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WOMEN IN ENGINEERING

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | AUGUST 2021

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Dear Valued wattnow reader

This issue features Women in Engineering. In celebrating my tenth year at the SAIEE AND celebrating Women's Month - it made me feel proud to be associated with such dynamic women.

Our first feature article sports a showcase of some of our SAIEE female members and a brief profile. Thank you to those who send me their profiles - you rock! Find this article on page 18.

On page 26, I share with you eight women in STEM at the forefront of the world's response to COVID-19. Women across the world have made an enormous contribution to the global efforts to tackle COVID-19. Not only do women make up 70% of the world's health workers and first responders, but women in STEM fields have also been leading research into the virus, creating trackers and developing vaccines.

Female retention in engineering remains a persistent problem. Even after overcoming hurdles to enter the profession, women leave at much higher rates than men, often because of the stress of being female in a male-dominated field. Read this article on page 30 on how to overcome these stressors.

Dudley Basson compiled a brilliant masterpiece on Women in History. Find this article on page 36.

I wish all our female readers a fabulous Women's Day - may you have a blessed month!

Herewith the August issue; enjoy the read!

Minx

Sanitary Towels Drive

Many disadvantaged girls miss most of their academic days in a year due to unaffordability of sanitary products, with most using unhygienic materials which poses a health risk. SAIEE Women in Engineering would like you to join them in celebrating Women's month by touching the lives of schoolgirls from Gauteng Settlements.

Please help us in keeping the girls in school during their periods so that they can commit to their education and positive future.

SAIEE
WOMEN IN ENGINEERING CHAPTER

HOW YOU CAN HELP

Make a monetary donation and we will buy the sanitary packs and drop off at the Gauteng Settlements (any generous amount will be highly appreciated):

Account details:
SAIEE Central Gauteng
Standard Bank
Account number: 200089854
Account type: Current Account
Branch name: The Glen
Reference: Your Name-Sanitary Drive

Please send proof of payment to: cgc@saiee.org.za

#DignityForGirls
#StaySafe
#keepingGirlsInSchool

Deadline for Donations: 15 August 2021

SAIEE
WOMEN IN ENGINEERING CHAPTER

www.saiee.org.za

Dear Valuable SAIEE member,

SAIEE CHARGE REWARD PROGRAMME

Dear SAIEE member,

I hope that you receive this letter in good health and spirits.

The Charge Reward Program is now in full swing since being introduced, with members in good standing eligible to gain points for attending SAIEE events. This process is automatic for you and the appropriate points are allocated post-attendance. Please remember to use the unique hyperlink that was sent to you to check the number of points that you have already accumulated.

A bug was detected in the system in the last few months whereby intended accumulation and redemption points for various activities were incorrectly programmed into the system, allowing members to gain far more points than was intended. This was subsequently corrected, and you can rest assured that the points allocated to you do stand. Redemption opportunities were also revised to align them with the actual cost of the service. Do remember that we are constantly refining the program to ensure that you get the most out of it and your SAIEE membership.

The Program operates on a 5-year cycle starting from 01 December 2019. Members will be able to accumulate points for 5 years, after which the points are reset to 0 and a new 5-year cycle begins. Within the 5-year cycle members can redeem points for listed redemption (discharge) events. The matrix for Charge and Discharge events is shown elsewhere in this publication.

Wishing you all the best in Charging up!

Yours Sincerely,

For more information, on how this programme works, click here.

Yours faithfully,

Leanetse Matutoane
Acting CEO

CHARGE REWARD PROGRAMME





MEMBER LOYALTY

We appreciate our Member's support for 110 years

REWARD

A unique reward programme exclusive to SAIEE Members

FEEDBACK

We received your feedback and we listened to added benefits

EARN POINTS

Earn Charge Rewards by attending events, courses or writing articles

SATISFACTION

We want you, our Valued Member to feel satisfied when working with us





LOYALTY PROGRAM

Redeem your Charge Points towards CPD credits

QUALITY

We guarantee top quality events, courses, and services

SERVICE

We are here to serve you, our Valued Member better

RESPECT

We respect you and want to see value for your hard-earned money

SUPPORT

We are here to answer any queries you might have

For more information:

Visit your Membership Porthole on the SAIEE Website:
www.saiee.org.za

Alternatively, call Connie on 011 487 3003.

SAIEE
CHARGE
rewards programme

INDUSTRY AFFAIRS

Introducing our SAIEE Central Gauteng Center Committee Members

The SAIEE Central Gauteng Centre (CGC) is proud to introduce its 2021 committee. They are:

CHAIRPERSON: SHARON MUSHABE

Sharon has been a member of CGC for over three years and has volunteered much of her time to the position of Deputy Chairperson and, most recently, Chairperson. She will be leading the centre in 2021 to some significant initiatives.

DEPUTY CHAIRPERSON: SICELO MABUZA

Sicelo has been with CGC for three years and has previously led the Technology knowledge and leadership portfolio, and has been the Deputy Secretary. As Deputy Chairperson, he will assist Sharon in her role while supporting the committee.

PAST CHAIRPERSON: TEBOHO MACHABE

Teboho has been an involved member of CGC for five years. In 2019 CGC won the centre of the year under his chairmanship. He will use this experience to advise our 2021 CGC committee while serving as the lead for the Governance portfolio.

TREASURER: DONALD MOSHOESHOE

Donald has been part of CGC for the past three years. He has served as Secretary and Deputy Chairperson. This year, he will be the treasurer for CGC maintaining the finances and financial records.

TECHNOLOGY, KNOWLEDGE AND LEADERSHIP: KEITH KATYORA

Keith has been part of CGC for the past year. This year he will be leading the TKL portfolio, focusing on bringing new exciting activities and promoting innovation within the industry.

EDUCATION & TRAINING: DR LESEDI MASISI

Dr Lesedi Masisi has been part of CGC for the past four years leading the Education and Training Portfolio. He has been responsible for establishing and reviving student chapters.

SECRETARY:
CHRISTINAH MOHLOKI

Christinah has been involved with CGC for over four years, starting her term as Treasurer. She had since been the event and marketing portfolio lead and will be taking the role of secretariat.

CSI PORTFOLIO LEAD:
NEO MAPAPANYANE

Neo is one of the members who joined CGC last year in March and was appointed to lead the CSI portfolio for the year 2021/22 financial year. Our main objective is to give back to the communities that made us!

EVENTS AND MARKETING:
MANTSIE HLAKUDI

Mantsie is one of our newest members to join the CGC committee; with only one year under her belt, she is already leading the Events and Marketing portfolio. She will provide our members with information regarding upcoming events and other opportunities.

CO-OPTED MEMBER:
MAITE SAKO

Maite has been part of CGC for the past 3 years and has spent the last two years as a treasurer of CGC, maintaining finances and keeping the financial records on point. She joined the committee in an advisory role. wn

Multi-application Guided Wave Radar Level Transmitters

INSTROTECH offers Kobold's NGR, a robust, maintenance-free level sensor that uses TDR technology (time domain reflectometry) for the precise level measurement and monitoring of oil- and water- based liquids, grinding and hydraulic oils as well as mixtures with cleaning, degreasing and care products. The NGR can also work in deposit-forming and foaming liquids.

The NGR's guided radar uses time-off-light technology to measure electromagnetic pulses. The time difference between the sent pulse and the reflected pulse is used to calculate the level, both as a continuous value (analogue output) and a free position switching point (switching output).

For more info, click here. wn

KOBOLD's NGR Multi-application Guided Wave Radar Level Transmitters

Turning unwanted assets into Covid-19 relief funding

Ciena Bester of the South African Institute of Auctioneers

Companies with their backs to the wall due to Covid-19 lockdown restrictions are turning to auctions to raise much needed capital without changing the fundamentals of the business.

Auctioning of unwanted assets provides a quick and safe way to inject capital into an ailing business, especially where business finance is difficult to obtain or cash is needed in a hurry. Raising cash in this manner has the added advantage of minimising debt where repayment of bank loans can become problematic in cash strapped situations.

According to Ciena Bester of the South African Institute of Auctioneers (SAIA) there are a number of compelling reasons why businesses should consider a spring-clean to clear out unused or unwanted assets. There are fewer risks involved in selling goods at an auction, the seller exchanges goods for cash and the items are sold as is where it stands.

EASY STEPS

"The process is so simple and requires an asset list to be compiled and verified by the auctioneer to ensure that all items are present and saleable and that they understand the sellers' expectations. The next step is to sign a mandate that clearly stipulates the terms of engagement and allows the auctioneer to sell the items and to clarify the terms of conditions and requirements for the buyers.

"The auctioneer will then put together a catalogue or auction list and commence advertising in appropriate media during the run up to the auction. All items will be sold on auction day to the highest bidder as per the seller's confirmation.

The buyer then has a certain number of days to pay and remove his goods, transfer ownership and complete his transactions. The auctioneer will then complete and close the said auction and pay his sellers.

"Auctions enable you to buy goods in bulk at a reasonable price, some buyers can pick up great bargains if they time their buy correctly. However, it is worth noting that potential buyers must ensure that they know what they are buying as there are no refunds and no guarantees. Auctions are the only true reflection of the real value of an asset as the buyers will not pay more than the item is worth.

FASTER OPTION

"It is also important to note that speed of the sale is one of the main benefits, while other factors such as convenience and the safety of the seller also make auctions a more attractive option than selling out-of-hand. Companies can also move equipment or stock in bulk batches or even sell all their stock or assets in one auction," says Ciena.

She adds that there is almost no limit to what can be auctioned, if someone wants it, they will go out and buy it. Most auctioneers sell moveable assets including furniture, tools, loose goods, vehicles, plant hire equipment as well as immovable property in the commercial as well as residential markets, while others specialize in the fine arts, wine and almost anything else.

However, the most critical element of the sale is choosing a professional auctioneer who is a member of a professional body like SAIA, that ensures its member auctioneers adhere to a strict code of conduct that aligns them to a uniform way of conducting their business in a fair and just way.

PROFESSIONALS ONLY

"Dealing with SAIA members also offers peace of mind in the knowledge that the company is dealing with trained, professional auctioneers with the required expertise and infrastructure needed to fetch the best prices and ensure successful sales and prompt payment," Ciena concludes. wn

Sustenergy Training Academy partnership brings energy certification to Zimbabwe

Dr Fortunate Farirai
Founder and owner of Sustenergy Training Academy

The Institute of Energy Professionals Africa (IEPA) is proud to announce a partnership with Zimbabwe-based Sustenergy Training Academy to deploy Association of Energy Engineers (AEE) Certification programs and other IEPA training opportunities in the country. IEPA is based in South Africa and represents AEE in Sub-Saharan Africa, and deploys AEE Certification programs in partnership with training providers across the region.

Sustenergy Training Academy is a registered division of Sustenergy, an energy company that focuses on exploring renewable energy technologies to provide clean, modern, safe and affordable energy globally.

The company was founded and headed by Dr Fortunate Farirai, an experienced energy engineering professional registered as a professional engineer with the Engineering Council of Zimbabwe and Zimbabwe Institution of Engineers and an associate member of the Zimbabwe Academy of Sciences. She holds a PhD in Engineering from Wits, obtained her MSc in Renewable Energy Engineering from the University of Zimbabwe, and a BSc in Chemical Technology from the Midlands State University Zimbabwe.

IEPA has been delivering AEE Certification programs in the Sub-Saharan African region for almost 20 years now, previously under a different name. AEE programs available at Sustenergy Training Academy in Zimbabwe include; Certified Energy Manager (CEM), Certified Energy Auditor (CEA), Certified Measurement and Verification Professional (CMVP), Certified Renewable Energy Professional (REP), Certified Water Efficiency Professional (CWEP), Certified Carbon Auditing Professional (CAP), Certified Industrial Energy Professional (CIEP), Certified Lighting Efficiency Professional (CLEP) and Certified Business Energy Professional (BEP). Trainers and content will be quality controlled by IEPA, and all programs are available for in-house in-person or online training. wn

PARATUS ZAMBIA DATA CENTER FACILITIES OPEN TO MULTINATIONALS

Paratus, a leading provider of quality business communication and hosting services is opening a new state-of-the-art data center in the heart of Lusaka. Thanks to cloud computing, this data center not only offers state-of-the-art services to Zambia-based businesses, but also to multinationals that operate in Zambia. Business owners of international companies are assured of safe storage and access to their most valuable asset: their data.

Paratus Zambia MD, Marius van Vuuren says: "Through our investment in infrastructure, we are demonstrating our commitment to deliver the best quality services across SADC. While there are other data centers in Zambia, they are not of this quality, standard and capacity. Multinationals will be given peace of mind knowing their data will be utterly secure at all times in such a world class facility."

As a multinational, considering the off-site move to a data center may seem like an immense task. However, the long-term benefits of hosting at Paratus Zambia's data center are unlimited. Moving data off-site to a fully secured facility not only guarantees enhanced processing and protection of data, but offers redundancies on connectivity, power, cooling and features fire suppression and security capabilities with which traditional onsite setups could struggle. The carrier neutral facility will offer various physical and virtual hosting services as well as opportunities for Content Delivery Networks (CDNs) to help provide high-availability, faster performance, and security to websites within Zambia and in the region. wn

Booyco CXS PDS Spreads Wings into South America

South African proximity detection system (PDS) specialist Booyco Electronics has further extended its global reach with a recent contract to a surface gold mine in Chile.

The Booyco CXS has leveraged technology to achieve new levels in safety

According to Anton Lourens, CEO of Booyco Electronics, over 50 of its market-leading Booyco CXS systems have been installed on vehicles and other machinery on the mine. The installations followed a demanding testing phase which confirmed the customer's trust in the technology. The project was carried out in collaboration with Booyco Electronics' distributor in the region – mining and industrial technology company Insucam.

"South America is a key focus in our drive to open markets abroad, so we are excited about the take-up of our latest CXS offering in that region," says Lourens. "Safety on site is always a core concern for mines, and we value the opportunity to help them ensure that all their teams get home safely at the end of every day."

Carlos Pinto Reyes, business development and new technologies manager at Insucam, says the customer analysed several systems in the market, finding that the Booyco CXS gave them the greatest reliability.

This latest generation offering is built on Booyco Electronics' pioneering role in developing PDS solutions for over 15 years. Ongoing product improvement has allowed the company to continuously enhance its features and functionality, creating a best-in-class product.

"After the installation of the Booyco Electronics CXS systems, every operator on the mine is aware of the exact location of machines and their distance away," says Pinto Reyes. "They are quickly alerted to any possibility of collision, as the system tracks the trajectory, speed and position of each machine. Operators also appreciate how intuitive the system is, while not overwhelming them with persistent sounds."

He highlights that the Booyco Electronics CXS uses direct GPS signals from three constellations of satellites to determine spatial positions, so it is not reliant on the GPRS coverage used by mobile phones. This is an important advantage for mines located in remote areas without reliable GPRS signal. Lourens emphasises that the success of Booyco Electronics has been based on its high level of support wherever its products are installed, through which it builds long-term relationships.

"We therefore partner with credible companies like Insucam, with the requisite technical skills, resources and footprint to ensure the optimal performance of our PDS products," he says.

Insucam has over a decade of experience in systems to improve the operation of mining machinery, and serves customers in South American countries including Chile, Peru, Colombia and Mexico. The technology advances made by Booyco Electronics' CXS solution elevates it from being a warning system only to being a fully-fledged collision avoidance system – avoiding collisions between vehicles or between pedestrians and vehicles. It therefore provides a comprehensive and integrated response to Level 7, Level 8 and Level 9 safety levels – as defined by the Earth Moving Equipment Safety Round Table (EMESRT). wn

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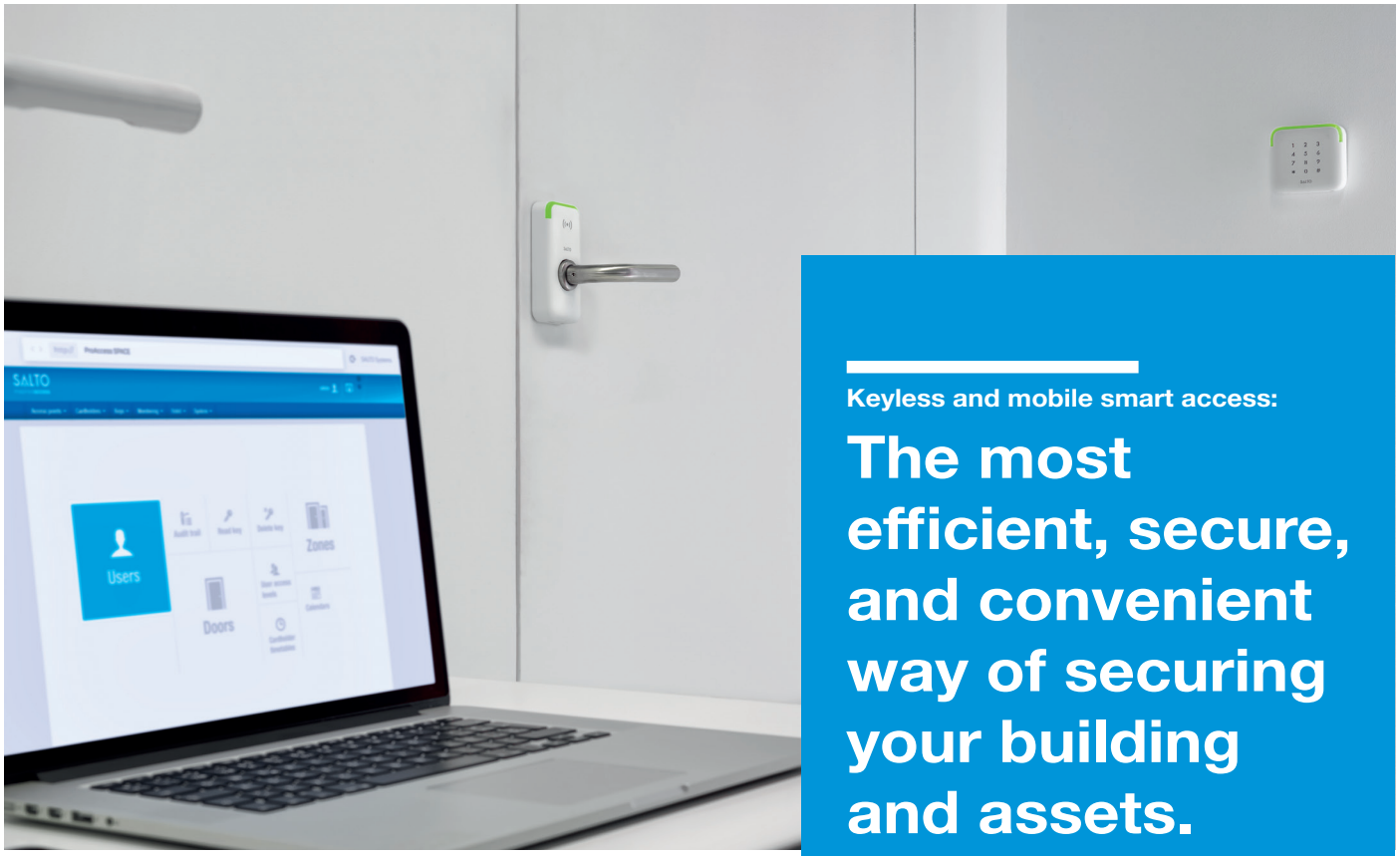

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SAIEE WiE Celebrates International Women in Engineering Day

The SAIEE Women in Engineering Chapter celebrated the International Women in Engineering Day on the 6th July 2021 with a webinar titled "Engineering Heroes". International Women in Engineering Day (INWED) provides a clear call to women to shape the world. Taking place annually on 23rd June, INWED is an international awareness campaign celebrating the work and achievements of women engineers. It has been running for the past eight years, and this year it celebrated the fantastic work that female engineers around the world do to improve the life of others and the society we live in.

BY | SAIEE WOMEN IN ENGINEERING CHAPTER

One of the reasons why women shy away from a career within the engineering field is often cited as a lack of role models. However, the reality is that our engineering heroes are often unsung. SAIEE WiE took an opportunity to look back on everything women have accomplished in engineering and their role to show women and girls that there is a place for them in the engineering industry.

We did this through a round table (webinar) discussion with three female engineers with diverse backgrounds sharing projects that have improved the lives of the society we live in. As lead engineers or managers in their respective engineering fields, they were fortunate to work on complex, challenging and rewarding projects that made a difference to the world.

Fatima Baloyi
Network Planning Engineer

Prudence Madiba
Senior Manager, Eskom

Petunia Seele
Managing Director, Standolan

Mpho Mahlamvu
Infrastructure Asset Management Executive

Projects that involved bringing water to the community, telematrix systems for a water treatment plant, development of ICT (Information and Communication Technologies) infrastructure for public infrastructure and Power stations mega projects. Unique opportunities exist to enable the next generation of female engineers to enable purpose-driven technological innovation with impactful societal wellbeing.

We discussed various questions like projects that have made a difference in our society, uplifting other upcoming female engineers, women in the engineering sector that have played a pivotal role in others' career growth, and changing women's workplace stereotypes. What resilience strategies can be adopted to retain female engineers?

From the discussions, role models, both Men and Women have opened up their minds and made them see that they can achieve things that they thought were unachievable.

Role models can pave the way, guide you on how to get to the top and achieve your goals. It was further noted that everyone is different with different needs, and role models inspire us with different characteristics.

As a result, we have to ensure that the role models we make visible represent as much diversity as possible to maximize the number of people we inspire.

According to the participants, the ball is in our court to change the mindsets as raising awareness of these challenges is insufficient. We have to start internally, Step up, have a voice, and drive change with everybody on board.

Furthermore, the participants on resilience strategies to retain female engineers said flexible working patterns would help attract and retain more female engineers by investing in the development of female engineers, not to the disadvantage of male engineers but levelling up.

An inclusive environment where everyone can be valued for their experiences and insights can contribute to the team and lead to a greater chance of success.

In conclusion, without more female role models, young women will continue to view a career in engineering as one dominated by men, so let us continue to break down the status quo and empower more women to start and stay within engineering careers.

#Engineering Heroes
Thank you to our engineering heroes for sharing their experiences, advice and perspectives. wn

Celebrating exceptional engineering talent at Zutari on Women's Day

MATHAPELO MORE sees herself as part of the transformation of the civil engineering and related industries, together with all of the other women hard at work in the field, and those about to embark on their journey. "I think being active in industry automatically inspires young women to join, as it shows it is possible to operate in this male-dominated world," says Mathapelo on the occasion of Women's Day on 9 August.

Born in Sharpeville, Vereeniging, Mathapelo is a Professional Engineer who has worked as an Asset Transformation Specialist at leading consulting engineering and infrastructure advisory firm Zutari for almost two years. This involves developing existing infrastructure that is otherwise a liability for the client and transforming it to the benefit of local communities.

Mathapelo's team has capability in the closure of mines or old power stations. It also piggybacks off Zutari's expertise in engineering, planning, science, the built environment and management to carry out these projects. "I fulfil an advisory role to the client regarding the use of existing infrastructure and developing and planning new projects. This is quite exciting, because often I do not know what shape or form the project will take."

Mathapelo has a Bachelor of Science degree in Civil Engineering and a Graduate Diploma in Civil Engineering, with her main focus on Hydraulic Engineering, with both qualifications obtained from the University of the Witwatersrand. She joined Zutari in November 2018, since when her career has transformed from "something I wanted to do into something more aligned to my heart."

Her work experience to date has included the Burnstone Metallurgical Plant in Balfour, Mpumalanga, where she contributed towards the site layout, on-site concrete batching plant and ultimately managing and being responsible for the manufacture of concrete and the site testing laboratory.

"One structure I am particularly proud of constructing was the mill feed silo, with a 2 m high base and a total height of 35 m, equivalent to a 12-storey building," says Mathapelo. The concrete used was a bucket mix poured for two weeks non-stop, with the team working 24/7 in two 12-hour shifts. "Everything went according to plan. It was such a success because it was a real team effort."

Mathapelo has also worked on the Medupi project in Lephalale, Limpopo, possibly the eighth-largest coal-fired power station in the world once fully operational. She was part of the team that constructed all of the infrastructure for the coal stockyards.

Zutari Principal Engineer **KARIN MEYER** graduated from the University of Pretoria in 2006 with a Bachelor's degree in Civil Engineering (BEng). She is currently studying for her Master's degree (MEng) in Civil Engineering from the University of Stellenbosch, specialising in Construction and Engineering Management. Her long road with Zutari began in January 2007. As junior engineer, she started her career in the design office in Durban, and worked in Angola for almost two years on some challenging road construction projects, followed by a stint as Engineer's Representative on the Matla Ventilation Shaft project between Ogies and Kriel in Mpumalanga. Karin then returned to KwaZulu-Natal to work on the Bayhead Road Upgrade project at Durban Harbour.

Being an eternal adventurist, Karin accepted an opportunity to work in Kenya as the Employer's Representative providing technical

support and oversight services on civil and structural work at the Tusker Brewery in Nairobi. "It was a completely new experience, and even though I was out of my comfort zone, it was fully rewarding," she says.

"From my experience, there are many great men out there that want women to succeed, and they will never treat women differently professionally. At the end of the day, it is how we treat each other that counts. I strongly believe a person should advance in life through hard work and merit. I expect promotion because I am capable and can stand my ground. I also believe that women are stronger than what they give themselves credit for and that they can do anything they set their minds to, or are passionate about. Diversity definitely gives us strength, and women, just like men, bring value to the table," says Karin.

If you wonder how Zutari manages to attract and retain amazingly talented people such as Mathapelo and Karin, you need look no further than **NATACHIA GEORGE**, Talent Acquisition & Retention Lead. Her team strategically partners with its business leaders to meet high-performing talent needs. "We work closely with our business leaders to understand our future skills needs to meet our growth aspirations," says Natachia.

She joined Zutari close four years ago to build up the talent acquisition function. "It has been a very rewarding journey as we evolved from a transactional recruitment function to a strategic talent acquisition partnership with our business leaders. I am fortunate to work on multiple people projects, collaborating with business to attract and develop our next generation of leaders and create a culture of inclusivity that enhances our employee experiences and retains our best talent."

Natachia points out that research reveals that the pace of change in achieving gender equality is painfully slow across all industries. "We have to move forward to achieve workforces that are inclusive and equal. Women have unique contributions to make in the workplace, enhancing institutional effectiveness and providing perspectives and priorities that serve to promote positive social outcomes and greater ethical accountability. Business leaders have to drive the journey of commitment to achieving equality in the workplace, and this can only be achieved through purposeful intentions with tracking and measuring in place to ensure sustainability.

"I think that the women in our industry are recognised and celebrated, but not enough. Women have a significant role to play socially and economically. However, workforce environments need to be empowering and supportive to deliver great impact. We need to shift from a tick-box exercise to total commitment and purposeful actions to achieve gender equality, because it is the right thing to do," concludes Natachia. wn

"Being active in industry automatically inspires young women to join."
– Mathapelo More

"A person should advance in life through hard work and merit."
– Karin Meyer

"We have to move forward to achieve workforces that are inclusive and equal."
– Natachia George

SAIEE Women in Engineering Showcase

Three things to know about women in Science, Technology, Engineering and Math (STEM) is that female students and employees are under-represented in STEM-related fields. On average, around 30% of the world's researchers are women. Less than a third of female students choose to study higher education courses in subjects like math and engineering. Women working in STEM fields publish less and often receive less pay. Science and gender equality are vital to reaching sustainable development goals. In recent years much has been done to help inspire women and girls to study and work in technical fields. But women continue to be excluded from participating fully, according to the United Nations. We are proud to showcase some of our female member's profiles in this article.

BY | MINX AVRABOS

Ayanda Noah

AYANDA NOAH, the Chairman of Central Energy Fund Group, is a Director of her consulting firm, AN Duke Solutions (Pty) Ltd. She is also the CEO of Utility Coach (Pty) Ltd and a Director at Enerdigm Energy Development.

Before venturing into business, she served at Eskom as the Group Executive for Distribution and later, Customer Services Division.

Since joining Eskom in 1992 as an engineer-in-training, she worked her way up the organisation, occupying various positions from middle and senior management to EXCO level before her retirement at the end of 2018.

As a result of her activities and contribution, she was recognised and received various awards, including Eskom's Executive of the Year runner-up (2005); Eskom's Special Award 2010 MW Project (2010); BWA's Business Woman of the Year Award Finalist (Government Category - 2014) and CEO Global's Africa's Most Influential Women in Public Enterprises (Country, Regional and Continental Winner - 2017).

Ayanda is a registered professional engineer with the Engineering Council of South Africa (ECSA) and a member of the South African Institute of Electrical Engineers (SAIEE) and the Institute of Directors.

Christinah Mohloki

CHRISTINAH MOHLOKI is a Senior Project Engineer in the Transmission Division at Eskom. She holds a National Diploma in Electrical Engineering (HC), BTech Power Engineering and Project Management (both from TUT), BSc (Hons) in Technology Management (UP) and Masters in Technology Management (UP).

She has extensive experience in secondary plant system protection and Engineering solutions within Transmission Division.

She also has Power Station experience in the Operation Support Department at Matimba Power Station in Lephalale. Her career in Energy Sector began at the South African Bureau of Standards (SABS) with extensive experience in electrical equipment testing before moving to Eskom.

She joined SAIEE in 2008, and in 2015, became a member of the Power & Energy Section. In 2017 she was nominated and elected to be a committee member of Central Gauteng Centre, where she is still serving.

She is currently mentoring and coaching Electrical Technicians and Technologists towards Professional registration with ECSA and Christinah is an active member of SAIEE, contributing positively toward realising the institutional goals and objectives with peers in the Electrical industry.

Faith Sibelo

FAITH SIBELO is a final year EE student at the University of Johannesburg, born and raised in Bulawayo, Zimbabwe. She serves in the SAIEE UJ Students Chapter as a Vice Secretary.

She loves celebrating women's month. It's truly a time when she feels like there is a communal celebration and, at the very least, an acknowledgement of women and their agenda.

Jasoda Naidoo

JASODA NAIDOO has a BSc and MSc in Electrical Engineering. She is a registered Professional Engineer with ECSA. Currently, she is a Field Services Engineer at Eskom. She loves to travel in her spare time.

Krystle Annamalai

KRYSTLE ANNAMALAI holds a BSc. Electronic Engineering degree with the University of KwaZulu-Natal (UKZN) and graduated with a Master of Business Administration (MBA) degree from the University of Pretoria's Gordon Institute of Business Science (GIBS).

She is a registered Professional Engineer with the Engineering Council of South Africa (ECSA). She serves as a committee member of the South African Institute of Electrical Engineers (SAIEE) since 2019, and she is a member of Cigre.

EThekwini Electricity has employed her as an MV/LV Operations Engineer for the past ten years.

Maite Sako

MAITE SAKO started her career as an Engineer in Training at Eskom Distribution in 2010. She was then appointed network operations engineer specialising in real-time power system analysis in 2011. She was appointed senior engineer in Eskom, System Operator specialising in integrating generators on the South African grid.

Currently, she is a Chief Engineer at Eskom, System Operator specialising in asset integration. She is a professional engineer registered with the Engineering Council of South Africa (ECSA). She holds qualifications including a BEng Electrical Engineering, Certificate in Business Management and a Masters degree in Engineering Management.

She has been a member of the South African Institute of Electrical Engineers (SAIEE) since 2016 and has been participating in SAIEE Central Gauteng Centre (CGC) activities. She served as vice-treasurer for CGC in 2019 and treasurer in 2020. She was elected vice-chairperson for the SAIEE Women in Engineering (WIE) chapter in 2020.

Makgola Mokololo

MAKGOLA MAKOLOLO graduated with a Bachelor of Science, Electrical Engineering from the University of KwaZulu-Natal. She obtained her MBA from GIBS, University of Pretoria. She is the current acting Deputy Director-General for energy in the Department of Public Enterprises (DPE) of the South African government with shareholder oversight on Eskom (energy), Safcol (forestry) and Alexkor (mining).

Miss Makololo has exceptional leadership capability and capacity and has served in various capacities in society. She served as a non-executive director on the board of Zenzele Technology centre, an incubator of SEDA that assists small scale miners in developing mining technologies and building sustainable businesses.

She was elected as one of the top 80 emerging leaders in science and technology in Africa and the Middle East. She participated in TechWomen in 2013, an exchange program for women in STEM fields. In 2017 she was listed in the Mail & Guardian Top 200 Young South Africans. Makgola is passionate about people and leadership development and is committed to excellence and good service. She currently serves as a chairperson for the SAIEE Women in Engineering Chapter.

Mantsie Hlakudi

MANTSIE HLAKUDI is a professionally registered and certificated (GCC) Electrical Engineer with over 11 years of experience in Distribution and Transmission, specialising in Specialised Plant Equipment Failure Investigations, Renewable Energy, Transformers and reactors.

She is currently a Chief Engineer for Transformers and Reactors, focusing on transformer specifications, design reviews, factory capability assessment, factory acceptance testing, failure investigations, asset health appraisal, and technical support. She holds a BSc (Honours) from UCT and is currently busy with MSc Electrical Engineering.

She is an additional regular member for Cigre A3 Study Committee, Cigre Utility Advisory Board Member and expert member on International Electrotechnical Commission (IEC) C SEG 10 Ethics in Autonomous and Artificial Intelligence Applications. She is the Secretariat for SAIEE Women in Engineering (WiE) Chapter and the Events and Communications Portfolio lead for SAIEE Gauteng Centre.

Mariam Paul

MARIAM PAUL is a registered professional Electrical engineer working in the Telecommunications sector for more than two decades.

She is a Chief Director at the Department of Communications and Digital Technologies in charge of ICT Infrastructure Macro Applications. Her responsibilities include connectivity and digital applications for the education sector, e-Government initiatives, Smart Community programmes. She is a board member of the South African National Space Agency (SANSA).

Prof Meera Joseph

PROF MEERA K. JOSEPH works as an Independent Contractor at the Independent Institute of Education, South Africa, from January 2020. She also serves as the (DBA) supervisor at Milpark Business School. Meerah is a Professional Member of the Institute of Information Technology Professionals South Africa and is currently the IEEE Computer Society South Africa Chapter chair. She is a Senior Member of the SAIEE and IEEE. She is a member of the SAIEE Cybersecurity Chapter.

She received DPhil. Engineering Management degree at UJ in 2014, her Master's degree in Computer Applications in and BSc. Chemistry in 1998. She has Java, UML, SAS (Introduction to statistics), and Python certifications. She authored and contributed to 76 research works and has 20 years of lecturing experience in the Computer Engineering / ICT field. She found and led the Information and Communication Technology for Development (ICT4D) research group at UJ's School of Electrical Engineering and supervised 14 Postgraduate students to completion and graduation at UJ within a short period. She was recently nominated for the NSTF award: Engineering Research Capacity Development Award.

Michelle Govender

MICHELLE GOVENDER is passionate about leadership in cybersecurity. She leads the development of services and solutions to help secure business and city strategy as we digitise and leverage Industry 4.0.

She believes that secure digital business is a way of life going into the future. She uses her engineering and leadership knowledge and experience, coupled with her passion for understanding people's digital behaviours, to secure business.

Her work experience includes power utilities, which includes nuclear power, cybersecurity strategy, including operating model design, culture transformation and cyber risk management.

Michelle is a professional Electrical engineer (Pr. Eng) and Certified Information Security Manager (CISM) endorsed by the international cybersecurity professional body, ISACA. Passionate about risk management, Michelle has achieved a post-graduate diploma at the University of South Africa in applied risk management. An advisor nationally and internationally, Michelle is driving a cyber-secure Industrial digital business.

Mokwape Lekganyane

MOKWAPE LEKGANYANE has more than 15 years of experience in the power industry and is currently the Senior Manager for eThekwini Electricity's HV Projects Branch responsible for high voltage equipment and capital projects. Before joining eThekwini Electricity, Mokwape was with Eskom Transmission working as an Assistant Engineer.

She holds a BSc and an MSc degree in Engineering from the UKZN, a Certificate in Technology Leadership from the Da Vinci Institute of Technology, a Certificate in Advanced Project Management and a Master of Business Administration (MBA) degree from the UCT.

She is a registered Professional Engineer with ECSA, a Senior Member of the SAIEE, a member of CIGRE and a member of the Golden Key International Honour Society.

Currently, she serves as a member of the CIGRE SA Executive Board, ECSA Reviewer/Moderator/Assessor and a member of the SAIEE KZN Committee since March 2017.
She has authored and co-authored several research publications for local and international conferences.

Neo Mapapanyane

NEO MAPAPANYANE is a registered professional engineer with ECSA and holds a Master of Engineering (M.Eng) degree in Electrical from the North-West University. She is a senior engineer at Eskom in the Power System Operations Performance department.

Neo is well versed in the power system protection for the transmission and sub-transmission network in Eskom. She is a member of the South African Institute of Electrical Engineering (SAIEE) and a committee member of the SAIEE Central Gauteng Centre, leading the Corporate and Social Investment (CSI) portfolio since 2020.

In her ten years of working experience, she has been involved in various projects within Eskom distribution and Transmission, respectively. One of these projects received a manager's award in the Customer's Satisfaction category, and she recently got an Employee of the Month: Exceptional recognition.

She is passionate about community projects and mentoring high school learners in the Science, Technology, Engineering and Mathematics (STEM) stream.

Nomthandazo Mpande

NOMTHANDAZO MPANDE is a social entrepreneur (philanthropist) with a disability and an electrical engineering professional with more than 15 years of experience.

She is a GCPIT global award-winning business leader in 2021. She is the Managing Director of Phoki Holdings, which specialises in energy management and disability empowerment consulting.

Her company is accredited through WeConnect International as a women business enterprise. Nomthandazo is a Business Advisor focusing on disability empowerment, technology, construction, energy industries.

She is a member of the SAIEE and a Professional Technician registered with ECSA and serves on numerous association boards.

Prudence Madiba

PRUDENCE MADIBA is a Senior Manager, Control & Instrumentation (C&I) Engineering Department at Eskom. Prudence holds a BSc in Electronic Engineering (UKZN), PGD Business Management (UKZN), GDE Industrial Engineering (WITS) and Masters in Engineering Management (UP).

She is one of the founders of the Pfuxani STEM Foundation. This non-profit organisation focuses on improving teaching and learning in Science, Technology, Engineering and Mathematics (STEM) subjects in township schools in Gauteng. Their objective is to increase the number of township learners that enrol for STEM courses at higher education institutions over the next five years.

Prudence serves on the SAIEE Council and has been a member since 2004.

Refilwe Buthelezi

Engineer **REFILWE BUTHELEZI** is an experienced infrastructure asset manager skilled, business/operational strategy development and translating these into attainable asset health and performance.

She is a prominent member of the Institute of Directors SA and has served as a Non-Executive Director in various companies in South Africa and abroad. Refilwe is currently the Vice President of the Engineering Council of South Africa (ECSA). She has represented ECSA internationally at various International Engineering Alliance Meetings that govern mutual recognition of tertiary qualifications in engineering and professional competence. She has over 15 years of business leadership experience in diverse management environments within the water and power utility industries. During her career, she has built a reputation for operational excellence, digital technology, corporate governance, innovative strategic thinking, working with the highest level of integrity, and passionate commitment to sustainability, environmental, social and governance. She is passionate about women's empowerment and has used her various roles as a champion of transformation to elevate the role of many women in the industry.

She holds BEng and MEng degrees from the University of Johannesburg and an MBL degree from Unisa. Besides her own experience and technical know-how, she has a sizeable portfolio of professional linkages that she has established over the years, which she could call on when required.

She has a strong flair for business and entrepreneurship, and this is demonstrated by her ability to identify an excellent opportunity to exploit strengths and market opportunities that she foresees. She is a believer that one should take the lead, lifting others as one climb and thrive!

Sharleen Masango

SHARLEEN MASANGO is an enthusiastic, skilful and highly motivated final year Electrical and Electronics Engineering student at the University of Johannesburg and is passionate about the social impact of technology.

She is a project leader - having led multiple class projects to completion. She is an active member of the UJ SAIEE Student Chapter and has participated in its executive committee since 2018. She was the UJ Student Chapter Chairperson in 2020 and the Deputy Chair in 2019. She continues to serve as deputy chair of the chapter in 2021.

She likes to take a proactive approach to solve problems when possible and to seek out new challenges.

Thandi Sishi

Sy Gourrah

SY GOURRAH has been part of the energy industry in South Africa for over 25 years. She started her career as a Consultant and later was appointed as the City Electrical Engineer for East London. With more than two decades of experience as an electrical engineer, Sy Gourrah also holds many qualifications, including a Bachelor in Engineering (Electrical & Electronics), Masters in Business Administration, and Government Certificate of Competency.

Currently, she is the Business Development Specialist for Transmission & Distribution & EPC within Actom. In this role, she is involved with the business development of the different products manufactured within Transmission & Distribution and the service offerings of the EPC division.

Sy served as the President of the AMEU from 2008 to 2010 and has been on the executive council from 2001 until 2011. She was the first female President of the AMEU.

She is a fellow of the SAIEE and has served as a council member since 2012. She has chaired the Professional Development and Finance committees and is the 2020 President of the SAIEE. She launched the SAIEE Women in Engineering Chapter during her presidency, striving to promote women's interests and champion empowerment programs within the SAIEE and broader electrical engineering fraternity.

She is a professionally registered engineer and was an active volunteer with ECSA, where she was the Chairperson of the Engineering Program Accreditation Committee.

She is an international accreditor for engineering programs in Washington Accord recognised countries and participates in the accreditation of South African University programs.

THANDI SISHI is a Chief Engineer at eThekwini Municipality. She leads a section responsible for Planning and Distribution of electricity within the eThekwini South Western Area. Thandi holds a Bachelor of Engineering (B.Eng) in Electrical & Electronics and Masters in Business Administration (MBA). She is registered with ECSA as a professional engineer since 2014 and is currently a candidate for examination for Electrical Engineers' Certificate of Competency: Factories.

Thandi is an active member of the SAIEE, currently serving in the KZN Centre committee since 2019, under the membership portfolio. Through her involvement with SAIEE, she has been able to network and appreciate the continuous development she obtains from committee members.

Tshego Cornelius

TSHEGO CORNELIUS is a BSc Electrical Engineering graduate from UCT with more than ten years of working experience, currently working as a Project & Contracts Manager at Eskom. She has recently completed her Master's degree in Business Leadership (MBL).

Tshego is a registered professional engineer with ECSA, an SAIEE Council member, and the IEEE and BMF. She has held various leadership roles within various organisations.

Tshego is passionate about giving back and promoting STEM and actively does that through her involvement with Pfuxani STEM Foundation and KoReTswangTeng Foundation.

These eight women in STEM are at the forefront of the world's response to COVID-19

Women across the world have made an enormous contribution to the global efforts to tackle COVID-19. Not only do women make up 70% of the world's health workers and first responders, but women in STEM fields have also been leading research into the virus, creating trackers and developing vaccines.

BY | KATE WHITING

But the pandemic has had a disproportionate social and economic impact on women, as many have borne the brunt of childcare duties or lost jobs in sectors most affected – including women scientists.

11th of February was UN International Day of Women and Girls in Science – and the theme this year is celebrating the women scientists at the forefront of the fight against COVID-19, including Dr Özlem Türeci, co-founder of BioNTech, which helped produce the first vaccine.

Women represent almost half the students at Bachelor's (45%), Master's (55%) and PhD (44%) levels of study, according to UNESCO's forthcoming Science Report – but only 33% of the world's researchers are women.

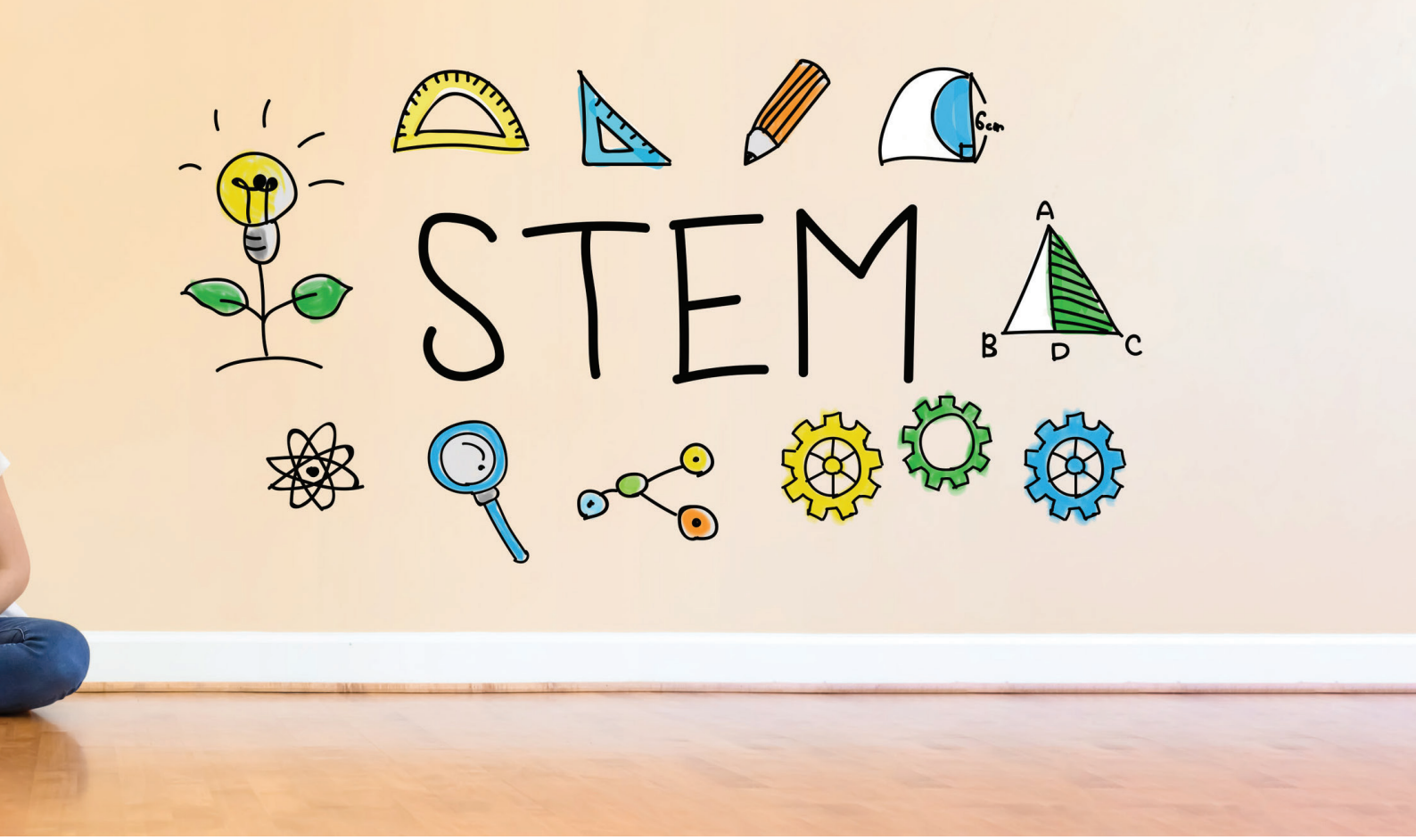
UNESCO is gathering some of the world's leading COVID-19 experts for a virtual event to encourage more girls and women to take up careers in the STEM fields.

"We need science, and science needs women. This is not only about committing equal rights; it is also about making science more open, diverse and efficient," said Phumzile Mlambo-Ngcuka, Executive Director of UN Women, and Audrey Azoulay, Director-General of UNESCO.

Here are just some of the women in STEM around the globe who have made a difference during the pandemic.

DR ÖZLEM TÜRECI

Dr Türeci and her husband, Dr Ugur Sahin, co-founded biotechnology company BioNTech in Germany in 2008. In 2020, BioNTech and pharmaceutical firm Pfizer developed the first approved RNA-based vaccine against COVID-19. They celebrated the news that it had 90% efficacy with a cup of Turkish tea, the pair told The New York Times. Recently featured on the cover of Time magazine, the scientists plan to produce two billion doses of the vaccine this year to help bring the pandemic to an end.



Dr Özlem Türeci

Dr Soumya Swaminathan

"I became a vaccine guinea pig because, in addition to wanting to be useful, I had a deep interest in the wondrous new roles now being played by RNA, the genetic material that is at the heart of new types of vaccines, cancer treatments and gene-editing tools."

DR SOUMYA SWAMINATHAN

A paediatrician and one of India's leading public health experts, known for her groundbreaking research on tuberculosis, Dr Swaminathan was appointed the World Health Organization's (WHO) Chief Scientist in 2019 and collaborative international work on vaccine development.

She spoke about challenges women researchers face at the Women Leaders in Global Health Conference 2020: "It is more difficult for women researchers to get their grants approved and women also have difficulties in getting their results published, if you are from developing countries, in journals, because of perceived biases.

Ramida Juengpaisal

Professor Sarah Gilbert

Somaya Faruqi

RAMIDA JUENGPAISAL

Within a night in March 2020, Ramida Juengpaisal and her colleagues at web design firm 5LAB in Bangkok, Thailand, built a tracker of COVID-19 cases, giving the city's eight million residents up-to-date news and information about the pandemic and helping to stop the spread of misinformation.

She told Reuters the perception that girls are less suited to technology-based roles is gradually shifting: "We need more women in tech. One good thing about this crisis is that we have seen people – including women – come forward to create things that are useful to others and be recognised."

PROFESSOR SARAH GILBERT

Prof Gilbert is the Oxford Project Lead for the Oxford/AstraZeneca vaccine, now recommended for use by all adults worldwide by the WHO. When the genetic sequence for the new coronavirus was published in January last year, she swiftly built on her work developing a vaccine for MERS, which used chimp adenovirus to deliver the spike protein into humans. Prof Gilbert is currently working on a new version of the vaccine to tackle the South African variant.

"It took a few weeks to create a vaccine that worked against Covid in the lab. Then the first batch went into manufacture by early April, as the rigorous testing regime expanded. The process as a series of small steps - rather than there being a big breakthrough moment."

SOMAYA FARUQI

Faruqi and her all-female robotics team began developing a low-cost, lightweight ventilator using locally available, second-hand car parts after the first COVID-19 case was reported in her home province of Herat in Afghanistan.

She told UN Women: "Sometimes, families think science and tech are male fields and prefer that their girls don't enter them. We have fewer role models for young women in these fields, and that makes it more challenging for young women to enter this industry."

"Girls account for some 60% of out-of-school children in Afghanistan. In some provinces, up to 85% of girls do not attend class.

I had classmates who dropped out of school due to early marriage," Somaya recounts. Worldwide, families marry off their daughters for various reasons, including to reduce economic burden. "I know how much they would have loved to continue their education..."

NEEMA KASEJE

Kaseje is the Founder of Surgical Systems Research Group in Kenya, which seeks to rapidly expand access to health services by leveraging youth, technology and community health workers.

Since May 2020, the group has helped to flatten the curve of COVID-19 cases

Neema Kaseje

Professor Devi Sridhar

Dr Anggia Prasetyoputri

in Siaya County by combining digital tools and data science with young people and community health workers to raise awareness about preventative measures.

"Here are four lessons we have learned in that time:

1. Engaging with youth and community health volunteers is feasible.
2. The use of digital technology has enabled rapid access to accurate and reliable data.
3. Our partnership with the Ministry of Health was important for rapid implementation of the solution.
4. A comprehensive and responsive approach was critical to achieving buy-in for our solution by multiple key stakeholders."

PROFESSOR DEVI SRIDHAR

American public health researcher Prof Sridhar is a leading authority on COVID-19 in the UK and Professor and Chair of Global Public Health at Edinburgh University. She is known for assessing the international response to the Ebola virus epidemic in West Africa.

Among her frequent media appearances, she spoke to the World Economic Forum's World Vs Virus podcast about why ethnic minorities in Europe and North America were at greater risk from COVID-19.

DR ANGGIA PRASETYOPUTRI

L'Oréal Indonesia awarded Dr Prasetyoputri the 2020 L'Oréal-UNESCO National Fellowship For Women in Science (FWIS) for her research on bacterial coinfections in COVID-19 patients using swab sample sequencing.

COVID-19 patients whose immune systems are already weakened by the virus are more susceptible to other viruses and bacteria. So Dr Prasetyoputri worked out a quick and straightforward way to identify these coinfections – and help doctors prescribe the proper treatment.

Latifah developed a robotic system that could significantly reduce physical contact between patients and doctors, decreasing risks during surgery.

Established in 2004, the L'Oréal-UNESCO For Women in Science program aims to acknowledge and support women in science. It has granted 59 fellowships to Indonesian women scientists.

"The recipients will immediately start their explorations to create solutions in the medical industry. L'Oréal believes that the advancement of science and women scientists in every sector will have a great impact on humanity," said Melanie Masriel, communications, public affairs and sustainability director at L'Oréal. wn

The Subtle Stressors Making Women Want to Leave Engineering

Female retention in engineering remains a persistent problem. Even after overcoming hurdles to enter the profession, women leave at much higher rates than men, often because of the stress of being female in a male-dominated field. This stress can be quite overt, like when women face gender discrimination or harassment, but our research shows that it can also be subtle, like when women feel that their contributions are less valued than their male peers' because tasks and roles have been gendered. When experienced daily, this kind of subtle stress can become depleting.

BY I M. TERESA CARDADOR AND BRIANNA BARKER CAZA

To build a deeper understanding of these experiences and how women deal with them, we interviewed and surveyed more than 330 engineers in the U.S. (43% female, 57% male) from 2013-2017 and spoke with more than 20 female engineers at professional conferences in the U.S. and Canada. These engineers varied in age from 22 to 50 and came from multiple engineering subfields.

Our data provide insight into engineers' professional identity and work experiences – their approaches

to work, career path decisions, work stressors, and intentions to leave the field. Our findings, combined with our other research on identity and resilience, suggest that female engineers experience stress from subtle and not so subtle cues that their skills and their work are not valued within the profession.

This stress increases feelings of not fitting in and made women more likely to think about leaving. But we also identified essential resilience strategies women can use to overcome it.

STRESS FROM GENDERED TASKS AND CAREER PATHS

Early in their training, engineers learn that there are two sets of skills required in engineering: "hard" engineering skills (such as technical ability and problem-solving) and softer "professional" skills (such as communication, relationship building, and teamwork). They also learn that these skills are gendered, with the former viewed as more masculine, more revered and higher status, and the latter viewed as more feminine and lower status.

Our research shows that many female engineers felt drawn to tasks that were not purely technical. Indeed, many of the engineers we talked to described enjoying and excelling at tasks involving people, communication, and organisation skills, in addition to technical skills. As one female engineer noted:

I knew I didn't want to sit in front of a computer and run a model and do calculations all day. That's not my personality, even though I have that engineering background. Also, I'm a

good people person. That has often drawn me to working with other people instead of being an individual contributor and just outputting work, submitting it to someone, and sitting on my own every day.

While some women gravitated toward these tasks based on their interests, mentors also encouraged women to take on tasks and roles consistent with the "professional" side of engineering. One male engineer described how he witnessed this happening to a female colleague:

They had her assigned to non-technical things, arranging things, putting things together, and representing the team in team meetings. She did very well at that, and I'd have to say being there, she brings strong communication skills to the table. And as a result, they want to put her in a full-time position because she's done so well.

However, as one woman noted, others tended to view these skill sets as less aligned with what it means to be a "real engineer." Because there is a tendency to define "real" engineers in terms of technical skills and values tied to being a technical specialist, many women felt that their unique skills were not always valued or recognised. For example, one told us:

It seems like these things, these skills, these traits that I've honed for a very long time…one might label as soft skills maybe…are not really the kinds of things that get rewarded as much on day-to-day. Or are being recognised.

Our interviews with male engineers confirm these beliefs. Men said that their female co-workers are often drawn to the "less valuable" tasks at work. Specifically, they pointed out that their female co-workers' tended to excel at the social aspects of the job (like relationship management and multitasking) but that these aspects were merely "peripheral" to the real, technical work.

Research also shows that women are disproportionately likely to move away from the most technical career paths and roles involving technical supervision or management as their careers progress. We found that while some women pursued these technical supervisor or management roles based on their preferences, some were also mentored into these roles. Other evidence shows that this can happen due to diversity initiatives and stereotypes about women being more skilled at communication and coordination than men.

One female engineer told us she was encouraged by her boss to take on a managerial role because she was perceived "to be extroverted" and "to have good people skills." A male engineer we interviewed echoed the idea that women are particularly suited for managerial roles:

Women do better at managerial roles…a lot of them display the traits to be good managers; they care about their people, care about how they communicate, and develop products. If you have ten engineers in a room from our company, they're all going to be smart, but it's the one who can communicate well, which can get people behind them… they're stereotypically female.

Engineering firms often have a prestigious hierarchy. The problem is that managerial roles are less valued in engineering. The most technical career paths are perceived as the highest status and most valuable. The less technical career paths, including project or product management, are less critical and even less desirable. Many of our interviewees – especially men – described managerial roles as undesirable, saying: "I don't like to be a called a manager" or "Maybe they get rewards out of it, but I don't see how I could do that."

When women disproportionately occupy less valued or unwanted roles, it can reinforce stereotypes about female engineers being less technically skilled, make them feel less respected, and create the illusion that they are not a "real engineer." Decades of social psychological research shows that others don't value feeling like you, and your work in your organisation creates chronic and persistent psychological stress. This stress may challenge female engineers' ability to cope with other stressors, such as high work demands and persistent bias in the workplace, leading them to burn out and consider an exit.

However, though some of the engineers we sampled reported intending to leave the profession, many persevered in the face of these obstacles and led fulfilling careers. We gained some insight into how these women effectively deal with this stress. They did "professional identity work" to minimise the rift between their gender and professional identities. Their experiences may help other women in engineering become more resilient and lead fulfilling and authentic careers.

BUILDING RESILIENCE THROUGH PROFESSIONAL IDENTITY WORK

Ask yourself what you want. Given the bias in engineering to prize technical skills and specialisation above all else, it is easy to feel pressured to privilege external expectations over your voice and values, creating a sense of being

inauthentic. Many women we spoke with described feeling "different from other engineers" or like they need to be "a different person at work."

Try privileging your dissenting inner voice rather than fighting to re-program your motivations to become aligned with the majority perspective.

One way to feel more authentic is to reflect on your personal and professional values. Engineers should ask themselves: What is important to me, and what is not? What experiences are most appealing, and how can I get them? What support do I need, and from whom? What are my strengths and weaknesses, and what do I want to change?

Being reflective about your aspirations, proficiencies, and energy sources helps silence the external noise that undermines the sense that your work is devalued and creates a sense of being true to oneself.

This, in turn, helps build confidence in your career choices and reduces stress from deviating from the norm. It can also help you recognise when you have been silently led astray – pursuing tasks and roles that you have been tracked into rather than the ones you enjoy – and help you get back to what is most important.

Female engineers also need to be conscious about decisions to take on specific tasks, roles and career paths. When presented with a career or task "opportunity," it is critical for women to develop a habit of asking themselves: "Am I taking on this role because I like it and it fits with my career goals?" or "Am I taking on a task because someone else thinks it fits my skill set?" One engineer who had been encouraged by her superior to pursue a managerial path told us:

I recently had a one-year stint in the managerial path. My management and portfolio managers pushed for because they felt I had skills – I am articulate, good with people, have excellent presentation skills – that would allow me to succeed. I hated it, switched back to a technical path, and disappointed most of my champions. Now I'm thankful that I know myself better not to do it again.

This doesn't mean you should turn down roles without exploring them; instead, you want to tune into yourself for feedback on what tasks and roles suit you. Another engineer we talked to found her niche in engineering by reflecting on her managerial interests.

She said:
I think it's a matter of finding out what you are cut out for. Now I'm feeling like, 'Yeah, turns out I do know what I'm doing, and I'm pretty damn good at it'…Find what you are cut out for, what are you passionate about.

Embrace your complexity. Female engineers also need to learn to embrace their identity complexity — the fact that they may hold both feminine and scientific values — rather than trying to force themselves into socially constructed gender or engineering boxes. This complexity will allow you to embrace the uniqueness you bring to the profession, thus reducing feelings of dissonance and tension.

Focus on the synergies between your identities (gender, profession, role) rather than the conflict. What are the benefits of being a woman in engineering or a female engineering manager? What are the benefits to the company of someone who has technical, organisational, and communication proficiencies? How can you articulate these benefits? Indeed, the qualities that women bring to engineering, such as effective communication and management skills and the ability to organise teams' work, are suggested to be critical to the future of engineering.

Embracing and helping others understand the advantages of your complexity can help you express your unique and vital "brand" in the engineering workforce as someone who possesses a broad set of skills, interests, and aptitudes. When you're in a role that embraces your unique combination of skills and abilities, it can increase satisfaction and lower stress. As one woman explained:

If you get that my interests are not traditional and they're not textbook thermodynamics, there's no way I could not do a role like that. [The role I have chosen] is more of an untraditional engineering career path, and it's fun. And it's very technical [but]… it's outside the box. It's creative. It's kind of a combination. The balance between technical expertise and business understanding puts me in a unique place in engineering and the technical community… I'm a happy woman.

Our research shows that women engineers experience hidden stress stemming from the gendering of tasks and roles in engineering. Subsequently, female engineers perceive that their work and roles are devalued within the profession.

By reflecting more on what they want out of work and embracing their complex identities, women in engineering may become more resilient in the face of stress to create long, meaningful careers. wn

Breaking Down The Barriers:

Why More Women Should Consider Engineering

Sorria Douglas knew she wanted to go into a technology or science-related job – she just wasn't sure what precisely until she took an online questionnaire that highlighted mechanical engineering as a possible career choice.

Sorria, now 26, didn't even know what mechanical engineering was at the time, but she thought it sounded interesting.

After watching videos and contacting universities for information on their related courses, she enrolled at the University of Derby and studied Mechanical Engineering (BEng Hons). She was one of only five females on her course – out of 100! Here she shares her journey and why she thinks more women should consider a role in her field.

HOW I GOT INTO THE INDUSTRY

After discovering mechanical engineering from my research, I instantly knew that I wanted to do this. I loved how varied the university course sounded; I'd get to learn about things like thermodynamics, thermo fluids and machine design. I also liked the fact that it was rooted in maths and science, which I'd always enjoyed since school.

My first lecture at The University of Derby was relatively daunting as I didn't initially see any other females. This led me to wonder if I was the only one on the four-year course, but it turns out there were five of us in total. While this might have been a concern to other people, it was not a deterrent for me. We instantly gelled and are still friends to this day!

Throughout my degree, I particularly enjoyed the problem-solving element and how the course challenged me; it was exciting to work through various situations and discover the most effective solutions. In my last year, I decided to specialise in mechanical design that focused on 3D and 2D modelling machinery, allowing for better visualisation of features and components of an overall build.

I was so happy when I received 76% in my dissertation (which involved designing and developing a novel wind turbine that could be used in a rural village) and was awarded a First Class Honours for my degree overall. It cemented the fact I'd chosen the right career path.

GRADUATE RECRUITMENT IN THE ENGINEERING MARKET

Due to the competitive nature of the graduate market, I began looking for employment during my dissertation. I felt lucky to land myself a role at a local company, but I knew it wasn't for me; I gave it a bit more time then left after a year.

After browsing LinkedIn one afternoon, I saw a job advertisement for a mechanical design engineer role featured on STEM Graduates. Once I knew the company hiring was L.A.C. Conveyors and Automation within the Nottinghamshire area, I was excited as the company was developing quickly and worked on various projects. I also liked how there was an existing pool of engineers there that I could learn from.

I am the only female engineer at L.A.C. Conveyors and Automation. It's something that the company raised

during my second interview as they wanted to check whether I'd feel comfortable within the environment, which I appreciated. Growing up with three older brothers, two older sisters and completing a male-dominated degree, I responded with something along the lines of 'I'm pretty used to it, and I wouldn't be bothered.

I've now been working at the company for three months, and not one person has made me feel less, and everybody has been warm to me!

WHAT I DO ON A DAY-TO-DAY BASIS

I have a lot to learn, but I'm learning something new every day, and I'm excited about my future here. During my day-to-day role, I usually design components for client projects, which I was put on straight away. I loved having the extra responsibility, though it was somewhat nerve-wracking. I also ensure the designs are sent to the manufacturer and oversee the assembly of the projects being built.

What I find exciting about L.A.C. Conveyors and Automation is the work it does in the A.I. and robotics industry, which is a hot topic. Working for such an innovative company provides a wide range of learning and progression opportunities (and equal opportunities for men and women). The diversity of the work also allows me to expand my engineering knowledge to include electronics and control engineering.

WHY MORE WOMEN SHOULD CONSIDER A CAREER IN ENGINEERING

It's undoubtedly an exciting time to be involved in the engineering industry. Every skill learnt is valuable, and there's a constant demand for fresh minds to keep developing ideas.

The issue with women in engineering (or lack of) seems to be a bit of a 'chicken and egg' situation. Women need someone they can look up to in the industry, but that doesn't exist in many places. If we educated children more on STEM in primary and secondary school, you'd see increased females going into the industry. As mentioned, I didn't even know what mechanical engineering was until I'd finished my GCSEs! At school, woodwork and bricklaying were offered, but from my experience, it was always boys on those courses, which I understand can put girls off.

You can do so much with engineering; it's a field that's interesting and ever-changing. If you're into science, technology, maths, enjoy being challenged and want to make a real-world impact, then engineering could be for you!

The industry itself is starting to make progress, but it's slow. I recently spoke at a women-in-engineering event for children aged 12+ and was asked many questions about gender diversity in the industry and how I felt about it.

It was so lovely to respond that I've never once felt out of place or treated differently by my male colleagues. wn

Women in History

The idea that girls required nothing more than elementary schooling goes back scarcely two centuries. Even to this day, some backward countries will allow no schooling for girls at all.

Things were, however, different in ancient Greece.

COMPILED BY | DUDLEY BASSON

Before tertiary education became available to women, they needed to study on their own. A notable example is Sophie Germain, who studied mathematics by candlelight to conceal this activity from her parents. She went on to study through the Paris École Polytechnique by using the name of a dropped-out student.

Her excellent work brought her to the notice of the famous mathematician Lagrange who became her mentor. Sophie's work was held in high regard by Fourier and Gauss.

Gauss convinced the University of Göttingen to grant Sophie an honorary degree. However, she died before she could receive this honour.

Mary Somerville was assisted by her brother's tutor (despite her parent's disapproval of this un-ladylike behaviour) to become a world-renowned mathematician and scientist. She was the first person to be known as a 'scientist'. Previously, scientists were known as 'men of science'.

A notable achievement was her translation of Laplace's five-volume "Mécanique Céleste", when the mathematics of Laplace was not well understood in England.

Laplace remarked that Mary Somerville and Caroline Herschel were the only women who understood his work.

Malala Yousafzai, born 12 July 1997, is a Pakistani activist for female education and became the youngest Nobel Prize laureate. She is known for human rights advocacy, especially the education of women and children in her native Pakistan, where the local Taliban had banned girls from attending school.

She narrowly survived an assassination attempt, and her advocacy has grown into an international movement. According to a former Pakistani Prime Minister, she has become "the most prominent citizen" of the country.

In First World countries, women are now given every encouragement to study in all academic faculties of tertiary education, including the STEM subjects – Science, Technology, Engineering and Mathematics, and in Medicine, Law and the Human Sciences.

A large number of University Colleges for women have been established over the years, but most of these have subsequently become co-educational, admitting both men and women students.

Girton College of Cambridge has produced many renowned alumni.

Another famous women's college is Bryn Mawr of Pennsylvania.

Click here for an extensive list of women's colleges, most of which have become co-educational.

Vassar College, Poughkeepsie, is one of the 'Seven Sisters' women's colleges, subsequently converted to co-ed.

The conversion of most women's colleges to co-ed is a confirmation that men and women should have the same education and that there is no need for young ladies' "Finishing Schools."

The Society of Women Engineers (SWE) was founded in the USA in 1950 with stated core values:

We aspire to the highest level of ethical behaviour as evidenced by honesty and dignity within our personal and professional relationships and responsibilities.

We embrace diversity in its broadest interpretation and commit to creating an inclusive environment for all our members and stakeholders. We value the contributions of a diverse membership, which enables SWE to achieve its full potential.

We provide an organisation that fosters mentoring and the development of professional and personal networks.

We professionally conduct our activities, demonstrating and demanding the highest standards of business practices.

We share a common definition of success with open, transparent access to information, building mutual respect and confidence in the abilities of those with whom we lead, serve, and partner.

Click here for an interactive tiki-toki timeline of women mathematicians.

Click here for a demonstration of a DIY tiki-toki 3D timeline.

The careers of several prominent historical women of science and maths have been described in previous issues of the **watt**now magazine.

In the March 2014 issue pp42-49:

- Theano of the Pythagorean School (6th cent. BC);
- Émilie du Châtelet (1706-1749);
- Caroline Herschel (1750-1848);
- Sophie Germain (1776-1831);
- Mary Somerville (1780-1872);
- Ada Lovelace (1815-1852);
- Lise Meitner (1876-1968);
- Grace Hopper (1906-1992).

In the August 2015 issue pp28-38:

- Elena Piscopia (1646-1684),
- Maria Merian (1647-1717),
- Laura Bassi (1711-1778),
- Maria Agnesi (1718-1799),
- Mary Anning (1799-1847),
- Anna Atkins (1799-1871),
- Sofia Kovalevskaya (1850-1891),
- Charlotte Angas Scott (1858-1931)
- Anna Pell Wheeler (1883-1966).

In the November 2019 issue pp52-58:

- Hypatia of the Neoplatonic School (360-415 AD)

Let us continue selecting more women who made exceptional achievements in their careers and contributions to science, mathematics and engineering. Click on the photos to get more detailed information and references of the STEM women.

FLORENCE NIGHTINGALE, was an English social reformer, statistician, and modern nursing founder. Nightingale came to prominence while serving as a manager and trainer of nurses during the Crimean War, in which she organised to care for wounded soldiers at Constantinople. She gave nursing a favourable reputation and became an icon of Victorian culture, especially in the persona of "The Lady with the Lamp", making rounds of wounded soldiers at night.

Nightingale was a prodigious and versatile writer. In her lifetime, much

Florence Nightingale
1820 - 1910

of her published work was concerned with spreading medical knowledge. Some of her tracts were written in simple English to easily be understood by those with poor literary skills. She was also a pioneer in data visualisation using infographics, effectively using graphical presentations of statistical data. Much of her writing, including her extensive work on religion and mysticism, has only been published posthumously.

MARY EVEREST BOOLE was a self-taught mathematician who is best known as an author of didactic works on mathematics, such as Philosophy and Fun of Algebra, and as the wife of fellow mathematician George Boole.

Her uncle was George Everest, the surveyor and geographer after whom Mount Everest was named. She spent the first part of her life in France, where she received an education in mathematics from a private tutor. On returning to England at the age of 11, she pursued her interest in mathematics through self-instruction. Self-taught mathematician George

Mary Everest Boole
1832 - 1916

Emily Warren Roebling
1843 - 1903

Phoebe Sarah Hertha Ayrton
1854 - 1923

Boole tutored her, and she visited him in Ireland, where he held the position of professor of mathematics at Queen's College Cork.

Mary took an active interest in politics, introducing her daughter Ethel to the Russian anti-tsarist cause under Sergei Stepniak. After the Anglo-Boer war 1899-1902, she became more outspoken in her writings against imperialism, organised religion, the financial world and the tokenism she felt that Parliament represented.

EMILY WARREN ROEBLING was an engineer known for her contributions for more than ten years to completing the Brooklyn Bridge after her husband Washington Roebling developed caisson disease and became bedridden.

Washington Roebling was assigned as chief engineer of the Brooklyn Bridge's construction. As he immersed himself in the project, Washington developed decompression sickness, known as "caisson disease", by going to underwater depths to study the placement of caissons and not rising at the proper speed. It affected him so severely that he became bedridden.

As the only person to visit her husband during his sickness, Emily Roebling relayed information from Washington to his assistants. She reported to him the progress of work on the bridge. Emily developed an extensive knowledge of materials, stress analysis, cable construction, and calculating catenary curves through Washington's teachings. She complimented her knowledge by her prior interest in and studying the bridge's construction when her husband was appointed chief engineer.

For the decade after Washington was confined to his sickbed, Roebling was dedicated to completing the Brooklyn Bridge. Emily and her husband jointly planned the bridge's continued construction. She took over much of the chief engineer duties, including day-to-day supervision and project management. She dealt with politicians, competing engineers, and all those associated with work on the bridge, to the point where people believed she was behind the bridge's design.

PHOEBE SARAH HERTHA AYRTON was a British engineer, mathematician, physicist and inventor, and suffragette. Known in adult life as Hertha Ayrton, born Phoebe Sarah Marks, she was awarded the Hughes Medal by the Royal Society for her work on electric arcs and ripple marks in sand and water.

At Girton, Ayrton studied mathematics and was coached by physicist Richard Glazebrook. George Eliot supported Ayrton's application to Girton College. During her time at Cambridge, Ayrton constructed a sphygmomanometer (blood pressure meter), led the choral society, founded the Girton fire brigade, and formed a mathematical club together with Charlotte Scott. In 1880, Ayrton passed the Mathematical Tripos, but Cambridge did not grant her an academic degree because, at the time, Cambridge gave only certificates and not full degrees to women. Ayrton passed an external examination at the

Alicia Boole Stott
1860 - 1940

Winifred Edgerton Merrill
1862 - 1951

Grace Chisholm Young
1868 - 1944

University of London, which awarded her a Bachelor of Science degree in 1881.

In 1902, Ayrton published "The Electric Arc", a summary of her research and work on the electric arc, with origins in her earlier articles from the Electrician published between 1895 and 1896. With this publication, her contribution to the field of electrical engineering began to be cemented.

ALICIA BOOLE STOTT was an Irish mathematician. Despite never holding an academic position, she made several valuable contributions to the field. Stott learned of Pieter Schoute's work on central sections of the regular polytopes in 1895. Schoute came to England and worked with Alicia Stott, persuading her to publish her results in two papers in Amsterdam in 1900 and 1910. The University of Groningen honoured her by inviting her to attend the tercentenary celebrations of the university and awarding her an honorary doctorate in 1914. After Schoute died in 1913, Alicia took a hiatus from mathematical work. Alicia made two further important discoveries relating to constructions for polyhedra related to the golden section. She presented a joint paper with Coxeter at the University of Cambridge. Coxeter later wrote, "The strength and simplicity of her character combined with the diversity of her interests to make her an inspiring friend.

WINIFRED EDGERTON MERRILL was born in Ripon, Wisconsin. She was the first woman to receive a degree from Columbia University and the first American woman to receive a PhD in mathematics.

She studied math and astronomy at Columbia, which at the time was an all-male institution. Her teachers included Professor John Krom Rees, Professor J. Howard Van Amringe and Professor William Guy Peck. After her first appeal to receive a degree was rejected by the trustees, President Frederick A. P. Barnard advised her to speak to each of the trustees individually. At the next meeting, she was awarded the PhD with high honours from Columbia University in 1886 by a unanimous vote. Her thesis was "Multiple Integrals and Their Geometrical Interpretation of Cartesian Geometry, in Trilinears and Triplanars, in Tangentials, in Quaternions, and Modern Geometry; Their Analytical Interpretations in the Theory of Equations, Using Determinants, Invariants and Covariants as Instruments in the Investigation".

GRACE CHISHOLM YOUNG was an English mathematician. She was educated at Girton College, Cambridge, England and continued her studies at Göttingen University in Germany, where in 1895, she received a doctorate.

This was four years after the decease of Sofya Kovalevskaya, who was the first woman to have received a doctorate at a northern European University, also Göttingen, in 1874, after being tutored privately by her supervisor Karl Weierstrass in the period 1870-1874. Her early writings were published under her husband, William Henry Young, and they collaborated on mathematical work throughout their lives.

Philippa Garret Fawcett
1868 - 1948

Olive Clio Hazlett
1890 - 1974

Lillian Evelyn Moller Gilbreth
1878 - 1972

For her work on calculus (1914–16), she was awarded the Gamble Prize for Mathematics by Girton College, University of Cambridge.

PHILIPPA GARRETT FAWCETT was an English mathematician and educationalist. She was the first woman to obtain the top score in the Cambridge Mathematical Tripos exams. She taught at Newnham College, Cambridge, and the Johannesburg Normal College. She became an administrator for the London County Council. See the link for Philippa's phenomenal success at Cambridge and the rest of the poem:

Hail the triumph of the corset
Hail the fair Philippa Fawcett
Victress in the fray
Crown her queen of Hydrostatics
And the other Mathematics
Wreathe her brow with bay.
If you entertain objections
To such things as conic sections
Put them out of sight
Rather sing of the essential
Beauty of the Differential
Calculus tonight.

OLIVE CLIO HAZLETT was an American mathematician who spent most of her career working for the University of Illinois. She mainly researched algebra and wrote seventeen research papers on subjects such as nilpotent algebras, division algebras, modular invariants, and the arithmetic of algebras.

In 1916 she was appointed to Bryn Mawr College, where she worked for two years before accepting an appointment as an assistant professor at Mount Holyoke College.

She was promoted to associate professor in 1924, the same year she gave a talk on The Arithmetic of a General Associative Algebra at the International Congress of Mathematicians in Toronto.

In 1925 Olive left Mount Holyoke because she felt she was not given enough time or resources to pursue her research in algebra. It was then that she took a job as an assistant professor at the University of Illinois, where she would spend the rest of her career.

LILLIAN EVELYN MOLLER GILBRETH was an American psychologist, industrial engineer, consultant, and educator who was an early pioneer in applying psychology to time-and-motion studies. She was described in the 1940s as "a genius in the art of living."

For more than forty years, Gilbreth's career combined psychology with the study of scientific management and engineering. She also included her perspectives as a wife and mother in her research, writing, and consulting work. Gilbreth became a pioneer in what is now known as industrial and organisational psychology. She helped industrial engineers recognise the importance of the psychological dimensions of work. In addition, she became the first American engineer ever to create a synthesis of psychology and scientific management. (Gilbreth introduced psychology to study management at the Dartmouth College Conference on Scientific Management in 1911.) Gilbreth had a lifelong interest in teaching and education. As an undergraduate at the University of California, Berkeley, she took enough

Amalie Emmy Noether
1882 - 1935

Edith Clarke
1883 - 1959

Martha Euphemia Lofton Haynes
1890 - 1980

education courses to earn a teacher's certificate. Her doctoral dissertation at Brown University was on applying the principles of scientific management to secondary school teaching.

AMALIE EMMY NOETHER was a German mathematician who made many significant contributions to abstract algebra. She discovered Noether's theorem, which is fundamental in mathematical physics. She invariably used the name "Emmy Noether" in her life and publications.

Emmy Noether taught at Bryn Mawr College until she died in 1935. Anna Pell Wheeler, another woman mathematician, was the head of the department at Bryn Mawr and became a great friend of Noether. Wheeler understood how Emmy struggled to have a career in mathematics in Germany and about being uprooted from her homeland. Noether was still a caring and compassionate teacher. She kept up her charismatic teaching style, often lapsing into German if she was having trouble getting her ideas across to the students. Noether's death in 1935 surprised nearly everyone, as she had told only her closest friends of her illness.

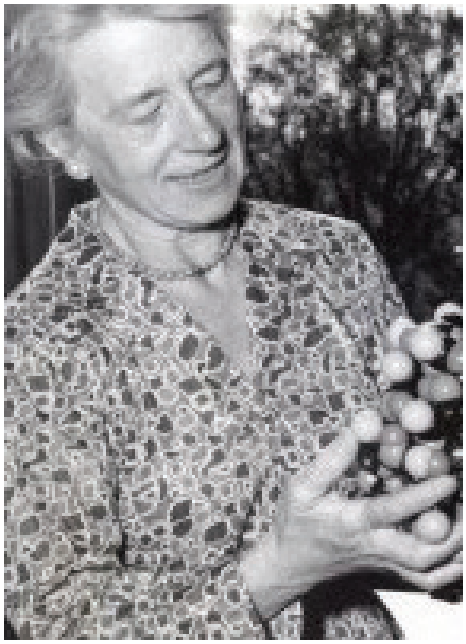
Emmy Noether made many contributions to the field of mathematics. She spent her time studying abstract algebra, with particular attention to rings, groups, and fields. Because of her unique look at topics, she was able to see relationships that traditional algebra experts could not. She published over 40 papers in her lifetime. She was also a teacher who was able to inspire her students to make their contributions to mathematics.

EDITH CLARKE was the first woman to be professionally employed as an electrical engineer in the United States and the first female professor of electrical engineering in the country.

Her background in mathematics helped her achieve fame in her field. On 8 February 1926, as the first woman to deliver a paper at the American Institute of Electrical Engineers (AIEE) annual meeting, she showed the use of hyperbolic functions for calculating the maximum power that a line could carry without instability. The paper was important because the transmission lines were getting longer, leading to greater loads and more chances for system instability. Clarke's paper provided a model that applied to large systems. Two of her later papers won awards from the AIEE: the Best Regional Paper Prize in 1932 and the Best National Paper Prize in 1941.

She also worked on the design and building of hydroelectric dams in the West Hoover Dam, contributing her electrical expertise to develop and install the turbines that generate hydropower there to this day.

In 1943, Clarke wrote an influential textbook in power engineering, "Circuit Analysis of A-C Power Systems", based on her notes for lectures to GE engineers. This two-volume textbook teaches about her adaption of the symmetrical components system, which she became interested in while working for the second time at GE. This system is a mathematical means



Cypra Cecilia Krieger-Dunaij
1894 - 1974

Getrude Blanch
1897 - 1996

for engineers to study and solve power system losses and the performance of electrical equipment. Clarke adopted this system to the three-phase components that are the basis of the electrical grid in the United States. This textbook was used as the basis of education for electrical engineers for many years.

MARTHA EUPHEMIA LOFTON HAYNES was an American mathematician and educator. She was the first African-American woman to earn a PhD in mathematics, which she earned from the Catholic University of America in 1943.

CYPRA CECILIA KRIEGER-DUNAIJ was an Austro-Hungarian-born mathematician of Jewish ancestry who lived and worked in Canada. Krieger was the third person to earn a PhD in mathematics from a university in Canada in 1930 and the third woman to have been awarded a doctorate in any discipline in Canada.

Krieger began studying mathematics and physics at the University of Vienna in 1919 but moved with her family to Toronto, Ontario, Canada, in 1920. Krieger earned a BA in 1924 and a MA in 1925 from the University of Toronto. She obtained her PhD from the same university in 1930. Under the supervision of W.J. Webber, her thesis was titled "On the summability of trigonometric series with localised parameters—on Fourier constants and convergence factors of double Fourier series".

While pursuing her PhD, Krieger was appointed as an instructor in 1928 and promoted to Lecturer in 1930 when she completed her PhD. Krieger continued working at the rank of Lecturer until she was promoted to assistant professor at the University of Toronto in 1942. She taught in both the Department of Engineering and the Department of Mathematics.

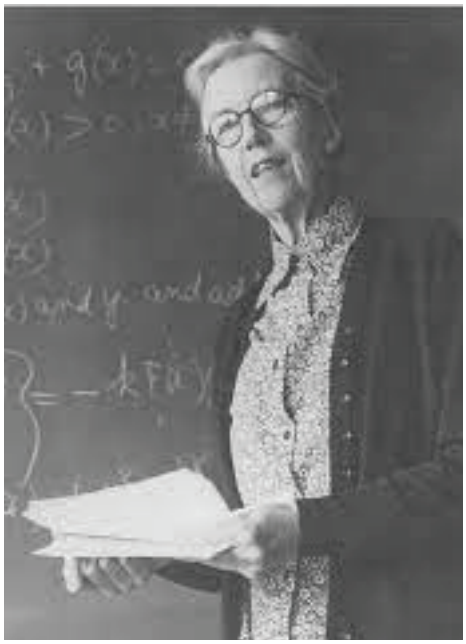
GERTRUDE BLANCH (born February 1897, in Kolno, Russian Empire, now Poland) – 1 January 1996) was an American mathematician who did pioneering work in numerical analysis and computation. She was a leader of the Mathematical Tables Project in New York from its beginning. She worked as the assistant director and leader of the Numerical Analysis at UCLA computing division.

She was head of mathematical research for the Aerospace Research Laboratory at Wright-Patterson Air Force Base in Dayton, Ohio.

Blanch received her Bachelor of Science degree in Mathematics with a minor in Physics from New York University. She graduated with summa cum laude and was a member of Phi Beta Kappa, a prestigious academic honour society.

That same year, she changed her name from Kaimowitz to Blanch, an Americanised version of her mother's name. After writing her thesis titled "Properties of the Veneroni Transformation in S4", she received her PhD from Cornell University in algebraic geometry in 1935.

The results from her thesis were published in the American Journal of Mathematics in 1936.



Mary Lucy Cartwright
1900 - 1998

Mina Spiegel Rees
1902 - 1997

Irmgard Flugge-Lotz
1903- 1974

DAME MARY LUCY CARTWRIGHT was a British mathematician. She was one of the pioneers of what would later become known as chaos theory. Along with J. E. Littlewood, Cartwright saw many solutions to a problem which would later be seen as an example of the butterfly effect.

MINA SPIEGEL REES was an American mathematician. She was the first female President of the American Association for the Advancement of Science (1971) and head of the mathematics department of the Office of Naval Research of the United States. Rees was a pioneer in the history of computing and helped establish funding streams and institutional infrastructure for research.

Rees was also the founding president and president emerita of the Graduate School and University Centre at CUNY. She received the Public Welfare Medal, the highest honour of the National Academy of Sciences, the King's Medal for Service in the Cause of Freedom (UK) and at least 18 honorary doctorates.

"I wanted a life which would never be boring - a life in which new things would always occur" - and thus began IRMGARD FLUGGE-LOTZ'S career as an engineer. Flugge-Lotz was internationally renowned for her contributions to aerodynamics and automatic theory control.

During the 1960's she was one of Stanford University's most distinguished professors. Several of her honours include the Achievement Award by the Society of Women Engineers in 1970, an honorary Doctor of Science degree by the University of Maryland in 1973, and selection by the American Institute of Aeronautics and Astronautics (AIAA) to give the prestigious annual von Karman Lecture in 1971.

The citation from her honorary doctorate provides a concise and independent evaluation of her career:
Professor Flugge-Lotz has acted in a central role in developing the aircraft industry in the Western world. Her contributions have spanned a lifetime during which she demonstrated, in a field dominated by men, the value and quality of a woman's intuitive approach in searching for and discovering solutions to complex engineering problems. Her work manifests unusual personal dedication and native intelligence.

ELIZABETH MURIEL "ELSIE" MACGILL, known as the "Queen of the Hurricanes" graduated from the University of Toronto in 1927 and was the first Canadian woman to earn a degree in electrical engineering; and in 1929 became the first woman in North America to be awarded a master's degree in aeronautical engineering.

In 1940 she remarked: "My presence in the University of Toronto's engineering classes in 1923 indeed turned a few heads. Although I never learned to fly myself, I accompanied the pilots on all test flights – even the dangerous first flight – of any aircraft I worked on."

She's credited with helping strengthen Canada's aircraft construction industry as the first woman to work as a chief aeronautical engineer at Canadian Car and Foundry (CanCar). At CanCar, she designed and tested a new training aircraft, the Maple Leaf Trainer II,

Elizabeth Murial MacGill
1905 - 1980

Emma Trotskaia
1906 - 2007

Dorothy Johnson Vaughan
1910 - 2008

during World War II. When the factory was chosen to build the Hawker Hurricane fighter aircraft for the Royal Air Force, MacGill's role changed. As the factory's workforce expanded from about 500 to 4,500 by the end of the war, she was tasked with streamlining operations in the production line.

MacGill was also responsible for designing solutions to allow the aircraft to operate during the winter, introducing de-icing controls and a system for fitting skis for landing on snow.

EMMA TROTSKAIA was born in Samara, Russia, but her college education was at the University of California at Berkeley. She earned a BA with honours in mathematics in 1928.

She married Derrick Henry Lehmer, a Berkeley physics major, that same year. Her father-in-law, Derrick Norman Lehmer, was also a mathematician who had employed Emma (at student wages) to do some tedious tabulating work that his son was also helping him with.

Emma and her husband moved to Brown University, where D.H. Lehmer received his PhD in mathematics, and Emma Lehmer received a master's degree, both in 1930. Her master's thesis was on "A Numerical Function Applied to Cyclotomy".

After her husband's death in 1991, Emma wrote up her husband's unfinished work and oversaw the publication of those materials.

In August 2000, UC Berkeley hosted the Lehmer Conference to highlight the mathematical contributions, inventions, and influences from Derrick Norman Lehmer, Derrick Henry Lehmer, and Emma Lehmer. It took three days and fifteen speakers to cover the range of their mathematical interests.

DOROTHY JOHNSON VAUGHAN was an African American mathematician and human-computer who worked for the National Advisory Committee for Aeronautics, and NASA, at Langley Research Centre in Hampton, Virginia.

In 1935, the NACA had established a section of women Mathematicians who performed complex calculations. Vaughan prepared to introduce machine computers in the early 1960s by teaching herself and her staff the Fortran programming language. She later headed the programming section of the Analysis and Computation Division (ACD) at Langley.

DOROTHY LEWIS BERNSTEIN attended North Division High School in Milwaukee. In 1930 she attended the University of Wisconsin, where she held a University Scholarship (1933–1934) and was elected to Phi Beta Kappa. In 1934 she graduated with both a BA degree, summa cum laude, and a MA. Degree in Mathematics. She did her master's thesis research on finding complex roots of polynomials by an extension of Newton's method. In 1935 she attended Brown University, where she became a member of the scientific society Sigma Xi. She received her PhD in mathematics from Brown in 1939 while simultaneously holding a teaching position at Mount Holyoke College. Her dissertation was

Dorothy Lewis Bernstein
1914 - 1988

Marjorie Lee Browne
1914 - 1979

Jacqueline Lelong-Ferrand
1918 - 2014

titled "The Double Laplace Integral" and was published in the Duke Mathematical Journal.

From 1943 to 1959, Bernstein taught at the University of Rochester, where she worked on existence theorems for partial differential equations. Her work was motivated by non-linear problems that were just being tackled by high-speed digital computers. In 1950, Princeton University Press published her book, Existence Theorems in Partial Differential Equations.

Goucher College was the first women's university to use computers in mathematics instruction, beginning in 1961. In 1972 Bernstein co-founded the Maryland Association for Educational Uses of Computers and was interested in incorporating computers into secondary school mathematics.

Bernstein was very active in the Mathematical Association of America, where she served on the governors' board from 1965 to 1968. She served as the vice president in 1972–73 and later became the first female president of the MAA in 1979–80.

She noted that attitudes and opportunities for women changed drastically after World War II, which she attributed to two causes. First, women demonstrated they could handle the jobs formerly held by men. Second, the rise of computer technology opened up many new areas of mathematical applications resulting in new jobs.

MARJORIE LEE BROWNE was a mathematics educator. She was one of the first African-American women to receive a PhD in mathematics. She briefly taught at Gilbert Academy in New Orleans. She earned her MS in mathematics from the University of Michigan in 1939, then joined the Wiley College faculty in Marshall, Texas, and started working on her doctorate in Michigan during summers. She became a teaching fellow in 1947 at the University of Michigan. In 1949, Marjorie earned her doctorate in mathematics. She was among the first Black women to earn a doctorate in mathematics. Doctor Browne went to North Carolina College (now North Carolina Central University), where she taught mathematics after graduating from Michigan University. She became the chair of the Mathematics department in 1951; she resigned as department chair in 1970. She stayed at NCCU until she retired in 1979. In 1952-1953, Marjorie won a Ford Foundation fellowship to study combinatorial topology at Cambridge University and travelled throughout western Europe. Dr Browne was a National Science Foundation Faculty Fellow studying computing and numerical analysis at the University of California at Los Angeles. When she studied differential topology at Columbia University in 1965-66, she won a similar fellowship.

JACQUELINE LELONG-FERRAND was a French mathematician who worked on conformal representation theory, potential theory, and Riemannian manifolds. She taught at universities in Caen, Lille, and Paris.

She published three papers in 1941 and defended a doctoral thesis in 1942.

Creola Katherine Johnson
1918 - 2020

Julia Hall Bowman Robinson
1919 - 1985

Deborah Tepper Haimo
1921 - 2007

In 1943 she won the Girbal-Baral Prize of the French Academy of Sciences and obtained a faculty position at the University of Bordeaux. She moved to the University of Caen in 1945, was given a chair at the University of Lille in 1948, and in 1956 moved to the University of Paris as a full professor. She retired in 1984.

Ferrand had nearly 100 mathematical publications, including ten books, and was active in mathematical research into her late 70s. One of her accomplishments, in 1971, was to prove the compactness of the group of conformal mappings of a non-spherical compact Riemannian manifold, resolving a conjecture of André Lichnerowicz based on this work, she became an invited speaker at the 1974 International Congress of Mathematicians in Vancouver.

CREOLA KATHERINE JOHNSON was an American mathematician whose calculations of orbital mechanics as a NASA employee were critical to the success of the first and subsequent US crewed spaceflights.

Awards: Presidential Medal of Freedom, NASA Group Achievement Award, Congressional Gold Medal.

JULIA HALL BOWMAN ROBINSON was an American mathematician noted for her contributions to computability theory and computational complexity theory—most notably in decision problems. She received her doctorate in 1948.

In that year, Robinson began to work on the Tenth Problem of David Hilbert's famous list: "to find an effective method for determining if a given Diophantine equation [polynomial equations of several variables, with integer coefficients, whose solutions are to be integers] is solvable in integers". This problem occupied most of her professional career, and in 1950 she presented some of her work in a ten-minute speech to the International Congress of Mathematics in Cambridge, Massachusetts.

In the summer of 1959, Martin Davis and Hilary Putnam sent Robinson their work on a theorem which later became

an essential part of the solution to the Tenth Problem. Robinson was a 1983 MacArthur Fellow.

DEBORAH TEPPER HAIMO was an American mathematician who became president of the Mathematical Association of America. Her research concerned "classical analysis, in particular, generalisations of the heat equation, special functions, and harmonic analysis".

She attended the Girls' Latin School in Boston and first became excited by mathematics in her sophomore year when she studied Euclidean geometry.

Entering Radcliffe College, she began studying physics because she thought that studying mathematics could only lead to a career as a schoolteacher. At that time, teachers were dismissed once they married. However, her experiences with unknown environmental influences in physics experiments led her back to mathematics, where "we have control over our assumptions". As an upper-division undergraduate at Radcliffe,

Mary Jackson
1921 - 2005

Cathleen Synge Morawrtz
1923 - 2017

Yvonne Choquet-Bruhat
1923 - 1961

Haimo could enrol in mathematics courses at Harvard College. Her instructors there included Hassler Whitney and Saunders Mac Lane, and it was in one of these classes that she met her future husband, Franklin Tepper Haimo. She graduated in 1943 from Radcliffe, with both a bachelor's and master's degree in mathematics. On completing her doctorate, she was promoted to a regular-rank faculty member at Southern Illinois.

MARY JACKSON was an American mathematician and aerospace engineer at the National Advisory Committee for Aeronautics, which in 1958 was succeeded by the National Aeronautics and Space Administration. She worked at Langley Research Centre in Hampton, Virginia, for most of her career.

Jackson worked as an engineer in several NASA divisions: the Compressibility Research Division, Full-Scale Research Division, High-Speed Aerodynamics Division, and the Subsonic-Transonic Aerodynamics Division. She ultimately authored or co-authored 12 technical papers for NACA and NASA. She worked to help women and other minorities advance their careers, including advising them how to study to qualify for promotions.

CATHLEEN SYNGE MORAWETZ was a Canadian mathematician who spent much of her career in the United States. Morawetz's research mainly studied partial differential equations governing fluid flow, particularly mixed type occurring in transonic flow.

A graduate of the University of Toronto in 1945, Morawetz received her master's degree in 1946 at the Massachusetts Institute of Technology. Morawetz got a job at New York University, where she edited Supersonic Flow and Shock Waves by Richard Courant and Kurt Otto Friedrichs.

She earned her PhD in 1951 at New York University, with a thesis on the stability of a spherical implosion, under the supervision of Kurt Otto Friedrichs. Her thesis was titled "Contracting Spherical Shocks Treated by a Perturbation".

In 1957 she became an assistant professor at Courant. At this point, she began to work more closely with her colleagues publishing important joint papers with Peter Lax and Ralph Phillips on the decay of solutions to the wave equation around a star-shaped obstacle. She continued with important solo work on the wave equation and transonic flow around a profile until she was promoted to full professor by 1965.

YVONNE CHOQUET-BRUHAT is a French mathematician and physicist. She has made seminal contributions to the study of Einstein's general theory of relativity by showing that the Einstein equations can be put into the form of an initial value problem which is well-posed.

MARY ELLEN RUDIN was an American mathematician known for her work in set-theoretic topology. In 2013, Elsevier established the Mary Ellen Rudin Young Researcher Award, which is awarded annually to a young researcher, mainly in fields adjacent to general topology.

Mary Ellen Rudin
1924 - 2013

Rudin is best known in topology for her constructions of counterexamples to well-known conjectures. In 1958, she found an unshellable triangulation of the tetrahedron.

Most famously, Rudin was the first to construct a Dowker space, which she did in 1971, thus disproving a conjecture of Clifford Hugh Dowker that had stood and helped drive topological research for more than twenty years.

Her example fuelled the search for "small" ZFC Dowker spaces. She proved the first Morita conjecture and a restricted version of the second.

Her last significant result was proof of Nikiel's conjecture. Early proofs that every metric space is paracompact were somewhat involved, but Rudin provided an elementary one.

LENORE CAROL BLUM is an American computer scientist and mathematician, formerly a distinguished career professor of computer science at Carnegie Mellon University.

Lenore Carol Blum
1924

After graduating from her Venezuelan high school at age 16, she studied architecture at Carnegie Institute of Technology (now Carnegie Mellon University) beginning in 1959.[3][4] With the assistance of Alan Perlis, she shifted fields to mathematics in 1960.

She married Manuel Blum, then a student at the Massachusetts Institute of Technology, and transferred in 1961 to Simmons College, a private women's liberal arts college in Boston. Simmons did not have a strong mathematics program, but she eventually took Isadore Singer's mathematics classes at MIT, graduating from Simmons with a BS in mathematics in 1963.

She received her PhD in mathematics from the Massachusetts Institute of Technology in 1968. Her dissertation, Generalised Algebraic Theories: A Model Theoretic Approach, was supervised by Gerald Sacks.

She had switched to being advised by Sacks after being unable to follow an earlier advisor in his move to Princeton University because, at the time, Princeton did not accept female graduate students.

Evelyn Boyd Granville
1924

EVELYN BOYD GRANVILLE was the second African-American woman to receive a PhD in mathematics from an American University; she earned it in 1949 from Yale University.

Boyd received an undergraduate degree in mathematics and physics from Smith College, Northampton, Mass., in 1945. She received a doctoral degree in mathematics in 1949 from Yale University, New Haven, Connecticut, where she studied under Einar Hille.

From 1949 to 1950 she had a postdoctoral fellowship at New York University, and from 1950 to 1952 she was an associate professor of mathematics at Fisk University, Nashville, Tennessee.

Boyd returned to academic life in 1967 as an assistant professor of mathematics at California State University, Los Angeles.

Lois Graham
1925 - 2013

Joan Sylvia Lyttle Birman
1927

Lida Baker Kittrell Barrett
1927 - 2021

LOIS GRAHAM was a professor of thermodynamics and cryogenics.

She was the first woman to earn a mechanical engineering PhD in the United States. Graham is remembered for her lifelong work recruiting young women into careers in science and engineering. She taught for nearly 40 years in the Illinois Institute of Technology's (IIT) Mechanical, Materials and Aerospace Engineering program.

Graham founded IIT's Women in Science and Engineering program, which recruited female high school students into science and engineering careers.

JOAN SYLVIA LYTTLE BIRMAN is an American mathematician specialising in low-dimensional topology. She has contributed to the study of knots, 3-manifolds, mapping class groups of surfaces, geometric group theory, contact structures and dynamical systems. After earning her bachelor's degree from Barnard, Birman accepted a position at the Polytechnic Research and Development Co., which was affiliated with Brooklyn Polytechnic University. She later worked from the Technical Research Group and the W. L. Maxson Corporation.

Birman's first academic position was at the Stevens Institute of Technology (1968–1973). In 1969 she published "On Braid Groups", which introduced the Birman Exact Sequence, which became one of the most essential tools for studying braids and surfaces.

During the later part of this period, she published a monograph, 'Braids, links, and mapping class groups' based on a graduate course she taught as a visiting professor at Princeton University in 1971–72. This book is considered the first comprehensive treatment of braid theory, introducing the modern theory to the field, and contains the first complete proof of Markov's theorem.

In 1973, she joined the faculty at Barnard College. She was a visiting scholar at the Institute for Advanced Study in the summer of 1988.

LIDA BAKER KITTRELL BARRETT was an American mathematics professor and administrator. She served on many committees and boards and contributed to mathematics, mathematics education, and increasing the participation of underrepresented groups in mathematics.

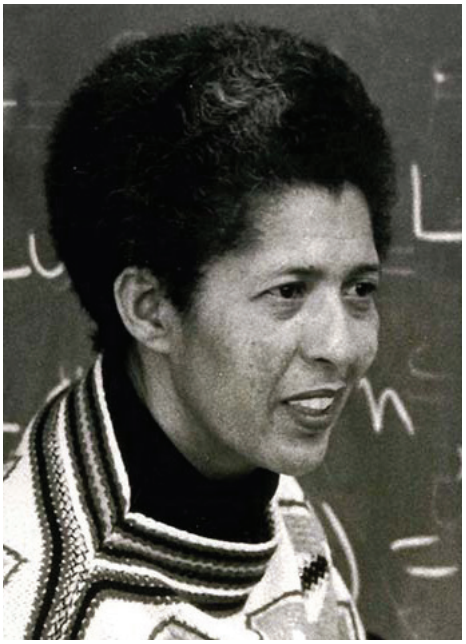
She served as president of the Mathematical Association of America in 1989 and 1990.

Barrett served as a mathematics faculty member at the universities of Utah and Tennessee and headed the mathematics department at the University of Tennessee from 1973 to 1980. During her tenure there, she also worked at The Oak Ridge National Laboratory in applied mathematics.

She served as an administrator and mathematics faculty member at Northern Illinois University, where she was Associate Provost, and at Mississippi State University, where she was Dean of Arts and Sciences. After retirement as Dean Emerita from MSU, she was a Senior Associate to

Nancy Burr Deloye Fitzroy
1927

Etta Zuber Falconer
1933 - 2002



Gloria Conyers Hewitt
1935

the head of the Education Directorate at the National Science Foundation for three years. She then served as a Professor of Mathematics at the United States Military Academy at West Point for three years.

NANCY BURR DELOYE FITZROY is an exceptional engineer, pilot and charismatic person, and an American engineer specialising in heat transfer and fluid dynamics.

She became the first female student to study chemical engineering at the Rensselaer Polytechnic Institute, graduating with a bachelor's degree in 1949. Hired by Knolls Atomic Power Laboratory in 1950, she worked as an assistant engineer with the heat transfer group.

In 1952, she became a development engineer for General Electric, initially working on the Hermes Missile Program and designing heat transfer surfaces for nuclear reactor cores.

Nancy would remain with the General Electric company for the next 37 years. Nancy specialised as a heat transfer engineer with the Advanced Technology Laboratories beginning in 1963. In 1965 she was a heat transfer consultant with the Research and Development Centre, working on gas turbines, space satellites and other technologies. She was appointed editor of the "GE heat transfer and fluid flow data books", a reference work made available by subscription to engineers worldwide beginning in 1970. Nancy Fitzroy was one of the first female helicopter pilots, and both she and her husband enjoyed flying, sailing and travelling.

ETTA ZUBER FALCONER was an educator and mathematician, the bulk of whose career was spent at Spelman College, where she eventually served as department head and associate provost. She was one of the earlier African-American women to receive a PhD in mathematics.

Zuber graduated summa cum laude from Fisk University in Nashville, Tenn., in 1953 with a bachelor's degree in mathematics. Among her teachers at Fisk was mathematician Evelyn Granville, one of the first African American women to receive a doctoral degree in mathematics. Zuber then received a master's degree in mathematics from the University of Wisconsin, Madison. From 1954 to 1963 she taught at Okolona Junior College in Mississippi, marrying basketball coach Dolan Falconer the year she began there.

GLORIA CONYERS HEWITT is an American mathematician. She was the fourth African-American woman to receive a PhD in Mathematics. Her main research interests were group theory and abstract algebra. She is the first African American woman to chair a math department in the United States. She entered Fisk University in 1952 and graduated in 1956 with a degree in secondary mathematics education. Without her knowledge, department chairman Lee Lorch recommended Hewitt to two graduate schools. As a result, she was offered a fellowship at the University of Washington in her senior year, though she had not applied for it. Hewitt received her masters

Bhama Srinivasan
1935

Mary Lee Wheat Gray
1938

Linda Jo Goldway Keen
1940

from there in 1960 and then her PhD (with a thesis on "Direct and Inverse Limits of Abstract Algebras") in 1962.

BHAMA SRINIVASAN is a mathematician known for her work in the representation theory of finite groups. Her contributions were honoured with the 1990 Noether Lecture.

Srinivasan was born in Madras, India. She attended the University of Madras, where she earned her bachelor of arts degree in 1954 and her master of science degree in 1955. She travelled to England for her doctoral study.

She remained in England to commence her professional academic career as a lecturer in mathematics at the University of Keele from 1960 through 1964. She then pursued a postdoctoral fellowship at the University of British Columbia through the National Research Council of Canada from 1965 through 1966.

She returned home to India to teach at the Ramanujan Institute of Mathematics of her Alma mater, the University of Madras, from 1966 through 1970. She served as President of the Association for Women in Mathematics from 1981 to 1983.

MARY LEE WHEAT GRAY is an American mathematician, statistician, and lawyer. She is the author of books and papers in mathematics, mathematics education, computer science, applied statistics, economic equity, discrimination law, and academic freedom.

Mary Gray was one of the primary founders of the Association for Women in Mathematics (AWM) and its first president from 1971 to 1973. Patricia Kenschaft provides the following story about one of Gray's first acts as president:

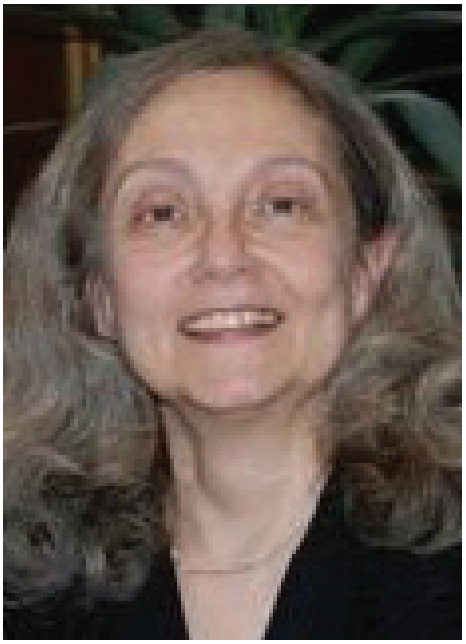
Mary Gray decided that women needed to be more integral to the central decision-making process of the American Mathematical Society (AMS). Shortly after she became president of the AWM, she carefully read the AMS bylaws and discovered that the AMS Council meetings were officially open to all members. One of her first acts as first AWM president was to show up in the room where the Council was about to meet and sit down.

She was asked to leave. She replied that according to the bylaws, the AMS Council meetings were open to all members, and she was a duly paid member. The response was that there was a gentleman's agreement that only board members would be present during board meetings.
"I'm not a gentleman," was her now-famous reply. "I'm staying."

LINDA JO GOLDWAY KEEN is a mathematician and a fellow of the American Mathematical Society. Since 1965, she has been a Professor in the Department of Mathematics and Computer Science at Lehman College. Keen has worked at the Institute for Advanced Study, Hunter College, University of California at Berkeley, Columbia University, Boston University, Princeton University, the Massachusetts Institute of Technology, and various mathematical institutes in Europe and South America. After her initial appointment in 1965, in 1974,

Sylvia Wiegand
1945

Sun-Yung Alice Chang
1948



Georgia McClure Benkart
1949

Keen was promoted to Full Professor at Lehman College and the CUNY Graduate Centre. She is currently Executive Officer of the Mathematics Program at the Graduate Centre.

SYLVIA WIEGAND was born in Cape Town, South Africa. She is the daughter of mathematician Laurence Chisholm Young and the granddaughter of mathematicians Grace Chisholm Young and William Henry Young. Her family moved to Wisconsin in 1949, and she graduated from Bryn Mawr College in 1966 after three years of study. In 1971 Wiegand earned her PhD from the University of Wisconsin-Madison. Her dissertation was titled "Galois Theory of Essential Expansions of Modules and Vanishing Tensor Powers."

In 1987 she was named a full professor at the University of Nebraska; Wiegand was the only female professor in the department. In 1988 Sylvia headed a search committee for two new jobs in the math department, for which two women were hired, although one stayed only a year and another left after four years. In 1996 Sylvia and her husband, Roger Wiegand, established a fellowship for graduate student research at the university in honour of Sylvia's grandparents.

SUN-YUNG ALICE CHANG is a Taiwanese American mathematician specialising in mathematical analysis ranging from harmonic analysis and partial differential equations to differential geometry.

She is the Eugene Higgins Professor of Mathematics at Princeton University as of 1998.

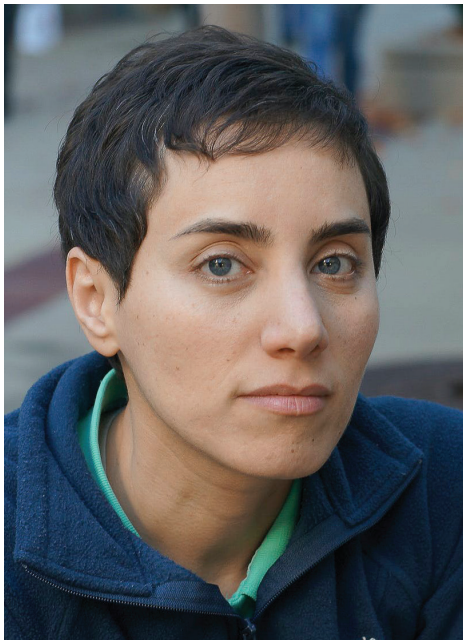
In 2004, she was interviewed by Yu Kiang Leong for Creative Minds, Charmed Lives: Interviews at Institute for Mathematical Sciences, National University of Singapore, and she declared: "In the mathematical community, we should leave room for people who want to do work in their own way. Mathematical research is not just a scientific approach; the nature of mathematics is sometimes close to that of art. Some people want individual character and an individual way of working things out. They should be appreciated too. There should be room for single research and collaborative research».

Chang's life was profiled in the 2017 documentary film Girls who fell in love with Math.

GEORGIA MCCLURE BENKART is an American mathematician known for her work in the structure and representation theory of Lie algebras and related algebraic structures.

Benkart received her BS from the Ohio State University in 1970 and an M. Phil. in Mathematics from Yale University in 1973. She completed her doctoral work at Yale under Nathan Jacobson and wrote a dissertation titled "Inner Ideals and the Structure of Lie Algebras". She was awarded a PhD in Mathematics from Yale University in 1974.

Upon completing her doctoral degree, Benkart began her long career at the University of Wisconsin–Madison, first as a MacDuffee Instructor and eventually as an E. B. Van Vleck Professor of Mathematics until she



Maryam Mirzakhani
1977 - 2017

Danielle Merfeld
1973

retired from teaching in 2006. She held visiting positions at the Mathematical Sciences Research Institute in Berkeley, California, the Institute for Advanced Study in Princeton, New Jersey, the Aspen Centre for Physics, and the University of Virginia.

MARYAM MIRZAKHANI was an Iranian mathematician and a professor of mathematics at Stanford University. Her research topics included Teichmüller theory, hyperbolic geometry, ergodic theory, and symplectic geometry.

From 2004 to 2008, Mirzakhani was a Clay Mathematics Institute Research Fellow and assistant professor of mathematics at Princeton University. In 2006 she was recognised as one of Popular Science's "Brilliant 10" extraordinary scientists. In 2008 she joined the faculty at Stanford University as a full professor of mathematics.

In August 2014, she was the first woman to be awarded the prestigious mathematics Fields Medal "for her outstanding contributions to the dynamics and geometry of Riemann surfaces and their moduli spaces."
Awards: Fields Medal, Blumenthal Award, Ruth Lyttle Satter Prize in Mathematics, Clay Research Award.

DANIELLE MERFELD

Driven by her passion for renewable energy, Danielle Merfeld is spearheading technical efforts to develop differentiated products and services across a broad renewable energy portfolio at GE, which combines onshore and offshore wind, blades, hydro, storage, utility-scale solar, and grid solutions as well as hybrid renewables and digital services offerings. Merfeld received her bachelor's degree in electrical engineering from the University of Notre Dame and a doctorate in electrical engineering from Northwestern University. Before her current role, she was the vice president and general manager at GE Global Research Centre. Before moving to GE's global research division, Merfeld ran the company's solar business, working on ways to make solar electricity accessible and affordable for communities. She is currently the co-leader of the GE Women's Network, a global organisation focused on recruiting, retaining, developing, and promoting talented women across the company.

One of the last business trips Danielle Merfeld took before the pandemic was to get an up-close look at the prototype for GE's Haliade-X, the most powerful offshore wind turbine in operation, installed at the tip of the Port of Rotterdam in the Netherlands. Merfeld, the chief technology officer at GE Renewable Energy, recalls feeling a sense of awe as she watched the three blades — each spanning the length of a football field — turn slowly on the 260-meter turbine tower, generating enough energy to power tens of thousands of Dutch households.

"When I saw that in person and went into the bottom of the tower, you can't help but look up and think, 'We did it — we made this cool thing that's going to sit out in the ocean and create renewable energy and help power the world," Merfeld says. wn

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As a new world of work takes shape in the aftermath of the crisis, many of us are also adjusting to 'hybrid work' – where staff split their time between the office, home and local flex spaces.

BUT WHAT ABOUT 'ASYNCHRONOUS WORKING'?

- Your time, not real-time

'Asynchronous' literally means 'not occurring at the same time', and it describes a situation where you might be working quite different hours from your colleagues.

It means that exchanges of information often don't happen in real-time. Instead, they happen on your own time – via email, VoiceNote or instant messaging software.

"Asynchronous working isn't new. Suppose you work in an industry where teammates are based overseas. In that case, you've likely been doing it for years – and the increased flexibility that many employers were forced to offer during lockdowns led to more asynchronous activity than ever", says Joanne Bushell, MD of IWG Plc. South Africa (Regus and Spaces in SA).

Now, as the pandemic appears to be coming under control, asynchronous working seems set to claim a permanent place in many working lives.

ADVANTAGES OF ASYNCHRONOUS WORKING

An obvious advantage of the asynchronous approach is that it empowers employees to work in a way that's effective for them.

How colleagues communicate with one another is vital.

Synchronous communication requires engagement in the present, whether it takes place around a table in a meeting room or via Zoom call. Often, people expect – or feel it's incumbent upon them – to give immediate answers to any questions they're asked.

A NEW BUSINESS BUZZWORD:

Asynchronous Working

The Covid-19 pandemic has spawned its own vocabulary over the past year and a half. Terms such as 'lockdown', 'R rate' and 'social distancing' have become part of our day-to-day discourse.

Asynchronous communication frees the individual to approach a task, project or problem when they're in the right mindset for tackling it. It also allows them the time to offer considered responses to anything teammates might ask. A short delay provides space for the sort of strategic thinking that it's impossible to put behind a quick-fire comeback.

Asynchronous working inevitably means fewer meetings and thus less meeting fatigue. It also enables employees to embark on more prolonged periods of focused work to concentrate without fear of interruption.

Another advantage of asynchronous work is that it usually means there's a communications' trail'. When people use platforms such as Microsoft Teams, Slack or Google docs for collaboration, there's often a written record of who's said what, so it's unlikely that critical points will be forgotten and difficult for information to slip through the cracks.

Challenges of asynchronous working

One obvious challenge of asynchronous communication is that it means less immediate feedback from colleagues. This lack of engagement can be discouraging or demotivating when – in a synchronous situation – a teammate's smile or "Well done" might have made all the difference.

The reduction in opportunities for 'watercooler moments' is also worth noting: opportunities for spontaneous collaboration are fewer and further between when teammates aren't available to chat during the same periods.

Organisations where asynchronous communication is the norm also tend to prioritise employees to stay up to date on projects and policies. When the answer to what should be on your to-do list for the day lies in a Google doc instead of with a person you can talk to, the onus is on you to check and respond to it.

Employers need to trust their people for asynchronous working to be effective. Where they don't, leaders end up micromanaging their teams and, ironically, the freedom to work asynchronously might mean employees are subject to more clock-watching than during a traditional 9-to-5 day.

Communicating primarily via email and messenger services can also cause issues. Reading the tone of messages isn't always easy, and they can be misconstrued in ways that are less likely when people meet face to face.

Similar to working from home, asynchronous hours can blur the line between your life and your job. Moreover, some asynchronous workers complain about the sheer volume of messages they receive – not to mention the pressure to stay on top of them. Basing yourself at a local Regus rather than in your own home is one way to help to mitigate this.

MAKING ASYNCHRONOUS WORK WELL

"In the new world of hybrid work, it seems likely that many firms will adopt a mixed approach to asynchronous working. Some employees might work asynchronously for some of the time, perhaps with core hours set for most colleagues, or defined as mandatory for everyone on particular days", Bushell adds.

Even in a largely synchronous role, it's possible to claim some advantages of asynchronous communication. Demarcating separate windows for checking and responding to your emails, for instance, can open up lengthier periods for completing complex tasks.

Likewise, employing software such as Trello or Asana can allow for remote and asynchronous project management, reducing the need for a catch-up meeting, whether virtual or face-to-face.

Blake Thorne of management software firm I Done This says that we can all make small changes to improve our productivity. "We have many asynchronous tools at our fingertips," he comments. "But we've been using them like synchronous tools." Thorne argues that picking up your emails within seconds or answering every Teams Chat message immediately is not what these tools were designed for.

"The modern workplace is filled with communication and chat tools like Slack, Zoom, Skype, Google Hangouts and more," Thorne concludes. "When used properly, they allow us to spend less time talking and more time working." wn

Hybrid working can lead to greater productivity and a better work-life balance. Use our location finder to search for a Regus centre near you.

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SAIEE CALENDAR

AUGUST 2021

DATE	TITLE	CPD CREDITS
04/08/2021	Fundamentals of Power Distribution	2
05/08/2021	Principles of Practical Machine Learning	TBC
10/08/2021	Incident Investigation And Root Cause Analysis	2
11/08/2021	Photovoltaic Solar Systems	2
11/08/2021	SALTO Workshop - Day 1	TBC
12/08/2021	SALTO Workshop - Day 2	TBC
17/08/2021	Planning Strategic Feasibility Studies	3
17/08/2021	SAIEE Load Research Chapter morning seminar	TBC
18/08/2021	SALTO Webinar	TBC
19/08/2021	HV Measurement and Testing	2
19/08/2021	KZN webinar: "Striving for a future of inclusive and equitable women's participation in STEM"	TBC
24/08/2021	OHS ACT	2
24/08/2021	SAIEE President's Invitational Lecture: "Enhancing Manufacturing competitiveness in South Africa: A perspective on Supply Chain & Logistics"	TBC
25/08/2021	An Introduction To Artificial Intelligence For Engineering Professionals	2.5
25/08/2021	SAIEE Rotating Machine Section webinar	TBC
26/08/2021	Cable Jointing, Termination and Testing	2
26/08/2021	SAIEE Women in Engineering Chapter webinar	-
30/08/2021	Design Thinking and Innovation for Engineering Professionals	2
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31/08/2021	SAIEE Cybersecurity Webinar	TBC

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