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SUBJECT EDITOR: ANNA MORRIS

Gender Disparities in Oral and Maxillofacial Leadership

-Riya Patel

ARTICLE:

The Oral and Maxillofacial sector is a surgical speciality which bridges dentistry and medicine, focusing on diagnosing and treating conditions, injuries and deformities of the mouth, jaws, face and neck. For example, facial traumas and oral cancers. Oral and maxillofacial leadership is a largely male-dominated sector. The gender disparities arise from a combination of different factors including mentorship gaps, work-life structure conflicts and absence of visible leaders.

The absence of females in leadership roles

The paucity of female role models in leadership positions makes it more challenging for inspiration to drive motivation for more women to apply for senior roles. An abundance of advice is given; there is less advocacy for females to apply for leadership positions. This is as a result of societal views on women in leadership and the bias that women should be in more care-giving roles within dentistry rather than senior positions. Despite the work force in dentistry being predominantly female as of 2026, the leadership roles are heavily occupied by men, with only 25% of senior dental roles occupied by women reported in 2024. Additionally, workplace bias can lead to a decrease of female leaders in Oral and Maxillofacial Surgery (OMFS). Women are often perceived to be less ambitious or less capable than their male colleagues, despite having the same qualification and experience, which increases subtle bias that progressively grows until women are brushed over in promotions or excluded from important decision-making. Therefore, this creates more challenges for women to obtain leadership positions.

Work- life structure conflicts

The training pathway for leadership roles requires sustained commitment over an extended period of time. For OMFS especially, the typical training pathway requires a dental degree and a medical degree as well as 5 years of specialised training which could take up to 11-13 years in the UK. During this training period, some women may have an interest in starting a family and this introduces childcare responsibilities which can make it difficult for them to progress in their career.

Typically, women are expected to take a step back in their careers and are more likely to reduce their working hours after having children, which can lead to career interruptions and slower advancement compared to their male counterparts. In 2024, 45% of women dentists reported that childcare obligations had a direct impact on their ability to take on leadership roles or work full-time, reinforcing the stereotypes of women being less career driven than men.

This affects not only a woman's earning potential but also the experience required to obtain a leadership position.

Solutions for reducing gender disparities

To reduce gender disparities in leadership roles, flexible work arrangements should be offered for all dentists, not just women, so that job-sharing and part-time leadership roles can help women manage family responsibilities without sacrificing career progression. In addition, having mentorship programmes that connect women dentists with experienced mentors can allow valuable career guidance on their personal career development and leadership. This would help increase women in leadership roles in the Oral and Maxillofacial sector.

In summary, the gender disparities in oral and maxillofacial leadership arise from various factors including the difficulties of work-life balance and the reduced number of females in leadership positions. However, to close this gender gap, more advocacy for females to strive for senior roles is needed, as well as flexible work arrangements for all dentists.

GLOSSARY:

Disparities- a difference in level of treatment, especially one that is seen as unfair

Maxillofacial – relating to the jaws and face

Paucity- small amount of something

Advocacy- public support for or recommendation of a particular cause or policy

Mentorship- guidance provided by an experienced person usually in a company or educational institution

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Further reading

https://youtu.be/aDYIrQsPPCI?si=GBrebbNTOmVC6ZtQ

https://dexis.com/en-za/blog/chairside-to-leadership-challenges-women-face-in-dentistry

6

The Mouthpiece of Immunity: Lady Mary Wortley Montagu -Blessing Oppong

ARTICLE:

Smallpox, influenza and measles: Three diseases which require carefully calculated vaccination dosages for immunity. However, how did smallpox treatment go from beer consumption to the use of vaccination without modern technologies assistance? Vaccination transcends Edward Jenner's innovation, which takes us back to 18th Century Ottoman Empire where Lady Mary Wortley Montagu witnessed the Turkish women residing there performing inoculation. This allowed her to relay the idea of inoculation to the western world. Lady Montagu invalidated the stigma on a woman's 'lack of knowledge' by counteracting religious fatalism as a source of incurable diseases, an idea sourced by the men of the time.

Born in 1689, Lady Mary Wortley Montagu was classically educated through her own efforts and ambition in defiance of the times, where she taught herself Latin and wrote a poetry collection by the age of 16. Mary's ambition supported her new chapter in Turkey, where she moved after her husband had been appointed British Ambassador there. Prior to her expedition to Turkey, Mary's brother had died from smallpox in 1713 and she herself was badly disfigured after having contracted it in 17152.

In Turkey, her personal experiences with smallpox sparked her fascination of the Turkish, and their immunity to the disease after having noticed the lack of smallpox marks on the women's skin. The source of this 'immunity' being inoculation by female healers. This involved the transference of live smallpox virus from a mild case of the disease and introducing it to a healthy person. Cleverly, this parallels modern techniques, though having been introduced by 'uneducated' women. The unconventional use of inoculation countered 'learned medicine'3 which was male dominated at the time, where they believed that its principles were the only legitimate approach to healthcare.

Bold, brilliant and brave. What makes all of this so out of the ordinary and establishes Mary a radical? Following her insightful voyage to Turkey, the extraordinary sightings witnessed led Montagu to act as a mouthpiece for the Turks and the newfound discovery, spreading the word of inoculation to the western parts of the world. She spread the discovery of not only women but of the Turkish people, who were foreign in the eyes of the western world, a world which has distrust in those inferior and unfamiliar.

Undoubtedly, her advocacy for inoculation challenged male authority. This was a display of women learning to save themselves rather than allow the contemporary men to act as believed saviours. These were women viewed as vulnerable and naive meddling with the most deadly, unfamiliar thing- pathogens -overstepping the line between curiosity and danger.

Later, she deliberately infected her own daughter with a tiny dose of smallpox- successfully inoculating her three year old4. It was unorthodox at the time but paved the way towards Edward Jenner's miraculous discovery, ironically saving the lives of men who had mocked her for her supposed heresies.

Overall, it is important to highlight the significant role women have had in the advancement of the medical field we see today. Many stories such as that of the Turkish women in the Ottoman Empire, are hidden behind the walls of history. Instead, we should strive to uncover the role of women, to fully recognise our progress in medicine, not only today but over time, with voices such as Lady Mary Wortley Montagu's.

GLOSSARY:

Inoculation- the action of immunising someone against a disease by introducing infective material, microorganisms or vaccine into the body.

Edward Jenner- Developed the world's first vaccine in 1796

Stigma- negative or harmful beliefs, attitudes or stereotypes towards a particular group of people

Religious Fatalism- Belief that a divine power has already decided everything that will happen, meaning humans have no power to change the future

Heresies- A belief or teaching that strongly contradicts the established, core doctrines of a religion

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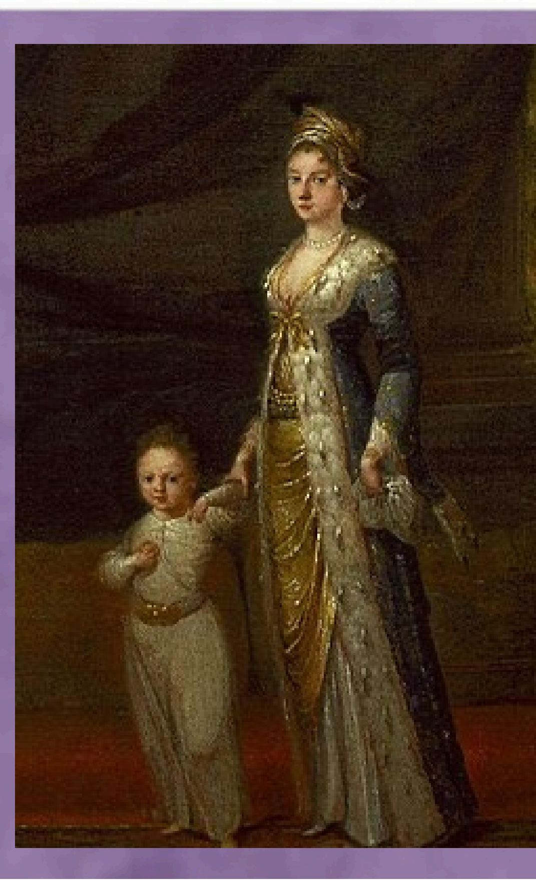


Endometriosis: A case study in medical misogyny in the UK -Rowan White

ARTICLE:

Medical misogyny refers to the inferiority of women's health-agency within the medical system, and is demonstrated by the societal dismissal and normalisation of women's pain. The sustained underfunding of research regarding women's bodies and the diseases which affect them, and the subsequent behaviours of healthcare professionals cause a lack of trust, evident throughout the global healthcare system. Today we will be investigating the overwhelming medical misogyny present within this field from diagnosis to treatment.

Endometriosis is a chronic disease that causes inflammation and scar tissue formation on internal organs, resulting in severe and often debilitating period pain, heavy bleeding, extreme fatigue, nausea and in the long term, infertility. It's an extremely widespread issue, impacting approximately 190 million women worldwide, yet there's a significant lack of research into causes, effective treatments and efficient diagnosis in comparison to similar conditions, primarily due to medical misogyny.

Researchers believe that the first recorded case of endometriosis was detected microscopically in 1860, and was treated for many centuries by Hippocratic doctors, theorised to be known as hysteria. This condition is thought to be one of the most misdiagnosed of all time, with the common theory of the time dictating that menstruation and hysteria made women unstable, physically unwell and psychologically vulnerable. Women were often blamed for their pain, and so there was little investigation or research into the causes of hysteria (and so endometriosis), other than it was normal and expected. This dismissal of the reality of the pain experienced not only delayed research into conditions which primarily affect women but also perpetuated a societal stigma and normalisation of abhorrent pain, which has persevered throughout time, leading to a lack of awareness in patients and healthcare professionals in the modern day.

This is particularly prevalent within the formal diagnosis and treatment of endometriosis, with the average time to receive a diagnosis being 7-10yrs. In a survey conducted by Endometriosis UK, 78% of women who went on to receive a formal diagnosis were told that they were making a fuss over nothing, had the severity of their symptoms questioned, or even that the cause of their pain is anxiety or stress. This is due to a perpetual lack of understanding of the condition, and a lack of awareness or even belief of the severity of symptoms experienced by women.

Societal taboo has also played a part in delaying efficient diagnosis of endometriosis as many women view their pain as normal, even if it prevents them from performing daily activities. This mentality has been passed down generationally, even by endometriosis patients, causing

stagnation within society in this area, and therefore women who seek help could be seen as weaker or dramatic. This misogyny creates invisible barriers against seeking medical intervention, even in dire situations, demonstrating that increased awareness, particularly amongst young people, is required.

There's no cure currently, treatments for the condition are evolving from rudimentary painkillers to more developed combined hormone therapy and increasing research into how targeting the immune system could relate to the development and treatment of the condition.

There's still a long way to go within the field of women's health, like funding more international and interdisciplinary epidemiological studies. However, these advancements demonstrate that as society and the prominence of women has progressed, particularly in the STEM community, healthcare has grown into a more helpful and secure environment for a variety of individuals. And as more focus and attention is funnelled into the sector, the benefits will only grow exponentially.

GLOSSARY:

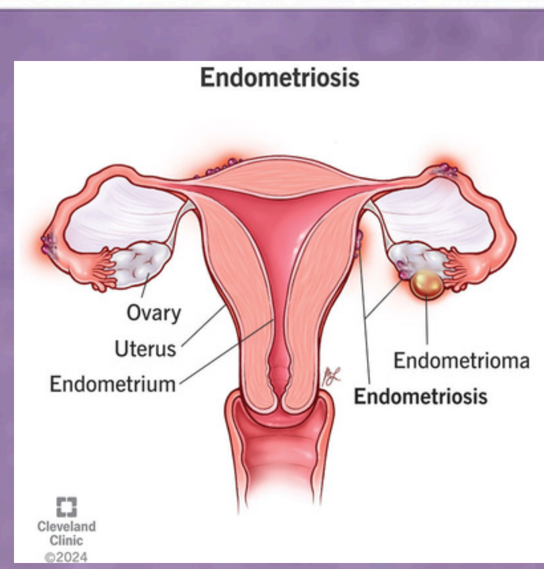
Chronic - (of a disease) persisting for a long time or recurring constantly

Medical misogyny - A prejudice against women in medical fields or a systemic hatred towards them

Stigma - a mark of disgrace associated with a particular circumstance, quality, or person

Hysteria - a cluster of signs and symptoms such as hallucinations, nervousness, and partial paralysis thought to affect only women, from the Victorian era (Greek for uterus)

Hippocratic - of or relating to the Greek physician Hippocrates or to the school of medicine that took his name



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8 The Woman who Ended Sterilisation Abuse in the U.S. -Mishca Cooray

ARTICLE:

Dr Helen Rodríguez Trías - the Architect of reproductive justice (1929-2001), While approximately one third of Puerto Rican women of childbearing age had been sterilised without informed consent, Dr Rodríguez Trías, witnessing this racism became an inspiring advocator to change reproductive health. Her leadership led to the landmark 1979 federal sterilisation guidelines, which mandate informed consent in patients' native language. Beyond this victory she became the first Latina president of the American Public Health Association and a pioneer in HIV care for women and children.

History is full of women who made enormous contributions to medicine, yet their work is often undervalued, underrepresented and underutilised. Women such as Dr. Helen Rodríguez Trías have been at the forefront of advancing health equity. Who is Dr Helen Rodríguez Trías? She is a paediatrician who was the first Latina to be elected President of the American Public Health Association in 1993 and advocated for Puerto Rican women facing eugenic abuse and helped reduce infant mortality.

Rodríguez Trías was born in New York City in 1929 but spent most of her early childhood in Puerto Rico. When she and her family moved back to New York, aged 10, she was faced with racism and discrimination as she grew up a Latina in the city. This experience would shape her future as she combined her two greatest passions: medicine and social justice.

Rodríguez Trías graduated from the University of Puerto Rico. Then in 1960, at the ripe age of 31, she earned her medical degree. During her residency, she founded Puerto Rico's first care centre for newborn babies. Three years later, the island's child mortality rate had been halved.

In 1970, she headed back to New York City and switched her focus from paediatrics to community health. Trías became an active member of the women's health movement and after attending an abortion conference at Barnard College, she decided to focus on reproductive rights. She fought for change in the disproportionate sterilisation of poor women, women of colour, and women with disabilities. White middle-class women were fighting to have access to birth control while poor women of colour were falling victim to sterilisation abuse. In Puerto Rico, from 1937 to 1960, one third of the mothers were being sterilised due to 'population control'; many were falsely convinced or misled into using sterilisation as a method of birth control. Her work in this area led her to draft federal guidelines on sterilisation. She wanted to ensure that sterilisation required a woman's consent and required that they be offered in a language they could fully understand.

To conclude, while we must celebrate achievements of women in science, we must still ensure that we fight for health equity and ensure that her efforts were not in vain. With Helen Rodríguez Trías' passion and courage her work has expanded the range of public health services for women and children in minority and lower income populations of the United States, Central and South America, Africa, Asia and the Middle East.

GLOSSARY:

Discrimination – Unfair treatment of individuals or groups based on characteristics such as race, gender, or social class.

Eugenics- A set of beliefs aimed at controlling reproduction to "improve" the genetic population. done through unethical or coercive means.

Health equity- ensuring fair and equal access to healthcare for all individuals, regardless of background or income.

Infant mortality rate- The number of babies who die before their first birthday, usually measured per 1,000 live births.

Neonatal care- Medical care provided to newborn babies, especially those who are premature or ill.

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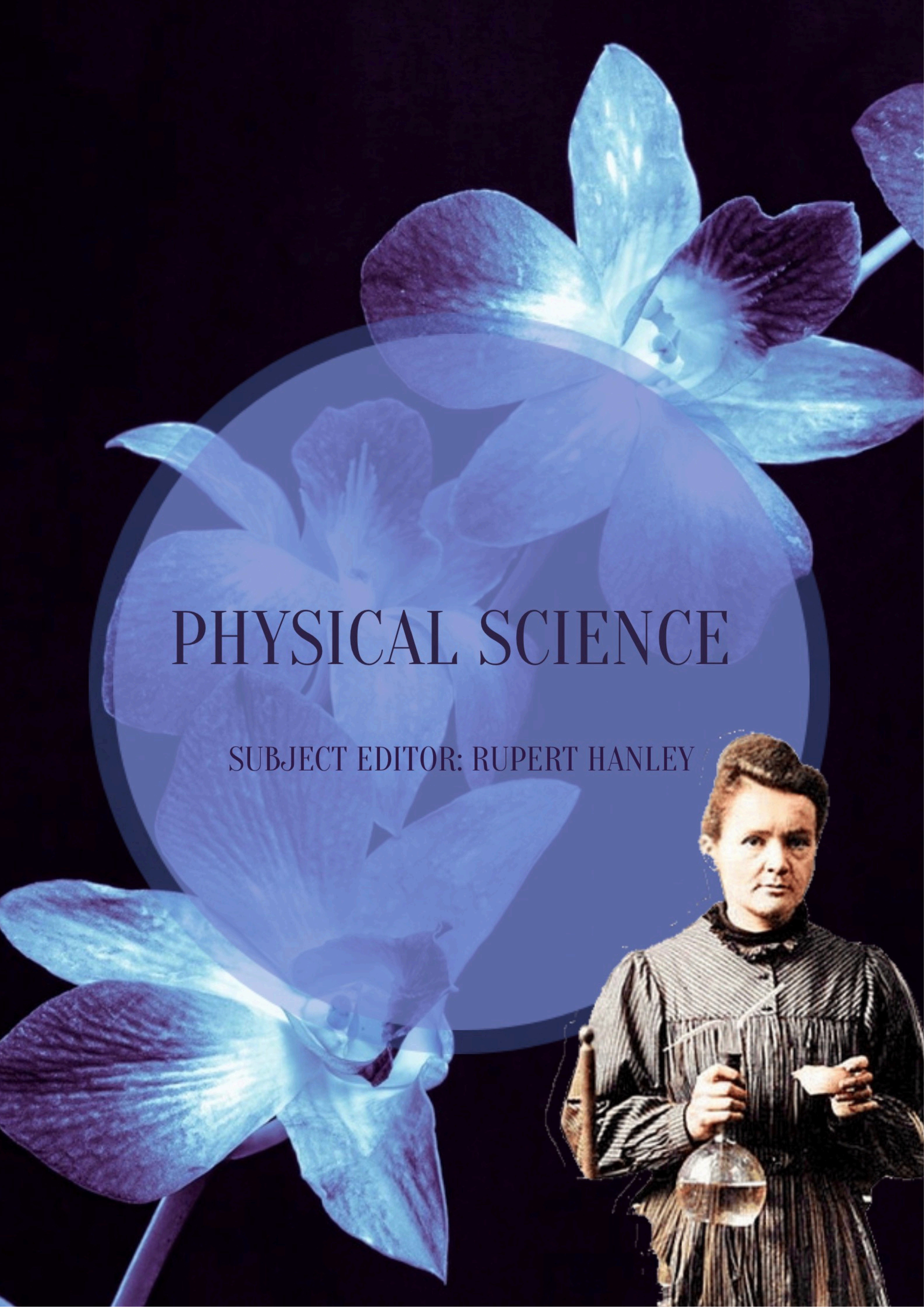


PHYSICAL SCIENCE

SUBJECT EDITOR: RUPERT HANLEY

The only Danish Seismologist -Zofia Fiega

ARTICLE:

'You should know how many incompetent men I had to compete with in vain.' – Inge Lehmann

During a time when women's contributions to science were undervalued, Inge Lehmann managed to transform the way we model the Earth's centre. Lehmann's pioneering insight is an inspiration to all women. It proves that with the power of perseverance, anyone can succeed.

Despite her later experiences with sexism in academia, in her childhood, Lehmann studied at a progressive, mixed-sex school. It was there, where she unearthed her love for mathematics. She attended the universities of Copenhagen, Cambridge and Hamburg and received a degree in mathematics and geodesy. After many years of study, she was appointed state geodesist at the Danish Geodetic Institute.

It was a large earthquake that occurred in New Zealand in 1929 that puzzled Lehmann, causing her to question the composition of the Earth. Some P-waves were picked up at seismic stations in unexpected locations suggesting they may have been deflected by some sort of boundary in the Earth's core. She calculated that these could only be explained if there was a layer at the centre of the Earth's core that was different from the solid core. P-waves would refract differently through solid versus liquid material, which explains the anomalous refraction and signifies the existence of a solid inner core and a molten outer core.

She published her ground-breaking findings in a research paper modestly titled P' which later became the ground evidence for 'the Lehmann Discontinuity'- named after her. It occurs around 200km from the surface. The Lehmann discontinuity is characterized by a change in seismic wave velocities, which indicates a change in the composition or state of the material at the boundary. P-waves face an increase in velocity and S-waves face a change in velocity gradients.

Her work was highly inspiring for geophysicists and seismologists internationally; however Lehmann was the first female state geodesist, and the only woman at the Geodetic Institute who wasn't a secretary or cleaner. Her work didn't gain traction in Denmark as no one worked in seismology and did not see the significance in her findings, reflecting her strong will and desire to break boundaries as a woman in science.

Studies to understand this discontinuity are still ongoing, but it helps us understand the upper mantle better, including how it flows and its composition. Being awarded numerous awards and honours cemented her significance in the sphere of science and demonstrated how many other scientists truly recognised her contribution. In honour of Lehmann, a beetle species- Globicornis (Hadrotoma) ingelehmannae was named after her. I believe it was her unwavering tenacity and sheer passion for seismology that made this all possible.

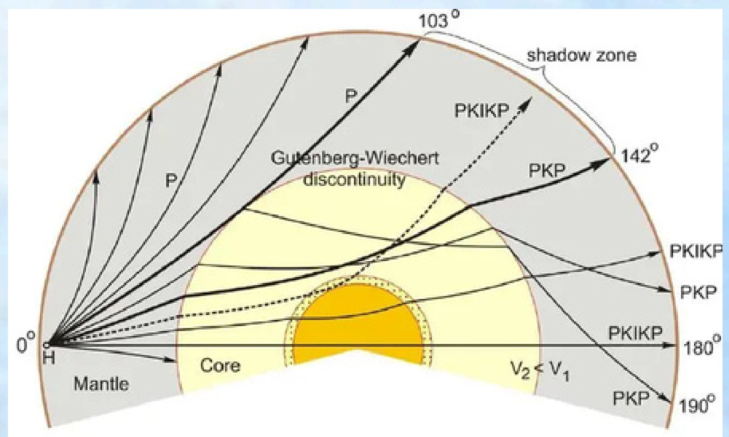
It's important to share and educate ourselves on stories of people like Inge Lehmann- to highlight the magnificent contributions underprivileged communities have made to our lives and our knowledge of science.

GLOSSARY:

Lehmann discontinuity - an abrupt increase of P-wave and S-wave velocities at the depth of 220 km (140 mi) in the earth's mantle

Seismic - relating to earthquakes or other vibrations of the earth and its crust.

Discontinuity- having intervals or gaps; lack of continuity



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Emmy Noether – The Mother of Modern Theoretical Physics -Rupert Hanley

ARTICLE:

"I do not seek to understand that I may believe, but I believe that I may understand." – Emmy Noether 1882-1935[1]

Amongst physicists, Noether is regarded as the intellectual architect of modern theoretical physics. Whilst a single theorem has her name attached to it directly, her influence is intrinsically linked to the entirety of theoretical physics; she revealed why conservation laws exist at all[2]. In doing so, she transformed symmetry into a governing principle of the universe, rather than an aesthetic feature of equations.

Noether's Life

Noether's intellectual authority was moulded within an academic system structured to exclude her. Born in 1882 in Germany, Noether entered university when women were not permitted formal enrolment. She often attended lectures unofficially, sitting in classrooms without institutional recognition. Post doctorate, Noether worked for years without a salary; at the University of Göttingen, at the time one of the world's leading mathematical centres, she lectured under David Hilbert's name because women were barred from holding academic titles. It was only in 1919, after years of marginalisation and casual sexism, that she was formally granted the right to teach.

Her marginalisation did not reflect intellectual deficiency; it reflected prejudice. Noether was the dominant mathematical mind within seminars, her students, later known informally as the "Noether boys" carried her structural methods across Europe and America. Despite it seeming like she had beaten marginalisation through being formally recognised as a professor, in 1933, she was dismissed from Göttingen due to her Jewish heritage under Nazi regime. This forced her to emigrate to the United States, where she continued her work at Bryn Mawr College until her death in 1935.

Noether's Theorem

Emmy Noether fundamentally reshaped theoretical physics through uncovering the relationship between symmetry and conservation laws. In 1918, she proved what is now known as Noether's Theorem, the demonstration that every continuous symmetry of a physical system corresponds to a conserved quantity.

If the laws of physics are invariant under time translation, energy must be conserved. If they are invariant under spatial translation, momentum must be conserved. If they remain unchanged under rotation, angular momentum is conserved. Under Noether's theorem, these once independent laws are unified under a single theoretical framework. This framework does more than explain known laws, it allows theoretical physicists to predict new conserved quantities when new symmetries are proposed.

This theorem now underpins Lagrangian mechanics, quantum field theory and gauge theory; even the work of Einstein in general relativity relies upon symmetry structures defined by Noether's mathematics. In particle physics, conservation laws emerge from invariances under gauge transformations. This concept of gauge symmetry is central to understanding the fundamental forces, demonstrating the significance of Noether's theorem.

Noether's significance as a woman in STEM.

Noether's significance in stem not only lies in her revolutionary mathematics, but her resilience against academic exclusion in a male dominated system. She demonstrated that intellectual authority is independent of gender, pioneering the framework of modern theoretical physics and moulding future generations of mathematicians. Today, Emmy Noether stands as a symbol of academic rigor for women in STEM, showing that excellence is not confined to a single gender.

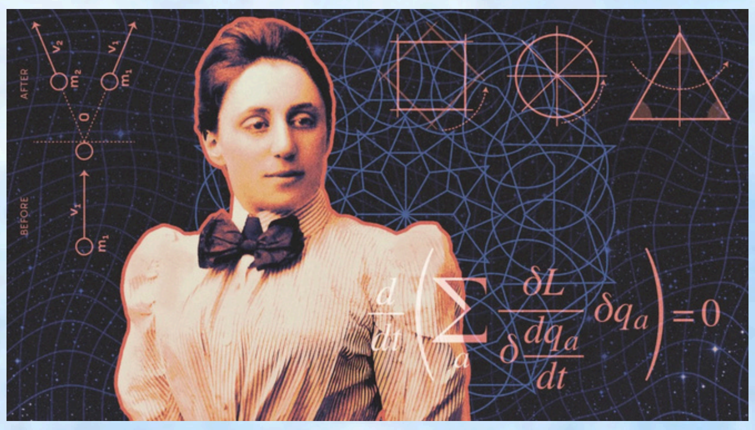
GLOSSARY:

Intrinsically - in an essential or natural way

Angular momentum - the measure of an object's rotational motion, depending on its mass, speed of rotation, and distance from the center of rotation

Lagrangian mechanics - a formulation of classical mechanics that is based on the principle of stationary action and in which energies are used to describe motion

Invariances - The property of remaining unchanged regardless of changes in the conditions of measurement.



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The Curious mind of Marie Curie -Patricia Dinu

ARTICLE:

IIn December 1903, a cohort of scientists at the Royal Swedish Academy of Sciences stood to honour the first woman to ever receive a Nobel Prize, Marie Curie. A decorated career inspired by intrigue and curiosity in a male-dominated field, despite the setbacks that came with simply being a woman, Curie made her mark in history and is now a renowned scientist known- not only for her absolute devotion to the science of radioactivity - but also for actively fighting for her rights to pursue her passion.

"Nothing in life is to be feared; it is only to be understood."
This quote truly encompasses what Curie advocated for throughout her life. Notably, she was awarded Nobel prizes in both Chemistry and Physics, which showcases her passion and thirst for knowledge and seamlessly connects her ideals with her achievements.

Curie and her husband, Pierre, researched invisible rays from uranium after Henri Becquerel discovered these rays could pass through fog, solid objects, and photographic film. While examining rocks that contained uranium—the only radioactive material known then—Curie found a sample that gave off 330 times more radiation than usual. This led her to discover a new radioactive element, which she named 'Polonium' after her home country, Poland. When she removed Polonium from the sample and tested the remaining liquid, it was still very radioactive. This showed there was another unknown element present. The couple published evidence for this second new element, which they named Radium. By 1902, they had successfully separated Radium in the form of Radium Chloride from the mineral Pitchblende. Obtaining Pitchblende was risky because it was a waste product left after industries extracted Uranium, and it was much more radioactive than other materials.

Later in 1911, Marie Curie's determination resulted in another Nobel Prize in recognition of her services to the advancement of chemistry, essentially for the discovery of the method for measuring radioactivity. Her procedure is now known as the "Curie method" with an objective to measure the number of electric charges produced by radioactive rays (which electrify the air) as the number of electric currents produced is proportional to the sample's radioactive emissions.
Curie's contributions to both physics and chemistry were not limited to the academic world but also warfare, particularly as part of the evacuation route for injured soldiers during the First World War. Considering the fact that craters and mud plagued an average battlefield, escorting the wounded to the nearest hospital without them dying of shock or sepsis (due to shrapnel infecting their blood) would be near impossible. Despite this, mobile ambulances containing x-ray machines called "Petits Curies" were able to locate any lodged objects comparably faster than waiting to be brought to a regular hospital. This aid helped save countless lives as doctors were able to perform less intrusive surgery as they knew the precise location of a bullet or a fractured bone, which not only led to advancements in surgery but also the eventual civilian use of X-ray technology.

Ultimately, Marie Curie's passion is also what caused her the most harm, as despite her astonishing accomplishments, the prolonged exposure to radiation had made her terminally ill, resulting in her death in 1943 due to damage to her bone marrow. Nevertheless, today we still remember her dedication to the field of science, where, despite all odds, she was able to thrive in a field designed to work against her.

GLOSSARY:

Radioactive - emitting or relating to the emission of charged particles or waves
Sepsis - a serious condition resulting from the presence of harmful microorganisms in the blood which may lead to death due to shock
Shrapnel - fragments of a bomb, shell, or other object thrown out by an explosion

At the first Solvay Conference (1911), Curie (seated second from right) confers with Henri Poincaré, Rutherford and Einstein

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ENGINEERING & TECH

SUBJECT EDITOR: DION BAHO

Irène Joliot-Curie
-Olivia Brock

ARTICLE:

While many people know of Marie Curie and her research and development of the topic of radioactivity, few know about her daughter, Irène. Irène was, just like her mother, a Nobel prize winner, and she advanced the field of nuclear science in ways that still impact modern technology.

Irène took after her mother, having a passion for science and learning that was instilled in her from a young age. Irène had many advantages from her mother being a Nobel prize winner, and she was enrolled in her mum's rigorous education system. Unlike the opportunities other women got at the time, this allowed her to prove what women can do when given the chance of a great education. She developed deep knowledge in many areas of life, from Chinese scripture to trigonometry, but she showed exceptional talent in mathematics.

Irène and her husband, Frédéric Joliot-Curie, tried many different approaches in the field of chemistry in the 1930s, experimenting on neutrons, positrons and the nature of protons, but they didn't correctly identify what they were looking at and so failed to prove anything. After many years of experimenting, Irène decided to follow in her mother's footsteps and began experimenting with radioactivity, eventually discovering how to make their own radioactive materials in 1934. This was revolutionary at the time, as radioactive materials had just begun to be used in medicine, and a cheap, efficient way to produce them was perfect for the evolving field. This discovery earnt both Irène and her husband the Nobel prize in chemistry and added to the Curie legacy.

Irène had to struggle to be seen behind her mother's shadow, and the challenges of overcoming the issues women faced in STEM at the time were still significant. Irène, however, had not been raised to give in and actively advocated for women's rights, applying to science organisations that she knew wouldn't let her in, just to prove a point, and she attended talks at the International Women's Day conference and tried to get more publicity for women in STEM.

Women in STEM is not just about fairness and including everyone, but about advancing our world through different perspectives. When science is accessible to only one group, we stop growth and prevent progress. This harms everyone and especially disadvantages those who are denied the chance to pursue their passions or receive an education simply because of outdated beliefs. The women of our past fought to change this and proved that women can do anything men can do. We must remember them and ensure their stories are not forgotten.

GLOSSARY:

Positron – The opposite of an electron – it has a positive charge

Trigonometry – The mathematical study of triangle and angle relationships

Radioactivity – When particles emit energy as they decay

STEM – Science, technology, engineering and maths

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Frances Arnold

-Lucas Chen

ARTICLE:

Frances Arnold is a Nobel Prize winning scientist at Caltech who changed chemistry forever. In 2018, she won the Nobel Prize for creating "direct evolution." This method copies the way nature evolves over millions of years but does it quickly in a laboratory. By guiding the evolution of enzymes, she made it possible to create biological tools that are cleaner and more efficient, helping industries move away from toxic chemicals and toward a more sustainable, green future.

For a long time, scientists thought the only way to make a better enzyme was through something called rational design. This meant they had to understand every detail of how a protein was shaped to predict how it would work. But proteins are super complicated, and even a tiny change can make them stop working entirely. In the early 1990s, Frances Arnold realised that humans weren't smart enough to figure out yet, so she decided to use the power of revolution instead. This method she came up with directed revolution, is like a fast forward button for nature. It starts with a gene for a specific enzyme. Scientists purposely cause random mutations in that gene to create a whole bunch of different versions. These versions are put into bacteria, which then grow into different enzymes. Then, scientists test all of them to see which ones are the best at a specific task, like surviving in high heat or breaking down a certain chemical.

The best enzymes are picked, and then the whole process starts over again using those winners as the new starting point. By doing this over and over, Arnold showed that you could "breed" molecules to do things they never did in nature. This was a huge deal because it meant we didn't need to have a perfect map of how every atom moved. We just had to create the right environment for the proteins to change on its own.

Today, Arnold' s work is used everywhere to help the environment. Usually, making chemicals requires heavy metals and lots of energy, which creates a lot of pollution. Because of her work, we can now use enzymes to do these reactions in water at room temperature. This is being used to make everything from eco-friendly jet fuel to medicine that has fewer side effects. It's a way of making chemistry much greener and safer for the planet.

GLOSSARY:

Direct Evolution- A lab method that copies natural selection to create proteins with specific traits that scientists want

Enzyme- A type of protein that acts as a catalyst to speed up reactions in species

Biocatalyst- Using natural things like enzymes to make chemical reaction happen faster

Rational Design- An older way of trying to change proteins by predicting how their structure should look

Selection Pressure- The specific test that decides which proteins "survive"

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The Mathematical Key Behind the Moon Landing: Katherine Johnson at NASA

-Omari Khushall

ARTICLE:

Katherine Johnson was a mathematician who did important work for the United States space program. She worked at NACA and NASA. Used maths to disentangle the best paths for spacecraft to take. Katherine Johnson applied math to lots of things, like getting spacecraft into orbit and bringing them back to earth safely.

Her work was immensely consequential, for the Mercury, Gemini and Apollo programs. Katherine Johnson helped make sure that the maths used for space travel was inherently absolute, and this helped make it possible for people to explore space.

Katherine Johnson was a mathematician from America. She did important work in aerospace research. This work changed the way the United States thought about space travel. Katherine Johnson's job was about using maths to solve real problems. She liked to work with numbers and shapes. She was exemplary at figuring out the paths that objects take in space. Katherine Johnson also worked on navigation, which is like giving directions to spaceships. She worked at the National Advisory Committee for Aeronautics. Then, at NASA. At NASA, Katherine Johnson's work was very important because small mistakes could cause dire problems.

Johnson started out doing maths problems by hand. She looked at the data from flights. Pondered up equations that showed how planes and spacecraft moved. Johnson was really good at picturing shapes. How they moved. This helped her figure out problems that were hard for other people to understand. She took the things that happened during flights. Turned them into math problems that engineers could use. Johnson did a job of turning flight information into maths that people could work with.

She did some important work on trajectory analysis. This is the study of the path something follows. She figured out when it was best to launch a spacecraft and what path they should take to get to where they're going. She also determined where they should land. To do all of this, she used some maths that is based on the way things move and the force of gravity.

She used equations to understand the curvy paths that objects take when they are orbiting something. She also used systems of equations to model how fast something is going, how fast it is speeding up or slowing down and the force of gravity that is acting on it. When it was time for the spacecraft to come back to Earth, she considered the fact that the Earth is rotating, that there is air resistance and that everything is connected and moving together. This helped her find a path for the spacecraft to follow as it came back down to trajectory analysis and landed safely on Earth with trajectory analysis.

During Project Mercury Johnson figured out the path for Alan Shepard's flight that did not go all the way around the earth. She found the spot where the capsule would land in the water. Johnson did her work when John Glenn went all the way around the earth. When people were not sure about the results from the computers, Glenn asked Johnson to check the math for the orbit by hand. Johnson was very careful when she did the math again. She made sure the numbers were right. The mission did not start until Johnson said it was okay.

Johnson was important for the Apollo program. She did a lot of work to figure out the paths for the Command Module and the Lunar Module to meet up. This was not easy because it required her to change coordinates between two kinds of systems. The Apollo program needed this information to plan for emergencies. Johnson's work was used during the Apollo 13 mission to help with navigation. The Apollo program was a deal, and Johnson played a key role in it.

Johnson did a lot more than just work on missions. Johnson helped make sure that aerospace engineering was based on math. Johnson wrote papers with other people that created standards for figuring out the path something would take and for analysing mistakes. The work that Johnson did made human spaceflight more reliable. Johnson made a difference in the field of human

GLOSSARY:

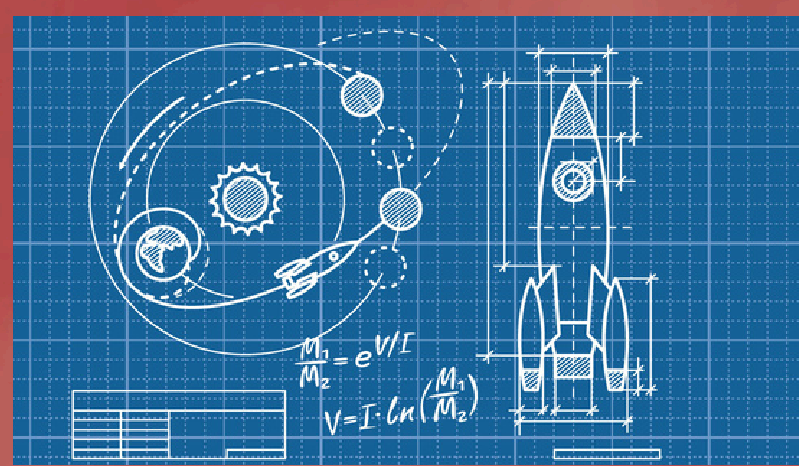
Immensely: adverb; to a great degree, extremely, hugely, or vastly.

Consequential: Following as a result or effect.

Absolute: Not qualified or diminished in any way.

Exemplary: Serving as a desirable model; very good.

Inherent: something that is permanent, i.e something that will definitely happen.



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LIFE SCIENCE

SUBJECT EDITOR: NADIA VIRCHENKO

18

The Discovery of Jumping Genes

-Avantika Singh

ARTICLE:

Barbara McClintock was an American geneticist whose pioneering work on maize led to the discovery of 'jumping genes' (transposable elements) [5]. In the 1940s, she found that genes can move between chromosomes – a radical idea at the time, that challenged the prevailing belief that genes are fixed in place. Although her discovery was initially greeted with scepticism, it revolutionised genetics and earned McClintock the 1983 Nobel Prize in Physiology or Medicine

Early Cytogenetic Breakthroughs

McClintock's career in genetics began at Cornell University, where she helped establish maize as a model for studying chromosomes. In 1931, working with graduate student Harriet Creighton, she provided the first experimental proof that genes are physically located on chromosomes and can be exchanged by 'crossing over' during reproduction. This was a major validation of the chromosomal theory of inheritance (the idea that genes permanently reside on chromosomes). McClintock also identified special regions of chromosomes – the telomeres at each end, and centromeres in the middle – which are essential for the proper inheritance of genetic material. By 1944, her contributions had earned her election to the U.S. National Academy of Sciences, a rare honour for a female scientist

Discovery of 'Jumping Genes'

In the 1940s, at the Cold Spring Harbor Laboratory, McClintock noticed unusual mottled colour patterns in maize kernels, which defied normal genetic explanations [4]. Conventional science held that once a gene mutated (for example, changing a kernel's colour from purple to white), the change was permanent in that lineage [1]. Yet, some corn kernels were not uniformly white or purple, but spotted with both colours. McClintock deduced that a genetic element had 'jumped' into the pigment-producing gene, turning it off (resulting in a white patch) and later jumped out in some cells, restoring the gene's function and purple colour [1]. McClintock discovered that two genetic 'controlling elements' were responsible for this effect. She identified one element, which she named Dissociation (Ds), that could insert into a pigment gene and switch it off, and a second element, Activator (Ac), which was needed to trigger Ds to move [2]. Together, this Ac/Ds pair formed a two-part system that toggled other genes on and off, producing the spotted kernel patterns.

Significance of the Transposon Discovery

Before McClintock's work, biologists assumed that genes were stable, unchanging parts of chromosomes. Her discovery overturned this notion by revealing a genome that is dynamic and can reorganise itself. She realised that such 'jumping genes' provide a mechanism for genetic innovation and adaptation, but warned that transposition can disrupt genes and cause diseases like cancer [3]. Later research showed that transposons in bacteria can spread antibiotic resistance genes, underlining their role in evolution and medicine. Today, transposons are known to be ubiquitous in living organisms and a fundamental force in genetics [2].

Scepticism and Later Recognition

In 1951, when McClintock first presented her findings, most scientists reacted with disbelief or confusion [1]. Discouraged by this response, she largely stopped publishing on transposition after 1953, although she continued her maize experiments quietly [5]. By the late 1960s, however, other researchers had observed a mobile genetic element in microorganisms and animals, vindicating McClintock's conclusions. In 1983, more than 30 years after her discovery, McClintock was awarded the Nobel Prize in Physiology or Medicine, finally receiving widespread recognition for her ground-breaking work [1].

GLOSSARY:

Centromere – The central region of a chromosome where two chromatids are joined and spindle fibres attach during cell division

Chromosomal theory of inheritance – The scientific idea that genes are located on chromosomes and passed from parents to offspring

Cytogenetics – A branch of genetics that studies chromosomes under a microscope and how they behave during cell division

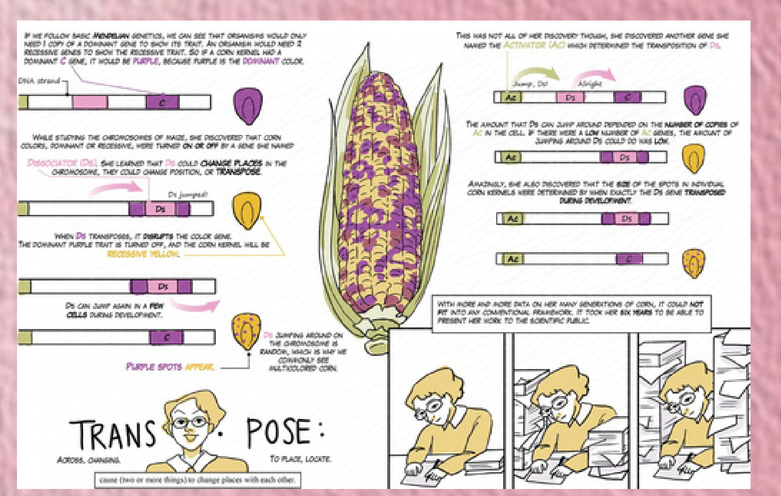
Gene – A section of DNA that within a genome that carries a specific set of information

Mutation lineage – a line of cells carrying the same mutation

Telomere – The protective end region of a chromosome that prevents DNA damage during replication

Ubiquitous – present everywhere

Vindicated – proven correct after earlier doubt (used in scientific context)



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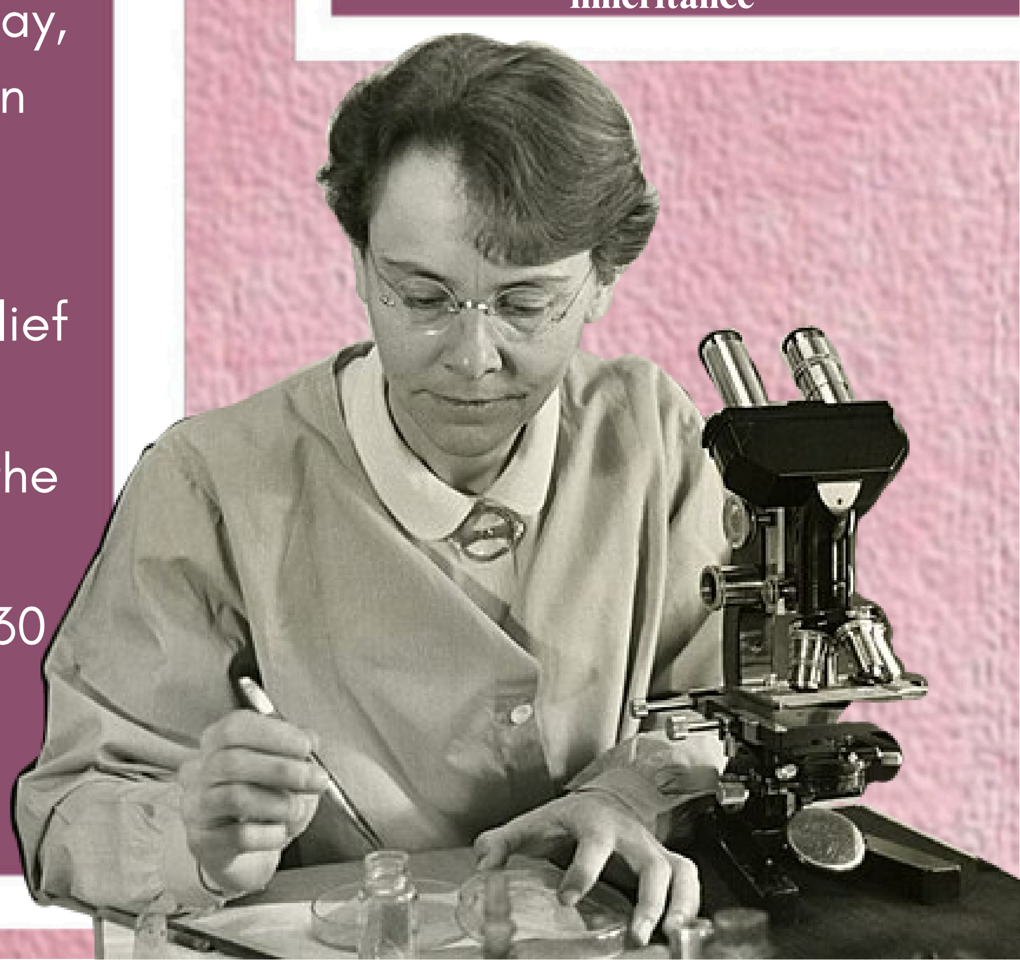


Elizabeth Blackburn: the first Australian woman to win a Nobel prize

-Alex Dixon

ARTICLE:

Elizabeth Blackburn was born in Hobart, Tasmania in 1948 before relocating to Launceston. Later, her family relocated to Melbourne, where Elizabeth attended the university of Melbourne, studying biochemistry. In 1975, she earned her PhD from the university of Cambridge. She led important discoveries and research into telomeres and went on to discover the enzyme telomerase in later life.

Article: Following the attainment of her PhD from Darwin college at the university of Cambridge, Blackburn began work at Yale. While researching the protozoan Tetrahymena thermophila, she found a repeating codon on the end of the rRNA strand which varied in size. She then realised that this hexanucleotide at the end of this chromosome had a TTAGGG sequence which was repeated tandemly, and also found that the ends of the chromosomes were palindromic. These breakthroughs allowed Blackburn and her colleague Jack Szostak to show that the unstable replicated plasmids of yeast were immune to degrading – a characteristic of telomeres. This showed that this TTAGGG sequence is a characteristic of these telomeres.

This led to further research, resulting in the discovery of an enzyme, which could fill the terminal ends of telomeres without making these chromosomes unable to function as they should. Soon after, this enzyme was purified in a lab, which found that the enzyme contained RNA and protein components – the RNA section acted as a template for adding the end portions of the telomere, while the protein sections carried out the enzymatic function of these additions. This enzyme was named “telomerase” and the end-replication process had finally been solved after years of confusion across the scientific community.

This telomerase enzyme works by adding base pairs to the overlap of DNA on the 3’ end, extending the strand so that DNA polymerase and RNA primer can complete the complementary strand and synthesise the DNA. Due to the fact that DNA polymerase only synthesises DNA in the leading strand direction, the telomere shortens, and telomerase comes in to replenish the telomere, conserving cellular division, stopping the loss of genetic information and therefore slowing cellular aging.

Her discoveries led to real world uses in cancer treatment, as when telomerase is added to cancer cells, it provides an immunity to proliferating, linking the enzyme activity to increased cellular growth and reduced sensitivity to cellular signalling. Telomeres are believed to have an important role in cancers such as bone, lung and kidney. The discovery of the importance of this enzyme lead to Blackburn’s ongoing research at the university of San Francisco, where she is looking into the effects of telomerase activity on cellular aging.

Throughout her life she has received many awards, the most prestigious being her Nobel prize in physiology and medicine, which was awarded to her (and her colleagues Carol Greider and Jack Szostak) in 2009.

To conclude, Blackburn’s work was crucial to solving the ongoing scientific confusion at the time, concerning the “end replication problem” and her work is also being used in the modern day in cancer research, displaying the importance and significant impact her work has had.

GLOSSARY:

Protozoan: single celled, eukaryotic organisms

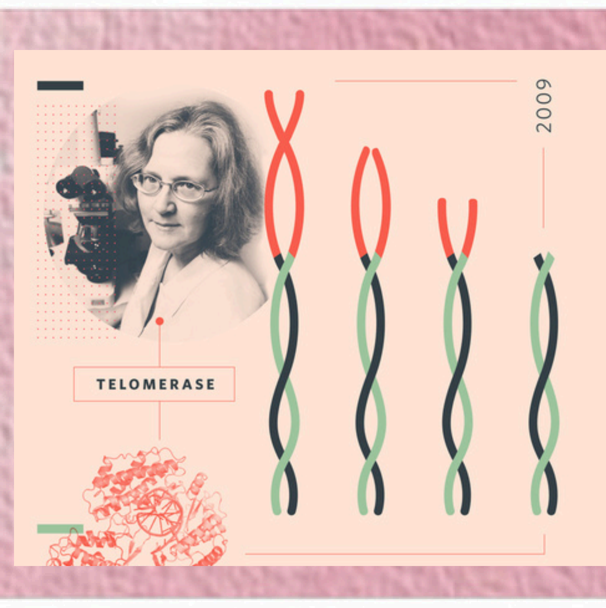
Codon: sequence of 3 DNA/RNA bases

Hexanucleotide: polymer consisting of six linked nucleotides

Palindromic: something that is read the same both forward and backwards

Telomeres: protective ‘caps’ of repeating DNA/proteins at the end of chromosomes

RNA: Ribonucleic acid, a single stranded nucleic acid



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Tu Youyou's cure for cancer -Zuleika Khoeshal

ARTICLE:

May 28th, 1967. Vietnam was already in the midst of a treacherous war with the USA, severely underarmed and underfunded against the advanced weaponry and training the US soldiers had undergone, when they faced another disadvantage. Malaria swept through the soldiers, forcing North Vietnam to send a plea for help to China for a cure. Thus, project 523 was born.

Two years after the launch of this secret project dedicated to finding the cure for malaria, a woman called Tu Youyou was appointed the head of project 523, after leading the research at the Academy of Traditional Chinese Medicine. Tu Youyou and her team identified 640 plants and more than 2000 remedies with potential antimalarial properties and subsequently tested 380 extracts for their ability to rid malaria-causing Plasmodium parasites from the blood of mice.1 During her research, Tu Youyou decided to delve further into ancient medical texts to investigate the traditional methods of fighting malaria and came across a reference to a plant called sweet wormwood. This was used in 400 AD across China to treat 'intermittent fevers' - a symptom prevalent in malaria patients.2 However, the team didn't initially get far at successfully isolating the active agent which cured malaria, as they were attempting to extract Artemisinin by heating, or using ethanol. It wasn't until Tu came across one sentence from 'Zhou Hou Bei Ji Fan' (a handbook of TCM prescriptions), that she decided to abandon western methods for extracting active Artemisinin. The book stated that patients were asked to steep a hold of Artemisinin in 2 litres of water and twist the Artemisinin, take the juice and drink it up. After following the process described in the book, they managed to distil a drug which had a 100% recovery rate.3

As a direct result of her monumental discovery, over 200 million patients have received Artemisinin combination therapies.

Tu Youyou was inspired to pursue a career in medicine after contracting tuberculosis at the age of 16 and being withdrawn from school for 2 years until she fully recovered. After this, she dedicated herself to a lifetime in medicine. Tu Youyou's work acts as an inspiration to millions of people around the world, because despite not having a PHD, she is responsible for a landmark achievement that reshaped modern medicine as we know it today. In 2015, she became the first Chinese woman to be awarded a Nobel Prize in the scientific category, and in her speech, she accredited her groundbreaking discovery as 'a gift from Chinese medicine to the world', reflecting her sense of duty and selflessness.

GLOSSARY:

Artemisinin – A natural compound used in medicine to treat malaria.

TCM – A system of medicine that originated in China years ago.

Intermittent fever – A fever that comes and goes back to normal.

Plasmodium parasites – Microscopic single-celled parasites that cause malaria.

Steep – to soak a substance in a liquid for a period of time to extract its active components.

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