conventional breeding for improving this crop. He also focused on the role of male sterility, hybrid DMH-II and pollination control systems developed in various species of *Brassica*. Addressing the gathering on the importance of value-added products from mustard and their applications in food and industry in the third technical session, D. K. Bhattacharya (University of Calcutta, Kolkata) gave an interesting account of many useful value-added products from mustard and its oil. He mentioned that modification of *Brassica* seed oils by chemical and enzymatic reactions provides scope for production of 'nutraceuticals' and functional food products. Rajeev Churi (SARBI Petroleum and Chemicals Pvt Ltd, Mumbai) dealt with use of environment-friendly lubricants from mustard, and its properties and advantages over mineral oils such as superior biodegradability and excellent viscosity. S. K. Saxena (Centre for Analysis and Training) made the audience aware of quality standards required for manufacturing and exporting food derivatives from mustard and the importance of quality in trade in the WTO regime.

There was a brainstorming discussion on how to improve the processing of mustard at various levels and make mustard oil a better heath choice for the public. Several measures in various sectors of research and marketing were suggested.

The conference concluded with a vote of thanks from H. B. Singh, MRPC. He thanked the delegates and speakers for their valuable inputs and encouraged the research scholars to indulge in pro-active research in frontiers areas of mustard sector to meet the future challenges.

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COMMENTARY

Scientists anonymous

Asha Gopinathan

As I sit down to write this piece, a seminar I attended recently comes to mind. It was an interesting talk given by a woman archaeologist on evidence collected of trade between the Roman Empire and India, especially Kerala in the period between the 1st century BC and 5th century AD. I asked her whether she had thought of any gender dimensions to her work. She replied that a few pieces of cloth had been discovered in some of the digs which led them to conclude that families may have been present. I probed her for any evidence to prove that the boat-builders, sailors and traders were all men. She had no answer to that. She wanted to know if I was specializing in gender studies. I answered in the negative and told her that I was a scientist who is interested in the workings of the brain.

As a scientist, I have often tried to locate in the past, women and other underrepresented minorities. Often, in a collection of stories of white men, one can find a sprinkling of men of colour and may be an odd white woman thrown in. In the few collections of biographies of Indian scientists, rarely does one find the story of even one woman. I have a scrap book in which I enter the names of important Indian and other women of colour who have worked in science. Of course, when one looks at contemporary science as we think of it today, to fill this book is a daunting task.

Women working in the area of the history of science and technology have slowly begun to change this by asking some fundamental questions of what constitutes science, who the people are whose contributions constitute recorded history and have formulated ways of rewriting the people at the margins back into the history books. It is in this connection that I find the writings of Patricia Fara, a Fellow of Clare College, Cambridge unique and interesting. In her book *Pandora's Breeches*, Fara makes the argument that during the Enlightenment, women took part in science in many roles ranging from being translators of major works to funding various projects[1]. In her more recent book[2], Fara takes this, one step further. This is a book written primarily for a younger audience, where Fara describes and lists the achievements of many women in science in Europe (though a few from the US are also mentioned) from the 17th century to the present. The stories form interesting reading for the range of activities these women engaged in, the obstacles they faced and the strategies adopted by them to succeed. It is clear that these anonymous women carried out experiments, recorded observations, created theories, built-up collections, went on expeditions, illustrated apparatus, specimens and translated foreign books. Some of these names have been retrieved by Fara and form the content of this very readable book.

Fara begins her story in the 17th century because that is when the first scientific society appeared. The Royal Society of London was established in 1660. It was during the period 1550 to 1700, referred to as the period of the Scientific Revolution, that reformers campaigned to bring about a change in methods of learning about nature. They put forth the view that conducting experiments was a better way to learn about nature than relying on books that were centuries old. The new scientific societies were formed to advertise this new approach. They supported research and its communication. However, no woman was ever a part of these societies. During the 17th century, there were no scientists as we understand the word today. The word was not invented till 1833. Even Isaac Newton was not called a scientist, but a natural philosopher. These natural philosophers did not work from laboratories, had no research grants and most oddly, they believed that their work helped them to learn more about God. However, even though these societies excluded women, Margaret Cavendish, a wealthy woman who critiqued the work of Robert Boyle, demanded that she be

allowed to visit the Society in 1667. The Society was packed on the day she came, as many Fellows wished to see this curious specimen. She was called 'Mad Madge' for this action. After this, the Fellows decided to close ranks and formally ban women. In 1904, Hertha Ayrton was the first woman to read a paper 'The origin and growth of ripple marks' to the Royal Society of London. Although eight Fellows nominated her to join the Society, she was disqualified because she was married! It would be another forty-one years before the first female Fellows were elected. In 1945, the biochemist Marjorie Stephenson and the crystallographer Kathleen Lonsdale were both elected. However, even today while the Royal Society of London has 1200 Fellows, only about 4% of them are women. In India too we find that only about 3.2% of INSA, 4.6% of IAS and 4% of National Academy of Agricultural Sciences members are women (2004 data). The picture is not all that different in other countries either.

In the 17th century Europe many of the extant craft-traditions like glass-blowing, metal-working and drawing were being used to make new instruments that were used for performing experiments or drawing maps and diagrams. Since these were run as family businesses, many girls were trained to be apprentices to their fathers. Many of them took over the family business. In astronomy, it was common to see women participating and even running their own observatories. Some of these were Maria Emmart, Elisabetha Hevelius, Maria Winkelmann, Margaret Flamsteed and Maria Cunitz. In Germany, about 14% of the astronomers were women.

Why then does one not remember the names of these women? There are many reasons for this. One of these is the practice of concealing the work of a woman behind that of a famous man. Sometimes the woman herself published joint work in the name of her husband/brother/mentor, while on other occasions, he may have refused to acknowledge or credit her work. In other instances, none of her work may actually be preserved. Take the case of Laura Bassi, Bologna, who started lecturing in physics at the university at the age of 21 and in 1776, became Europe's first female professor. She fought many battles, not only for herself, but for other women too, so that soon after her death the university changed its rules and would not admit any more women! Little wonder then that none of her lectures are preserved. Yet in other instances what was once considered 'scientific' work may no longer be considered to be so. Women were once solely responsible for treating illnesses, growing food efficiently, preparing chemicals such as dyes and preservatives. This knowledge would become the disciplines of pharmacology, agriculture, botany and chemistry.

Apart from women not being given a decent education so that they could participate in science, there were also many restrictions imposed by men on allowing women into the tribe. Sometimes women found ingenious solutions. One of these was to disguise themselves as men! The botanical explorer Jeanne Baret (1740–1816) sailed around the world disguised as a man called Bonnefoy collecting botanical specimens. The French mathematician Sophie Germain (1776–1831) took on the identity of a male student and entered university. She corresponded with various mathematicians using this name and even laid the foundations of modern number theory. Finally in 1816 she won a top prize set up by the Paris Academy of Sciences by entering anonymously. Thereafter, she became the first woman allowed to attend the Academy's meetings.

Strangely enough, even though women were constrained by many restrictions from participating in science, there were many wealthy women who were patrons of scientists and thus influenced the direction of science. Queen Elizabeth, Queen Christina of Sweden and Anne Conway are some examples. There were some men who held very disparaging views of women. Charles Darwin used to believe that women were created inferior to men. On the other hand, there were others like Leibniz and Faraday, who credited women for influencing and helping their scientific ideas. Fara's book is interesting in the number of women she has unearthed from obscurity. While Albert Einstein ignored his first wife, Mileva Einstein's career (she was a fellow-student of his in Switzerland) and did not encourage her, Pierre Curie proved to be just the opposite.

So can we conclude then that women are not members of scientific societies because of their inherent inferiority and inability to conduct science? Or is it because they are unable to meet the 'standards' set by these societies or because they are simply not elected to become members, whether or not they meet all the 'required' criteria? Names like Ada Lovelace (1815–52) who invented computer programing, Emily du Chatelet (1706–49) who critiqued, explained and translated Newton's work into French, and the several hundred others in Fara's book really make one question the 'inadequacy' theory of women in science.

I go back to the question that I had started with. Even if there is no evidence to prove that it was women who built the ships that sailed back and forth from India to Rome in the early part of the 1st century BC, is there any evidence to disprove this? In the hands of a creative and imaginative scholar, perhaps justice will be done soon to the long history of Indian women in science, technology, mathematics, engineering and architecture. One hopes that the scientific academies in India will be only too eager to fund such a project.

1. Gopinathan, A., *Science*, 2005, **307**, 522.
2. Fara, P., *Scientists Anonymous – Great Stories of Women in Science*, Wizard Books, 2005, p. 213.

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