

CONTRIBUTION OF WOMEN SCIENTISTS IN BIOLOGICAL SCIENCES IN GLOBAL PERSPECTIVE

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Abstract

To glorify the achievements of the women scientists, the theme of National Science Day 2020 has been selected as “Women in Science”. In this article we have tried to highlight the contribution of many recognised and non-recognised women scientists in biological field. In 19th century Nettie Maria Stevens, Beatrix Potter and many other women biologists had enriched the biological field through their works and effort. In 20th century Rosalind Franklin, Dian Fossey and many others had contribution in various branches of biology. Even till now, there are many successful women scientists in our world who continuously try to enrich the biological field by discovering new things.

Key words Women scientists, biology, women empowerment

Introduction

With the rapid progress of human civilization, head of the family started considering the potential of the women folk outside the home as well. We have numerous examples that proved their excellence equally lead the male dominated science fraction. The theme for International Women's Day, 2020 commemorate the global day celebrating social, economical, cultural excellence of women making a call to action for tackling the persistent barrier against gender equality. To glorify their achievements, the theme of National Science Day has been selected as “Women in Science”. This article tries to highlight the achievements made by recognized and non-recognised aspirants of Bioscience field.

Women scientists in 19th century

- **Nettie Maria Stevens (1861-1912)**

She was one of the early American geneticists and was among the first researchers who described the chromosomal basis of sex first in insects and then in humans [11]. Her early discoveries laid the basis for the Morgan's mapping the first gene locations onto chromosomes of fruit flies.

- **Beatrix Potter (1866-1943)**

She is best known for her Peter Rabbit series of children's books. She was interested in nature, but was rejected as a student at the Royal Botanical Garden, only for her gender. In spite of being discriminated she could not stop her innovative research work. She was the first person to hypothesize that lichens were actually a symbiotic

relationship between fungi and algae. She recorded her observations in exquisite painting and become respectfully reputed as mycologist. Her work on germination of spores was rejected due to her gender [11].

- **Florence Sabin (1871-1953)**

She has been called as the first lady of American Science who studied the lymphatic and immune system [11]. She was the first female full Professor at Johns Hopkins School of Medicine. In 1951 she achieved the Albert Lasker Public Service Award for her work.

- **Margaret Sanger (1879-1966)**

She was a nurse who promoted birth control as a means by which a woman could control her reproductive destiny. She opened the first birth control clinic in the United States. In 1929, she formed the National Committee on Federal Legislation for birth control [11]. She is widely regarded as a founder of the modern birth control movement.

- **Charlotte Auerbach (1899 – 1994)**

Charlotte Auerbach, a German zoologist and geneticist discovered the mutations that mustard gas could cause in fruit flies. Her approach was biological rather than chemical in that, while she acknowledged that mutation took place in the chemistry of the gene, she adhered to the idea that it was the biological interaction that gave the process its complexity. She was awarded the Royal Society Darwin Medal in 1977.

Women scientists in 20th century

- **Margaret Mead (1901-1978)**

She was a curator of ethnology at the American Museum of Natural History from 1928 to her retirement in 1959. She is an influential anthropologist who published her famous “Coming of Age” in 1928. By this book the boys and girl in the Samon culture were taught to and allowed to value their sexuality [11]. She died in 1978 and was posthumously awarded the Presidential Medal of Freedom, the Union States’ highest civilization honour.

- **Barbara McClintock (1902 – 1992)**

She is considered as the one of the greatest biologists of the twentieth century. Her research focused on colour mosaicism in maize during the 1940s. She is responsible for producing the first genetic map for maize. She also discovered the transposons, mobile genetic elements that tend to move between locations in the genome. For her remarkable work she was awarded the Nobel Prize in 1983.

- **Rachel Carson (1907 – 1964)**

She was an American marine biologist and a science writer, is best known for her book "*Silent Spring*" where she explored the long term effects of synthetic pesticides [11]. She won several awards for “The sea around us ” including the National Book Award and the John Burroughs Medal. Rachel received many honorary degrees from universities. She was the second woman to be elected to the National Institute of Arts and Letters.

- **Virginia Apgar (1909 - 1974)**

She was pioneer in anaesthesiology who developed the Apgar Newborn Scoring System, increasing infant survival rates. She warned that use of some anaesthetics during childbirth has negative effect [11]. She was a leader in the field of anaesthesiology and teratology and introduced obstetrical considerations to the established field of neonatology.

- **Ruth Dixon Turner (1914-2000)**

Ruth Turner was a marine biologist, a curator of malacology at the Museum of Comparative Zoology and also a world-renowned expert on Teredinidae, sharp-shelled molluscs that bore through wood. For this reason she was called “Lady Wormwood.” She was also the first woman scientist to use the deep ocean research submarine Alvin. Much of her work was done in co-operation with William J. Clench. They jointly described about 70 new mollusc species. She had published more than 200 scientific articles and had a successful career as a marine researcher [8].

- **Gertrude Belle Elion (1918 – 1999)**

Gertrude Belle Elion was an American biochemist and also a pharmacologist. She could not find a research job after graduating because she was female. After saving enough money to attend New York University she obtained her M.Sc. in 1941. Her fifteen financial aid applications for graduate school were not accepted due to gender bias. She had never obtained a formal Ph.D., but was later awarded an honorary Ph.D. from New York University Tandon School of Engineering in 1989 and an honorary S.D. degree from Harvard University in 1998. She had worked for the National Cancer Institute, American Association for Cancer Research and World Health Organization[1]. She played an important role in the development of AZT, one of the first drugs used to treat HIV and AIDS. For discoveries of “important new principles of drug treatment” Elion had received the Nobel Prize in Physiology or Medicine, together with Hitchings and Sir James Black in 1988[5].

- **Rosalind Franklin (1920-1958)**

She is called as “*The Dark Lady of DNA*” as she was the pioneer of DNA double helix discovery but she was not in focus [6]. Beside this she was an English chemist and X-ray crystallographer. There is very much controversy surrounding her life and work. Franklin is best known for her work on the X-ray diffraction images of DNA, which led to the discovery of the DNA double helix for which James Watson, Francis Crick and Maurice Wilkins shared the Nobel Prize in Physiology or Medicine in 1962 [9]. Watson suggested that Franklin would have ideally been awarded, along with Wilkins but she had died in 1958 although there was not yet a rule against posthumous awards, the Nobel Committee generally does not make posthumous nominations. After finishing her work on DNA, Franklin led pioneering work at Birkbeck on the molecular structures of viruses. Her team member Aaron Klug continued her research, winning the Nobel Prize in Chemistry in 1982. This work was exactly what Franklin had started and which she introduced to Klug, and it is highly possible that, if she alive, she would have shared the Nobel Prize [10].

- **Rosalyn Yalow (1921-2011)**

She was an American medical physicist who had overcome many hurdles as a woman in her field as the powerful male figures controlled opportunities for training, promotion, and many aspects of development in the science field. When Yalow entered the University of Illinois in September 1941, she was the only woman among

400 professors and teaching assistants. At 1950, she had equipped a radioisotope laboratory at the Bronx VA Hospital. There she joined with Berson to develop radioimmunoassay (RIA), a radioisotope tracing technique. In 1977, Yalow was the sixth individual woman and the first American-born woman, to win the Nobel Prize in a scientific field for her role in devising the radioimmunoassay (RIA) techniques [2]. In 1988, she received the National Medal of Science, the highest honour for American individuals in science and technology.

- **Martha Cowles Chase (1927 –2003)**

She was an American geneticist. In 1952, she and Hershey (a bacteriologist & geneticist) performed the Hershey–Chase experiment, which helped to confirm that genetic information is transmitted by DNA, but not by the protein. That experiment helped to resolve the controversy over the composition of hereditary information. For that discovery Hershey won the Nobel Prize in Physiology or Medicine in 1969, but Chase was not included.

- **Anne McLaren (1927-2007)**

She was a famous scientist in developmental biology. She was a member of the committee established to inquire into the technologies of in vitro fertilisation (IVF) and embryology, which later produced the Warnock Report. She had many contributions towards the development of new contraceptive methods for women. For her contribution in science she was made an officer of the Royal Society, the first female officer in the society's 330-years history. For her pioneering work on fertility she was made a Fellow of the Royal College of Obstetricians and Gynaecologists in 1986.

- **Dian Fossey (1932 - 1985)**

She was an American primatologist, conservationist who was known for undertaking an extensive study of mountain gorilla groups. Fossey made discoveries about gorillas including gorilla vocalization, hierarchies and social relationships among groups, rare infanticide, gorilla diet, and how gorillas recycle nutrients. She had supported the active conservation through anti-poaching patrols and preservation of natural habitat. She was recognized as the world's leading authority on the physiology and behaviour of mountain gorillas, defining gorillas as being "dignified, highly social, gentle giants, with individual personalities, and strong family relationships." After her death, Fossey's Digit Fund in the US was renamed the Dian Fossey Gorilla Fund International[3]. The Karisoke Research Centre is operated by this fund and it continues the daily gorilla monitoring and protection that she started.

- **Jane Goodall (1934 -Continued)**

She is an English primatologist, who is considered to be the world's famous expert on chimpanzees. She became the eighth person to be allowed to study for a PhD in the University of Cambridge without having a BA or BSc degree. Jane Goodall is well known for her studies of the chimpanzees at the Gombe Stream Game Reserve on Lake Tanzania [7]. She discovered that they are omnivores. She also found that, "it isn't only human beings who have personality, who are capable of rational thought and emotions like joy and sorrow." She became the global leader of efforts to protect wild apes and their habitats. But her unconventional practices, such as giving names to the chimpanzees she studied, have brought criticism from some scientists. In April 2002, Secretary-General Kofi Annan named Goodall a United Nations Messenger of

Peace. Her other honours include, the French Legion of Honour, Medal of Tanzania, the Benjamin Franklin Medal in Life Science, the Spanish Prince of Asturias Awards. In 2019 she had received Gold Medal of the Royal Canadian Geographical Society.

- **Lynn Margulis(1938-2011)**

Lynn Margulis, an American evolutionary theorist & biologist was the primary modern proponent for the significance of symbiosis in evolution. Her first publication was on the genetics of Euglena which published in 1958 in the Journal of Protozoology. In 1966, as a young faculty member at Boston University, Margulis wrote a theoretical paper titled "On the Origin of Mitosing Cells". This is considered today as a landmark in modern endo-symbiotic theory. For the Advancement of Science she was elected as Fellow of the American Association in 1975.

- **Wangari Maathai (1940 – 2011)**

Wangari Maathai, an environmentalist was the first African woman to win the Nobel Peace Prize. She had worked in veterinary medicine research at the University of Nairobi. Despite the opposition of the male students and faculty, she was able to earn a Ph.D. there. She was the first woman who became the head of the veterinary medicine faculty at that university [4]. In 1977 she founded the Green Belt movement in Kenya, which has planted more than 10 million trees to prevent soil erosion. She had also served as national chairperson for the National Council of Women of Kenya. Her efforts in environmental act led to a Nobel Peace Prize.

- **Lydia Villa-Komaroff (1947 -continued)**

Lydia Villa-Komaroff, a molecular & cellular biologist is known as a pioneer in the field of molecular cloning and DNA manipulation. She was part of a team that discovered how bacterial cells could be used to generate insulin. Villa-Komaroff's laboratory made several important contributions following the insulin research. She contributed to the discovery that a molecule known to be associated with Alzheimer's disease (amyloid beta) causes degeneration of brain cells (neurons). This had provided the first direct evidence that a fragment of the amyloid precursor protein could kill neurons. At 1992 she had received Hispanic Engineer National Achievement Award. Now she is a Fellow of the Association for Women in Science.

Recent Achievements of Women Scientists

- **Francoise Barre Sinoussi**

The French virologist shared Nobel Prize in 2008 in physiology/medicine with Luc Montagnier for discovery of HIV virus.

- **Elizabeth Blackburn and Carol Greider**

Both of them shared Nobel Prize in 2009 for discovery of Telomere and Telomerase which has wild application in research in health sector.

- **Ada E. Youath**

She shared Nobel Prize in chemistry in 2009 with Venkatraman Ramakrishnan for demonstrating the structure and function of ribosomes at the atomic level. X-ray crystallography was used to map the position of each and every atom making the ribosome.

- **Tu Youyou**

She won Nobel Prize for physiology/ medicine in 2015 shared with William C. Campbell and Santosh Omura. A new drug, Avernectin, discovered by Campbell and Omura lower the incidence of River Blindness, Lymphatic Filariasis as well as other parasitic diseases. Another drug discovered by Youyou was Artemisinin found to have a significant reduction in mortality rates of malaria patient.

- **May Britt Moser**

A Nobel laureate in physiology/medicine in 2014- the awareness of one's location and how to find the way to other places is crucial for both human and animals. She with her husband discovered that nerve cells of a rat fire in the entorhinal cortex, a region near the hippocampus when the animal scuttled past particular location arranged in a hexagonal grid. These grid cells associated with other cells to form the brains positioning system. Similar grid arrangements were found in human brain. Their work paved the way for other neuroscientists working on diseases like Alzheimer's.

- **Barbara Rosemary Grant**

An evolutionary biologist shared Kyoto prize in 2009 with her husband Raymond Grant for demonstration of rapid evolution caused by natural selection in response to environmental changes. This award is for significant contribution to cultural and spiritual betterment of mankind.

- **Francis Arnold**

She was a Nobel laureate in chemistry in 2008 for her evolution of enzyme. She shared the prize with George P. Smith and Gregory P. Winter who discovered the technique called Phage- Display to isolate genes for targeted proteins.

- **Linda J. Saif**

She was an American microbiologist at Ohio state university. She was the first women scientists to win wolf prize agriculture awarded in 2015 for her contribution in the field of virology and immunology.

- **Xiaowei Zhuang**

She was a multitalented women scientist recipient of one of the most prestigious awards, Heineken prize (2018) in biochemistry. She was a Chinese -American biophysicist, professor of chemical biology as well as an investigator at the Howard Hughes medical institute. She is best known for her work in developing stochastic optical Reconstruction microscopy (STORM), a super resolution fluorescence microscopy method and discovery of novel cellular structure using STORM.

Conclusion

This article herein has discussed proficiency of quiet a few scientists. Still there remains scope for recapitulation of other researchers, whose innovations have not got due prominence for several factors which can be a topic of further studies. As of 1901-2019, it is noted that Nobel prizes had been awarded to 866 male scientists whereas 53 female scientists had been honoured. This figure evaluates that ratio of women scientists is not appreciable in global context. Still the representation to this discipline on the part of women researchers needs to be encouraged for which opportunities to them should be made through proper mentoring or encouraging collaboration. Less likely to have full time contracts and fewer opportunities to gain influential position than male colleagues, sexual harassment, gender biased attitude- all these anomalies needs to be redressed so as to inspire the women potential. However, it is surprising to know that till enthusiasm and inspiration among women researchers is not up to the mark in developed nations.

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