

Seminar on
“Women in Science : A Career in Science”
5 April 2008
Venue: SMS Auditorium
Cochin University of Science and Technology

Background:

Women in science comprise only a small percentage of the total number of working women in India. Although there is no explicit discrimination against women in enrollment and recruitment at the college, university or faculty levels, attitudinal biases and absence of supportive Institutional/Social structures have, over the years, operated as powerful forces against talented women realising their full potential in the pursuit of productive and rewarding careers in science. It does not appear that there is a societal perception in India of women being incapable of intellectual attainment in science since women students are not in short supply at the under-graduate and post-graduate levels in science. Many of these university students do brilliantly and are gold medalists. Many of them also enter Ph.D programs. However their numbers drop in faculty positions, and drop even more in higher faculty positions, in selection committees, and so on. The under-representation of women in science, particularly at the senior levels of teaching and research in India, has become a serious cause of concern for women scientists and science policy planners.

There is an overwhelming body of empirical and qualitative evidence for this 'leaky' pipeline in science, as well as presence of gender inequity in the practice of science. There is a need to make women aware of a career in science as a possible career option and then to retain them in the profession. It is becoming increasingly evident that if we want more women to be successful in science we need to create, at all levels, support structures for and positive attitudes about a science career for women. The pressure for change has to come from within the scientific community, not just from women but from all those who believe that the practice of science cannot be built on a foundation of iniquity.

Objectives:

The aims of the seminar were as follows:

1. To have presentations by leading women scientists about latest developments in their area of activity, to showcase the work done by women scientists, to an audience of both genders.
2. To inspire and motivate young women to take up a career in Science
3. To create an awareness on various career options available to young women scientists
4. To explore avenues for entrepreneur development for women through Science

This was part of the role model program of the WiS Panel of the Indian Academy of Sciences (<http://www.ias.ac.in/womeninscience/>). By holding the Seminar in Cochin University, we hoped to target graduate and undergraduate students, research scholars, teachers and scientists in Kerala and inspire more young women to take up a career in science.

The seminar had 197 registered participants comprising of students, research scholars, school teachers, faculty from colleges and Universities such as Kerala Agricultural University, Kannur University, M.G.University, Calicut University, Kerala University and Cochin University. Participants were also present from nearby research institutes such as CMFRI, NIO, KFRI and RRL.

Theme of the Seminar:

The focal theme of the seminar was the recent developments in different fields of science, while simultaneously highlighting the career options for women scientists.

The seminar had six speakers, one each from mathematics, chemistry, biology, engineering, physics, and remote sensing. The names of the speakers and the titles of their presentations are given below:

Dr. Mythily Ramaswamy TIFR Centre, IISc Campus, Bangalore	Some new trends in Differential Equations
Dr. Aruna Dhathatreyan Chemical Laboratory, CLRI, Adyar, Chennai	Properties of molecular organized assemblies at interfaces
Dr. Usha Vijayraghavan Department of Microbiology and Cell biology, IISc, Bangalore	The making of a flowering stem : lessons from molecular genetic analysis of flowering plants
Dr. Rama Govindarajan Engineering Mechanical Unit, JNCASR, Jakkur, Bangalore	Flow instabilities and other challenges in fluid mechanics
Dr. Neelima Gupte Department of Physics, IIT, Madras	Transport, congestion and traps in a communication network
Dr. Geetha Ramkumar Space Physics Laboratory, VSSC, Trivandrum	Women Power in Space Science

Inaugural Session:

The seminar was inaugurated by the Vice Chancellor of Cochin University of Science and Technology, (CUSAT).

The participants were welcomed by the Seminar coordinator, Dr.Padma Nambisan, Department of Biotechnology, CUSAT. Prof Rohini Godbole , Chairperson, WiS Panel, Indian Academy of Sciences, then updated the participants on the various initiatives of the Women in Science panel as well as the “Career in Science” Initiative, as this seminar was the inaugural seminar of this particular initiative.

The Vice Chancellor of CUSAT, Prof. Gangan Prathap in his Inaugural address remarked on the observed gender differences in the approach to scientific experimentation – while most male scientists were disorganized, but often capable of thinking out of the box, women scientists were more methodical and organized in their procedures. He attributed these gender differences to evolutionary imprinting which possibly reflected the need for role definitions and a division of labour necessary for survival of the species. For the practice of good science, both capabilities were required and he attributed the success of many to the “androgynous” minds described by Coleridge. Dr. Gangan Prathap was also concerned about the recent reports from UK indicating a decrease in the number of men taking up a career in science and felt that in this scenario, there is a heightened need for more women to take up science as a career. He also felt that there should be greater visibility for the contributions of women, including a change in the norms of author citations in literature- traditionally, citations are made with the surname and initial of the first name, and no indication of the gender of the author. He referred to a recent paper in the journal Nature, in which three authors from Asia, examined this issue of author citation norms.

During the Inaugural session, the Vice Chancellor also released a book authored by Prof. N.G.Devaki, Department of Hindi, CUSAT, titled “Web of Language: Random thoughts on its Science and Technology”.

The inaugural session ended with a vote of thanks proposed by Dr.Sarita G.Bhat, Seminar coordinator, Department of Biotechnology, CUSAT.

Session I:

The fore noon session had three talks as follows:

1. **Some new trends in Differential Equations** by
Dr. Mythily Ramaswamy
TIFR Centre, IISc Campus, Bangalore

Abstract:

Mathematical models have been studied for the last few centuries, starting from Newton, who formulated his famous equations of motion and solved them also using his calculus tools. After tracing the major developments in differential equations very briefly, we focus on recent developments in control problems.

Optimal control problem definitions, 2 major approaches to the problem of characterizing optimal control, namely, dynamic programming and Pontriagyn's maximum principle are indicated. The major questions regarding controllability, observability and stabilizability are introduced via examples. Main results for linear systems with constant coefficients are outlined.

2. **Properties of molecular organized assemblies at interfaces** by
Dr. Aruna Dhathatreyan
Chemical Laboratory, CLRI, Adyar, Chennai
Abstract:

The research work deals with the general areas of soft condensed matter using Langmuir and Langmuir-Blodgett films of novel organic molecules and the dynamics in these films based on interfacial phenomena and complex fluids; in particular: relating structure with phase behavior at interfaces. New experimental techniques to probe the 2-dimensional organization at interfaces in these films have been developed and crystallization of proteins and other macromolecules have been carried out. Some of the highlights of the work are

- the synthesis of stabilized ordered 2-d arrays of semiconductor nano-particles and tuning of their sizes using mixed Langmuir films
- Design of organized structures (using electron microscopy, Langmuir films) of novel amphiphiles with rigid polar groups with new phase transitions at interfaces and use of the above phases as templates for chemical reactions
- development of a hydrophobicity scale for proteins based on surface energy at solid/liquid interface

3. **The making of a flowering stem : lessons from molecular genetic analysis of flowering plants** by

Dr. Usha Vijayraghavan

Department of Microbiology and Cell biology, IISc, Bangalore

Abstract:

A central question in developmental biology is to understand how the single cell zygote, produced by fertilization, is programmed to generate the adult body form with complex tissues and organs. The roles played by genes and epigenetic mechanisms in regulating this process are a topic of investigation in many model organisms. Until about two decades ago much of the excitement in this field came from studies on animal models such as worms, flies, fish and mammals. *Arabidopsis thaliana*, a flowering plant of the mustard family, has recently become a flagship plant model to understand many aspects of development is regulated in flowering plants. Its advantages include its short generation time, small genome content and amenable laboratory growth conditions all of which are conducive for molecular genetic analyses. As in other flowering plants its embryo is a simple structure with only rudimentary pre-established pattern. Formation of plant organs like leaves, shoots, branches, flowers and roots occurs post-embryonically. This requires the activity of pluripotent yet uncommitted cells located at the shoot and root apex.

Understanding mechanisms that regulate when, where and how flowers are formed will provide insights on how cell-fate may be determined in plants. Flowers provide a central identity to all angiosperms and are a critical species determining parameter. A typical flower is composed of four organ whorls; the outermost being sepals followed by the petals, stamens and carpels. The flower is also a determinate/ finite structure as all cells generated by the young floral primordium are consumed in making these organs. While sepals and petals are sterile organs, stamens and carpels form the male and female reproductive organs respectively. Because the floral organ positions are nearly invariant in all flowering plants genetic studies in tractable model plants hold immense value.

Specification of floral organ identity is best described by the ABC model, initially proposed in the early 1990's, based on mutants in model dicotyledonous species *Antirrhinum majus* and *Arabidopsis thaliana*. This model postulates that three activities: A, B, and C specify organ formation by acting in a combinatorial manner. Cells in the nascent floral meristem that express 'A' alone are directed to form sepals, 'A with B' activity specifies petals, 'B and C' activity together direct stamen formation and 'C' activity alone creates carpels. I will review these pioneering studies and discuss our current understanding of how master regulatory transcription factor choreograph flower formation. To exemplify how evolution generates morphological diversity using such conserved master regulators that are found in plants with diverse floral morphologies I will discuss the recent studies of rice genes related by sequence to key *Arabidopsis* floral organ identity genes.

Session II:

The post lunch session had three talks as follows:

4. Flow instabilities and other challenges in fluid mechanics by

Dr. Rama Govindarajan

Engineering Mechanical Unit, JNCASR, Jakkur, Bangalore

Abstract:

The talk was aimed at giving a general idea about research in fluid dynamics, and the problems we try to solve. Examples were given to show that there are interesting, and deep unsolved problems at all scales, beginning from the galactic and down to nanoscale. Recent work in our group on gravity-free hydraulic jumps and their connection to metal femtolitre cups was developed and used as an example to show how a scientist would choose what to work on, how the work would begin, and what would ultimately go into a PhD thesis. Another example of instabilities in vortical density-stratified flows was used to show how every problem has many ramifications, the attempt to understand which leads to physical and mathematical insights. It was emphasised that a multi-pronged approach is often necessary.

5. Transport, congestion and traps in a communication network by

Dr. Neelima Gupte

Department of Physics, IIT, Madras

Abstract:

6. Women Power in Space Science by

Dr. Geetha Ramkumar

Space Physics Laboratory, VSSC, Trivandrum

Abstract:

The objective of this presentation is to make aware of the younger generation about the Space Science programs in India and to enthuse them to participate in the program, take up challenging responsibilities and contribute towards the development of the country.

The presentation will cover the vision, responsibilities, on-going and future programs of Indian Space Research Organisation (ISRO) under the Department of Space (DOS). The vision of ISRO is to “develop India as a major space faring nation with a multi-dimensional program in space science & technology and a wide spectrum of their applications, for the socio-economic benefit of the country, benefiting every citizen”.

The strength of women employees is 17.6 % of the total manpower of DOS and in that in the scientific/technical area is 7.18% only. During past few years the trend appears to be encouraging and more women scientists and engineers are joining and continuing in service. A few women leaders are there at the top and it is found that given the requisite qualifications and opportunities, the women in science and technology in India can be achievers.

DOS supports ‘Research and developmental projects, educational programs, scientific activities at the academic institutions and R and D laboratories in the country, focusing space technology, science and applications, which are directly relevant to Indian space program and also basic research, which will have futuristic linkages with Indian space program. The various programs and plans for this purpose are discussed in the presentation. The venues for space science research and the facilities offered by DOS and the outreach activities of DOS are also presented.

Concluding Session:

The seminar concluded with a panel discussion:

Moderator :

Prof. Rohini Godbole

Centre for High Energy Physics

IISc, Bangalore

Members :

Prof. Archana Bhattacharyya

Director,

Indian Institute of Geomagnetism

Navi Mumbai

Prof. K.G.Nair

Director,

Science in Society, CUSAT

Prof. A. Vijaykumar

Department of Mathematics,

CUSAT

Prof. Rohini Godbole began the discussion with a definition of the problem – women do not participate at all levels in science. There is a drop in the numbers of girl students from graduate to doctoral levels, and more drastically so after doctoral programmes, so much

so that in most institutions the numbers of women scientists and faculty members are small. While several policy changes have already been made and several more are in the pipeline, it is evident that more importantly a social change is required. Dr. Godbole appraised the gathering of the Panel on Women in Science initiative to compile a databank of all women doctorates in India with special categorization into four groups: (a) whether engaged in research, (b) whether engaged in teaching, (c) whether engaged in industry, or (d) whether discontinued and if so, the reason for doing so. The databank was to be analysed by both scientists as well as sociologists doing gender studies, so as to understand what needs to be done to retain more women in science.

The other major initiative of the Panel that she mentioned was the “Role model programme”. This seminar was the inaugural seminar of the “Career in Science” initiative aimed at showcasing work done by women scientists. The aim of this initiative is to inspire more participation by girl students and bring home the fact that women can “do” science and that a “scientist” could be of either gender.

Prof. Archana Bhattacharyya expressed the opinion that there are several challenging problems in science of a multidisciplinary nature. She stressed the fact that women need not necessarily do research only in well established fields, but perhaps could maintain flexibility or switch from one area of specialization to another, so as to fine tune research to accommodate possible breaks in career. Dr. Archana cited the example of Dr. Rama who did her Doctoral research in Aerospace, but moved to Fluid Mechanics. She mentioned fellowship programmes offered by Department of Science and Technology which could facilitate return to active research for those women, who due to circumstances could not avoid a break in their career. The upper age limit of these fellowship schemes was set at 50 years. Dr. Archana also felt that there was a pressing need for change in the mindset of men so that the contributions of women are better appreciated and valued the same as those of their male colleagues.

Dr. Vijaykumar posed the rhetorical question as to why men dominate science. He mentioned the highly provocative theory of Lawrence Summers of Harvard University that females do not have the innate ability to do mathematics or science. He observed that less than 10% of Nobel Prize winners were women and that there were only 11 women scientists who were Nobel Prize recipients. He mentioned that women appeared to do better in certain countries like Sweden where equal opportunities are provided for men and women. Dr. Vijaykumar was of the opinion that greater attention should be paid to the teaching of science in schools and to attracting school students to take up science as a career. He remarked that in several cases, career choices are influenced by parental decisions. And the best way to attract students to a career in science would therefore be by instilling a love for science in the formative years.

Prof. K.G.Nair bemoaned the lack of basic infrastructural facilities and basic amenities such as a rest room and clean toilets in most institutions. He mentioned that the UGC had awarded a sum of one crore to each university for setting up of such infrastructural facilities for women. He appraised the participants on the activities of the Science in

Society cell in Cochin University and some of the initiatives for women being undertaken by the cell.

Prof. Neelima Gupte maintained that in several discussions, marriage and family usually appear as roadblocks in the career path of the women scientist. However this need not be necessarily so and in many cases, the family is a source of strength, helping the scientist achieve greater heights. Also, she expressed the opinion that although several government and institutional policies may exist to help a woman scientist to either avoid a break in her career or to return to the lab-bench after a break, ultimately it depends on each one of us to make appropriate changes in our own situation, the laboratory or institution, to make it more friendly and supportive of the women scientist.

Prof. Usha Vijayraghavan emphasized that in experimental science, a break in career should not be the norm. In most instances, a break in career makes it inordinately difficult to come back. Thus infrastructural support should be made available to the scientist to prevent the necessity for a break. Also, it is important that the women also develop the proper attitude and to prove performance, so that performance should be the main criteria for promotions.

Prof. Aruna Dhathatreyan mentioned that she had been a member of the selection panel for award of fellowships under the DST schemes for women who have had a break in career, and emphasized that the selection process is very rigorous and women with the requisite attitude and determination alone are selected. This was said in the context of the need for women scientists also to develop a more aggressive attitude to “doing” research and to not take the availability of such schemes as an excuse for taking a break. Ultimately every woman scientist needs to prove attitude first as performance should be the main criteria for promotions.

Prof. Rama Govindarajan felt that there was a need to de-emphasize differences between men and women, and strive towards gender parity.

Prof. Mythily Ramaswamy also echoed the same sentiment.

Dr. Geetha Ramkumar mentioned that infrastructural support is important for women to work long hours in the laboratory, and was happy to inform the audience of the support received by ISRO staff. They were permitted to work after office hours provide there was one more woman staff and were provided adequate transport and refreshments while doing so.

Prof. Rohini Godbole summarized the panel discussion and the following recommendations were made:

1. In the case of women, the child bearing period inevitably coincides with the period of active research and career advancement. Consequently, women scientists are often faced with questions of priority of family or career, often resulting in hard choices of one or the other. There is thus a need for more

- fellowships, such as those instituted by Department of Science and Technology and DBT for women who have had a break in career to return to active research.
2. A break in career however makes it inordinately difficult for a woman to regain the tempo of research and is often associated with a lack of confidence to do cutting edge science. In certain fields, numbers of women scientists are few and opportunities for keeping abreast of recent developments due to lack of peer consultations has also been noticed. Therefore it was felt that there should be more short term refresher courses and workshops for women scientists to keep themselves up to date, for the benefit of those who have had a break in career as well as for those who have been in teaching or technical services and would like to do research. The initiative of IITs to host refresher courses for their alumni for keeping them updated with more recent developments in their field is laudable and should be adopted by other teaching and research institutions.
 3. A break in career can be avoided if women scientists are provided adequate social and institutional support. A few of the recommended support systems are:
 - Flexible working hours – pregnant, nursing or mothers with infants could be given the option of putting in the requisite hours on a 24hr routine rather than the prevalent 9 to 5 routine.
 - Fewer working hours with pay commensurate to the number of hours.
 - Pay allowances for engaging help for child/ geriatric care to be availed by oneself or spouse for a period specified on a case by case basis
 - Infrastructural facilities in research and teaching institutions to be made mandatory. These include:
 - Clean toilets and a rest room in each department
 - Crèche/ old age home / community centre with trained staff
 - Basic health centre with a doctor on call
 - On campus 24 hour transport shuttle service for commuting between quarters/hostels/departments and the main gate or nearest public transport stop

Conclusion:

The seminar brought home the need for social and institutional support if women are to “do” science. The seminar was appreciated by the participants for the attempt to sensitize students and scientists of both genders to the need for gender parity in science practice. To quote Prof. V.L.Chopra, Member, Planning Commission, “...this seminar is a laudable initiative of highlighting the need of women scientists being visible as major contributors to science practice and promotion. This should be viewed more as a ‘rights’ than a ‘favour’ proposition.....”.