life sciences, including stem cell science, physics and cosmology, nanomaterials and material science, and mathematics. This apart, there was a panel discussion on the issues that arise in international collaboration and also the means of promoting the extent and quality and the recognition of the work of women researchers in the sciences.

Unlike usual conferences of specialists in a field, the participants at this meeting were from different subject areas. The presentations, hence, could not use specialist jargon nor assume that the audience knew the background or context of the research being described. All presenters had to explain their work at a basic level, often prefaced by a primer of the fundamentals of the field. This was rewarding for the audience and, as some presenters said, educative for them as well. Here are a few of the presentations made.

Shobhana Narasimhan

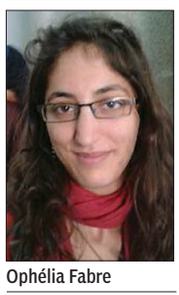
Designing nanomaterials

Much of modern technology had been discovered through the process of trial and error, said Shobhana Narasimhan from the Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru. The Bosch process for the manufacture of fertiliser, for instance, is economical because it uses iron as an agent to speed up the reaction. But iron, as the correct trace element to use, was isolated after trying out 4,000 other materials! An alternative that is now available is to study different materials based on a drawing-board analysis of their crystal structures and the use of computers in place of actual experiments, she said.

The method uses the atomic structure and atomic mass of individual elements and carries out calculations on how they would behave when they form materials. The methods of quantum mechanics are relevant at the atom-size scale involved and numerical methods, which are very good approximations arrived at by computers, are used to get answers to complex equations. The calculations consider the relative dimensions of the atoms and the electric charges and look for structures whose energy is the least, to make for stability. A computational method called *density function theory* has proved fruitful in this quest, Narasimhan said.

Gold, which was generally an "inert" element, was proving to be useful when used as a nanoparticle to facilitiate other reactions, she said. The use of density functional theory had helped create layers of gold atoms just one atom thick. In one example, iron and gold atoms, which normally do not form an alloy, formed a two-dimensional "raft" when laid on a base of the metal ruthenium. In another example, the nature of gold nanoparticles deposited on a base of an oxide could be modified by adding trace impurities to the base so that the charges affecting the gold layer were changed. Such treatment then led to improving the capacity of gold particles to speed up other reactions,

Chanda Jog



Ophélia Fabre

Stars and galaxies

Chanda Jog of the IISc and "young researcher" Ophélia Fabre from France, working in the Indian Institute of Science Education and Research, Trivandrum, demystified the nature of research into the distant heavens. Jog outlined the interplay of stars, interstellar dust and dark matter, which we can make out from the observed profile and dynamics of galaxies. While stars and galaxies are mapped essentially through observation with telescopes, optical, X-Ray or radio, their movement is detected by the shift of the known emission or absorption lines in the spectrum of light that comes from the distant bodies.

Jog explained that when observing the rotation of galaxies, a peculiar feature was that the outer extremes went round at the same rate as the interior parts. This was unlike other systems, like the Solar System, where the distant planets like Pluto moved much slower than the inner planets like Mercury, Venus or earth. This feature gets explained if we take it that there is other unseen matter which has mass and thus creates gravity in the form of a halo around the galaxy, and this is what is known as *Dark Matter*.

Fabre first explained the huge masses of galaxies and groups of galaxies and the scale of distances that are involved. The *parasec*, she explained, which was 3.26 light years, was in fact the distance at which a star would need to be if the angle of lines from the star to two points as far apart as the sun and the earth were to be one second, or 1/3,600 of a degree. The work that she was doing, Fabre explained, was to find models that agreed with the observation that there were plumes of magnetic fields within and between galaxies that extended, without breaking up, to distances that compared with the extent of the galaxies, of the order of millions of parasecs. Fabre's team considered an early part of the history of the universe, where space was filled with photons, electrons and protons, all in motion, but no atoms, as yet. As the electrons were much lighter than protons, it was the electrons that would mainly constitute any electric currents.

How freely such a current would flow was estimated, considering the effect of photons bouncing off the electrons and also the electric forces between electrons and protons, and it was found that the effect of the photons should dominate to create a magnetic field that was in keeping with what was seen. The successful model had to account for both the strength as well as the extent of the magnetic field, Fabre said.

Shyamala Mani

Malnutrition on brain development

Shyamala Mani of the IISc described research into the mechanism by which malnutrition of pregnant mothers affected brain development in the foetus. In controlled experiments conducted on a mouse model, the effect of iron deficiency in the mother's diet on the development of the foetus' hippocampus, a part of the brain that controls spatial memory that is vital for learning and survival, was studied. It was found that iron deficiency led to heightened stress response and high levels of the steroid corticosterone, which also affected the rate of cell division. A function of the hippocampus is to slow down stress response, but less neurons in the hippocampus, thanks to high steroid levels, again failed to keep the steroid level down!

Mouse studies, using the *radial arm maze*, where learning ability is assayed, showed that pups of iron-deprived mothers had a low learning ability due to loss of working memory. As there is high pre-natal malnutrition in India, the study showed that taking remedial measures would have wide and long-lasting returns in terms of health and ability of the growing population.

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Fact file

The Unesco Institute for Statistics says that women's enrolment in research in India and France, of about 30 per cent in 2010, is no better than the world average. Cefipra funds joint Indo-French research projects, of which about 28 per cent had a woman as the principal investigator during 1999-2012.

CEFIPRA

CYTOSKELETAL SYSTEMS

TAPAN KUMAR MAITRA EXPLAINS THE COMPLEX NETWORK OF INTERCONNECTED FILAMENTS AND TUBULES THAT EXTENDS THROUGHOUT THE CYTOSOL

A variety of cellular processes and pathways occur in the organelles of eukaryotic cells in the cytosol, which is the region of the cytoplasm between and surrounding the organelles. Until a few decades ago, the cytosol of eukaryotic cells was regarded as a generally uninteresting gel-like substance in which the nucleus and other organelles were suspended. Cell biologists knew that proteins made up about 20-30 per cent of the cytosol, but these proteins were thought to be soluble and able to move freely. Except for those of known enzymatic activity, little was understood about the structural or functional significance of cytosolic proteins.

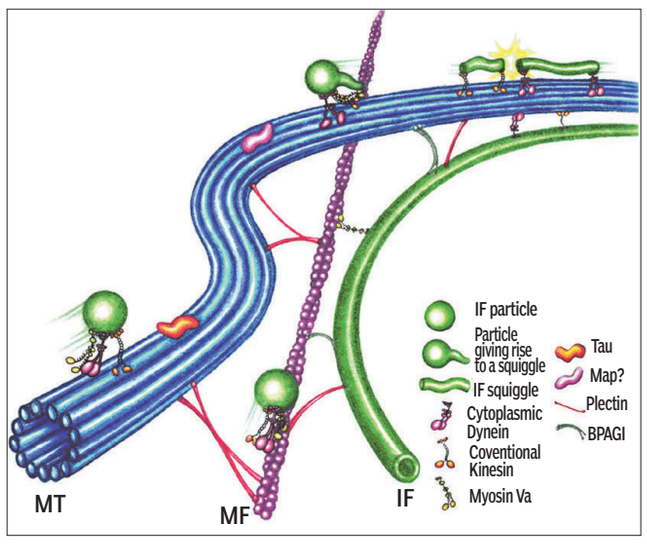
Advances in microscopy and other investigative techniques have revealed that the interior of a eukaryotic cell is highly structured. Part of this structure is provided by the cytoskeleton: a complex network of interconnected filaments and tubules that extends throughout the cytosol, from the nucleus to the inner surface of the plasma membrane.

The term *cytoskeleton* accurately expresses the role of this polymer network in providing an architectural framework for eukaryotic cells. It confers a high level of internal organisation on cells and enables them to assume and maintain complex shapes that would not otherwise be possible. The name does not, however, convey the dynamic, changeable nature of the cytoskeleton and its critical involvement in a great variety of cellular processes.

The cytoskeleton plays important roles in cell movement and division, and it positions and actively moves membrane-bounded organelles within the cytosol. It also plays a similar role for messenger RNA and other cellular components. Many enzymes in the cytosol are, in fact, probably not soluble at all but are physically clustered and attached to the cytoskeleton in close proximity to other enzymes involved in the same pathway, thereby facilitating the channeling of intermediates within each pathway. The cytoskeleton is also involved in many forms of cell movement and is intimately related to other processes such as cell signalling and cell-cell adhesion. The cytoskeleton is altered by events at the cell surface and, at the same time, appears to participate in and modulate these events.

It is a structural feature of eukaryotic cells revealed especially well by digital video microscopy, electron microscopy and immunofluorescence microscopy. It consists of an extensive three-dimensional network of microtubules, microfilaments and intermediate filaments that determines cell shape and allows a variety of movements.

Microtubules (MTs) are hollow tubes with walls consisting of heterodimers of a and b-tubulin polymerised linearly into protofilaments. MTs are polar structures and elongate preferentially from one end, known as the plus end. First identified as components of the axonemal structures of cilia and flagella and the mitotic spindle of dividing cells, microtubules are now recognised as a general cytoplasmic constituent of most eukaryotic cells. Microtubules can undergo cycles of catastrophic shortening or elongation, a phenomenon known as dynamic instability. Within cells, MT dynamics and growth are organised by microtubule-organising centres (MTOCs). The centrosome is a major MTOC that contains nucleation sites rich in **g**-tubulin that are used to nucleate MT growth. Microtubules are stabilised along their length and at their plus ends by microtubule-associated proteins.



Microfilaments (MFs) are double-stranded polymers of actin that were initially discovered because of their role in the contractile fibrils of muscle cells; they are now recognised as a component of virtually all eukaryotic cells. Microfilaments are required for many processes within cells, including locomotion and maintenance of cell shape. Like microtubules, MFs are polar structures, with actin monomers preferentially added to one end and removed from the other. Microfilament assembly within cells is regulated by the small G proteins Rho, Rac, and Cdc42, derivatives of phosphatidyl inositol known as polyphosphoinositides, and capping proteins. Other actin cross-linking, severing and anchoring proteins regulate the organisation of MFs within cells, which range from the parallel arrays of actin in microvilli to branched actin networks.

Intermediate filaments (IFs) are the most stable and least soluble constituents of the cytoskeleton. They appear to play a structural or tension-bearing role. IFs are tissue-specific and can be used to identify cell type. Such typing is useful in the diagnosis of cancer, as tumor cells are known to retain the IF proteins of their tissue of origin. All IF proteins have a highly conserved central-domain flanked by terminal regions that differ in size and sequence, presumably accounting for the functional diversity of IF proteins.

IFs, MTs, and MFs are interconnected within cells to form cytoskeletal networks that can withstand tension and compression, providing mechanical strength and rigidity to cells.

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Laced with humour

THOUGH HELD IN A REMOTE LOCATION, A RECENT CONFERENCE ON DEVELOPMENTS IN THE 'CONTROL, COMMUNICATION AND INFORMATION TECHNOLOGY' DOMAIN MADE IMMENSE IMPACT, WRITES **SANJANA MAJUMDAR**

One of the heartening aspects of the third international conference on computer, communication, control and Information Technology (C3IT-2015) was that it was conducted in the remote location of Adisaptagram and graced by the Who's Who of both academia and the industry. Organised on 7-8 February, at the Academy of Technology and hosted under the guidance of chairman trustee and founder Professor Jagannath Banerjee, it was supported by the Institute of Electrical and Electronics Engineers and the Institution of Engineers and chaired by Academy of Technology director Dilip Bhattacharya. The guests included NS Parthasarathy, president of Mindtree; Sanjoy Sen, divisional CIO at ITC, India, Limited; Debatosh Guha, chaiman, IEEE, Kolkata section; SC Dutta Roy, former professor at IIT, Delhi; Professor Bhabatosh Chanda of ISI, Kolkata; and Sambuddha Gupta, former executive vice-president, Wipro.

Over two days, around 123 technical papers were presented along with the keynote address, five invited lectures delivered by guests and the inaugural address by celebrated professor and Shanti Swarup Bhatnagar Awardee Dr SC Dutta Roy, who more than once enthralled the audience with his humour. "If not anything else, the conference will at least make you aware about who is doing what," he said before adding that he would like to reserve energy for a talk scheduled for the latter half of the first day.

Parthasarathy's keynote address provided a sense of what he called a "speed of change" of current trends. From connecting dots or topics like GDP, touch screen technology, food security, space colonisation and "Internet of Things", he talked about real time collaborations and the need to equip the next generation to make the crossover to the industry. "Courage, a sense of responsibility and curiosity" were qualities he wished to see in every youngster.

A series of invited talks began with Sanjoy Sen's "Digitisation of business" where he made the point that basically all businesses were being digitally remastered and that digital adaptation was the key to survival. Since business models were changing, digitisation was the "new normal" because it also embodied "product reinvention" and "next generation commerce and customer engagement". He covered social media analysis and security challenges where "end-user awareness" was a vital requirement. As an example, he credited US President Barack Obama's second term victory to some 200 scientists who worked round the clock over the Internet storing and analysing data during the campaign. This established that the importance of data was soaring and businesses needed to be reimagined.

Professor Bhabatosh Chanda shared insights on "Mathematical models and their applications in image processing", where he explained how by using mathematical operations on pixels one could fine-tune images to get the desired effects. Techniques like binary erosion, proximity filter and binary opening used mathematical operations, he said. Then again, noise cleaning could be achieved by placing less emphasis on smaller parts. Another realisation wa to extract objects from images by removing portions of it using an "open" operation.

The afternoon session, however, witnessed a stark distinction with Professor SC Dutta Roy's talk on "Resistive Network — Simple but fascinating" enlarging a very simple idea incorporating a resistive ladder circuit and Professor Bhaskar Gupta's talk on "Research on RF MEMS at Jadavpur University" expanding on an advanced topic. Three unsolved problems as open challenges were left for the audience and the takeaway involved the pleasures of simplicity.

The second day pushed the pace up with a different approach. It was devoted to a disciplined review and presentation of some 84 papers and a talk on Brain-Computer Interface by Professor Amit Konar of Jadavpur University, a one-of-its-kind initiative that has applications in rehabilitative robotics, cognitive failure detection in driving and olfactory perception ability detection.

The technical sessions spread over the two days with five parallel sessions on the first day itself (data mining and pattern recognition; wireless sensor networks and networking; devices; DBMS and data warehousing; control and instrumentation) and two further rounds each consisting of five parallel sessions covering a multitude of topics.

PLUS POINTS

Mehmet Oz was last year questioned by a Senate subcommittee regarding his statements on, among other things, a weight-loss supplement containing green coffee extract

Debunking junk

At a time when half of America believes in at least one of six medical conspiracies — according to a May 2014 *Journal of the American Medical Association* study — and celebrities with no medical background are giving advice to the public, there is a clear divide between scientific fact and general knowledge. Recently, one celebrity who *does* come from a medical background has come under fire: in connection with his claims regarding a weight-loss supplement, physician Mehmet Oz ("Dr Oz") was in June last year questioned by a Senate subcommittee and the research behind his statements on the compound was retracted in October.

Some of the blame can be put on scientists who like to think their research speaks for itself, that the peer-review process is efficient and relatively fair, and that the results published are therefore straightforward and easily understood. The well-intentioned fervour behind finding the next new cancer drug or a cure for chronic illness can easily turn a statistically significant published result into a sensationalist media piece, however.

Scientists need to be communicators. They must speak for research when necessary, call out media that misrepresents their results and publicly reprimand those who are trying to make a quick buck by passing off shoddy or falsified research.

Certain websites have done a wonderful job of publicly identifying these transgressions, but they are not enough. Scientists have to condemn offenders and extol the virtues of good science to the public and to one another. Only then will the discourse turn from distrust and blame to understanding, partnership and respect.

EDWARD MARKS IS A PHD STUDENT AT THE UNIVERSITY OF DELAWARE AND HIS FOCUS IS ON NANOMEDICINES FOR CARDIOVASCULAR DISORDERS

Google Glass

If you thought an eye-wearable device called Google Glass was dead, think again. The new team at Google Glass wants to "redesign the product from scratch and not release it until it is complete:, according to a *New York Times* report.

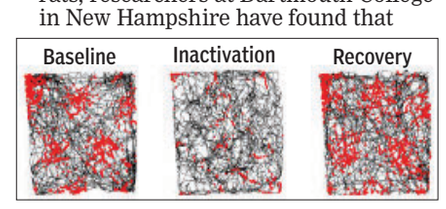
Glass is now overseen by Ivy Ross, a jewellery designer who runs Google's smart-eyewear division, and Tony Fadell, a former Apple product executive. "Early Glass efforts have broken ground and allowed us to learn what's important to consumers and enterprises alike," Fadell said. "I am excited to be working with Ivy to provide direction and support as she leads the team and we work together to integrate those learnings into future products."

The report quoted an adviser to Fadell as saying, "There will be no public experimentation. Tony is a product guy and he's not going to release something until it's perfect."

Google Glass was unveiled as a prototype in 2012 and was distributed to a select group of people as part of the Explorer programme who paid $1,500 to be early adopters. On 19 January, Google quietly suspended selling Google Glass to consumers while continuing to support Glass as an enterprise product.

'Inner GPS' support

Forming a network that's known as the brain's "inner GPS", neurons called grid cells help rodents and humans navigate. Now, by studying rats, researchers at Dartmouth College in New Hampshire have found that



Neuronfixing map.

these neurons receive spatial information from head direction cells in the thalamus. Theirs are the first experimental results demonstrating that the flow of information from head direction cells to grid cells is important for grid cell functioning. The results, published on 5 February in *Science*, confirm predictions previously generated using computational models.

ANNA AZVOLINSKY/THE SCIENTIST