Women in Science

“We need diverse representation at all levels of STEMM, including in leadership.”
– Namandjé N. Bumpus, PhD

“Establishing links is vital for this career path and it also provides a supportive network to learn and grow.”
– Winnie Courtene-Jones, PhD

“Find great mentors to inspire and challenge you... set goals and be your own champion.”
– Kristen Radford, PhD
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Jane C. Wright: The Woman Who Changed the Landscape of Oncology

By Holly Large

Dr Jane Cooke Wright – whether you’ve heard of her or not, her research changed the path of oncology, paving the way for cancer treatment as we know it.

In a time when medicine and research were predominantly white and male, Jane and her family had challenged the preconceptions of what a scientist should be. Jane and her sister, Barbara, represented the third generation of Wright family medics; the tradition began with their grandfather, who, after being born into slavery, later graduated from Meharry Medical College as valedictorian of his class. Their father, Dr Louis Tompkins Wright, was one of the first African-American graduates of Harvard Medical School and founded the Harlem Hospital Cancer Research Foundation (HHCRF).

After briefly considering the idea of pursuing an art degree, Wright graduated with honors from New York Medical College and in 1949 began working with her father at the HHCRF.

Changing the course of cancer treatment

It was at the HHCRF where Dr Wright began to explore the avenue of research that defined her career – chemotherapy.

Chemotherapy wasn’t always one of the “go-to” approaches for cancer treatment. In the early to mid-20th century, using drugs to treat cancer was considered somewhat experimental, only to be used if other treatment avenues had been exhausted. Despite the hesitant attitudes towards chemotherapeutic agents, Wright and her colleagues made many strides towards establishing chemotherapy as a viable treatment for cancer.

One of the most significant came in 1951; Wright led a seminal piece of research that laid the foundations for treating solid tumors chemotherapeutically. The study primarily established the efficacy of methotrexate, a folic acid antagonist, in treating breast cancer, which was a major result in itself. However, it also demonstrated the long-term efficacy of combination therapy and adjustment of treatment regimens according to the individual patient’s symptoms of toxicity. Methotrexate continues to be used to this day, alone or in combination, to treat a range of cancers from head and neck to non-Hodgkin’s lymphoma.

Adjusting treatment according to the individual was an idea forming the basis of much of Wright’s research, representing some of the early steps towards personalized medicine. Whilst previous researchers had used mice tumors as a model for predicting response to different chemotherapeutics, Wright and her colleagues cultured tumor tissue taken from patients. Once grown, the primary cultures were treated with a variety of chemotherapeutic agents and their response was assessed. In doing so, Wright helped to develop a method for testing and selecting the most effective course of chemotherapy for a particular tumor in an individual patient.
A leader in oncology

Wright wanted to make sure that her research had an impact in clinical care – this required collaboration amongst the oncology community.

The solution came in 1964, in the form of the American Society of Clinical Oncology (ASCO), of which Wright was a founding member and notably, the only woman of the founding group. In a 2010 interview, Wright explained why the society was created:

“Our goals were to bring about a set of standards for a clinical oncology specialty, to enlarge the area of knowledge in the field and to ensure that vital information was readily available and disseminated.”

Wright set out to achieve these goals during her tenure as associate dean and professor of surgery at her alma mater, New York Medical College, developing cancer treatment guidelines and a program teaching doctors how to use chemotherapy. Her appointment to the position was also a significant social feat at the time; upon taking office in 1967, Wright became the highest-ranked African-American woman at a nationally recognized medical institution. This was only one of a number of high-ranking positions held by Wright over the next 20 years.

An example to all scientists

Wright proved wrong those who said it was impossible to have a successful career and a family as a woman; when she retired in 1987, she had authored 135 scientific papers and won multiple awards, whilst raising two daughters. Her enduring dedication and impact on the field of oncology was such that ASCO’s Young Investigator Award was renamed in her honor.

In a 2011 interview, Wright’s daughter, Alison W. Jones, PhD, gave an insight into how her mother achieved so much in a time and society which often had preconceptions of what a woman’s life should be. “She never looked at things as obstacles,” Jones explained. “She looked at them as challenges and I think that she was a very ambitious person and I think that she never let anything stand in the way of her doing what she wanted to do.”

References

Lauren Edwards is a neuroscientist that is dedicated to using her scientific knowledge and understanding to generate excitement and enthusiasm about STEMM in young Black communities, and promote an inclusive and appreciative environment for Black Scholars. In this interview, she discusses her role as interim executive director at 500 Women Scientists at 500 Women Scientists, a grassroots organization, whose mission is to serve society by making science open, inclusive, and accessible and transform society by fighting racism, patriarchy and oppressive societal norms. She also explores some of the barriers that exist for women that wish to pursue a career in STEMM, and how she intends to help break down such barriers.

Q: What motivated you to pursue a career in science?

A: My pursuit of medicine brought me to science. I was in a research program the summer after high school where I worked in a biomedical engineering (BME) lab using nanoparticles to deliver chemotherapeutic drugs. I spent my first year in college as a BME major and quickly found out that I didn't want to keep doing math for years. I ended up switching universities and decided on neuroscience because it met all of my pre-medical requirements. It was by happenstance that I absolutely fell in love with the brain and broader central nervous system. I worked in a speech pathology research lab for three years in college and during that time, was selected as a National Institutes of Health (NIH) Maximizing Access to Research Careers (MARC) trainee. This program was imperative to my pursuing a graduate degree in neuroscience. I have always been the kind of person who easily excelled at school, particularly within my science and math courses. Furthermore, there were always more funding opportunities for the sciences in both undergraduate and graduate programs which was also really important for me. I grew up with a low socioeconomic status and it was my goal to not have student loans from school. My educational achievements afforded me the ability to attend school without loans and many of my scholarships were for the sciences. Science began primarily as a lucrative area to help get me to medicine, but I now have a much more thorough appreciation for how foundational science is to our society. I have learned the necessity for science to propel medicine forward and know it is a critical aspect of my career.

Q: Can you talk to us about your current research focuses, and your long-term career aspirations?

A: Our labs use a systems neuroscience approach to evaluate the plasticity of the motor system in stroke patients to advance our understanding of mechanisms underlying recovery of motor deficits in this patient population. My graduate work focused on whether previously reported heightened plasticity in the subacute post-stroke recovery period allows for increased learning of motor skills as reflected by improved motor ability. Specifically, I investigated how time post-stroke affects the neurophysiology of cortical sensorimotor regions and the patient's ability to learn a visuomotor task. The comprehensive study included techniques such as magnetic resonance imaging (MRI), transcranial...
magnetic stimulation (TMS), electroencephalography (EEG), clinical assessments and behavioral measures to understand motor recovery after stroke. My long-term career goals were, and still are, to become a physician-scientist conducting research centered on questions that will advance treatment strategies and improve outcomes of the patients I will be treating. I am certain I want to be in a pediatric subspecialty, with my current interests in hematology/oncology. My research interests lie in health disparities of children’s outcomes, with a focus on disparities facing Black children of low socioeconomic status. It is with utter excitement that I can confirm I have received my first medical acceptance and will undoubtedly begin my medical training Fall 2021!

Q: What do you believe are the greatest obstacles that women face when working in STEMM?

A: Systematic injustices and oppressive ideologies are the greatest obstacles facing women in STEM. There are both smaller scale and larger scale issues that can be really intimidating when we try to determine how to eliminate said obstacles. I’m sure gender discrimination may be so pervasive that it is harder to pinpoint how often it has impacted us. When gender coincides with other intersections (i.e. race, sexual orientation, socioeconomic status), the obstacles are further compounded. Currently in my field of neuroscience, women are outnumbering men in graduate school, as was the case with my incoming cohort. However, in academia, women are typically outnumbered, underpaid and less likely to be promoted for tenure compared to men. The numbers whittle down further when we discuss Black women specifically. This is true of many different sectors. Additionally, women face difficulties with how our other roles, such as being mothers and caretakers, disproportionally impacts our careers more than our male counterparts. There are many inequities that seem difficult to avoid regardless of career status. Furthermore, as women, we are subjected to stricter expectations on appearance and the unnecessary policing of our bodies, images and personal choices. I do believe it is harder for women to show up as ourselves. I am fond of the fact that I have piercings, tattoos and proudly wear bright clothes and coloured lipsticks. My hair is natural, and I unapologetically refuse to fit into the mould that has been presented to me. Presenting as ourselves at all times allows us to also change the image of what a stereotypical scientist looks like; this is one of the efforts we can take in making sure everyone is absolutely clear that yes, we do belong.

Q: You are the Interim Executive Director and former Director of the Fellowship for the Future at 500 Women Scientists. Can you tell us about how you came to this role, and what your duties involve?

A: I joined the Fellowship for the Future team in April 2019 while in graduate school. It was my first time hearing about 500 Women Scientists and the opportunity actually came by way of the Yale Ciencia Academy program I participated in the year prior. The Fellowship really struck a chord with me because I was being afforded the opportunity to pour my efforts into a much larger project that would have a greater scope of impact. As a core group of five amazing and powerful Women of Color (WoC) on the Fellowship team, we successfully launched Fellowship for the Future in January 2020. We have four exemplary fellows: Rose Bear Don’t Walk, Jasmine Drake, Seanna Leath and Kelly Montgomery. We provide our fellows with an honorarium, supplemental project funds, support of our international organization and a community that stands with them. Furthermore, we offer our fellows development of a personal mentoring network; advocacy skills for self and vulnerable populations; and personal and professional brand development.

In May 2020, I was asked to take over the Director role when the previous Director, Susan Cheng, had to step away to focus on her career in the academy. Even in this short amount of time, working for Fellowship has been one of my greatest professional experiences thus far. I really enjoy our team dynamics and love spending time with our fellows. My duties include fundraising and program operations, development and evaluation. We are currently working to ensure that Fellowship for the Future becomes an integral support system for WoC in STEMM. This includes being able to support more fellows directly, but also creating and culminating resources for WoC to broaden our scope of impact. The Black women on 500 Women Scientists’ leadership team recently formed a collective to also have a specific piece of our work that is geared exclusively to addressing global issues pertaining to the protection and celebration of Black women. It is beautiful to me the various ways in which we are figuring out how best to show up for WoC and I’m thankful to have an integral role in these efforts.

Q: You advocate for academia to be a more appreciative and nourishing space for Black scholars. Can you tell us more about your efforts here, and discuss some of the greatest challenges that Black scholars currently face in the academic space?

A: I have taken the approach of creating community and safe spaces for Black scholars across their educational pursuits. I have led interactive science sessions for Black students in elementary school. I find these efforts particularly important because very early on, Black students are deterred from pursuing STEMM through channels making these subjects inaccessible and hard to grasp. By creating interactive sessions that show students these concepts can be taught to them in a way they understand will then help them gain the confidence and interest in pursuing subjects that are traditionally perceived to be harder. I have coordinated a day-long
“Cradle to College” event for Black middle school students and their parents. We chose middle school as a point of intervention given that many students are unaware that grades in their high school careers are important for their college applications. It was our hope that by informing both kids and parents, we could create a strategy for high school that is most conducive to a student’s success post-high school. I also founded a Black Scholar’s Club for Black girls at my past high school to help prepare them for the college application process. In both my undergraduate and graduate careers I became an integral member in Black serving organizations (i.e. Black Student Union, Black Graduate Student Association) to figure out the needs of my fellow Black scholars and then coming up with solutions to meet those needs. It was through these organizations that we were able to bring our ideas to our broader university to ensure that our voices are heard.

Q: If you could give one piece of advice to a young woman that is considering a career in STEMM, what would you say?

A: My advice would be to know your worth. It seems simple enough and can be applied to any career field, but it is really difficult to know your worth when so often, we are in systems that routinely undervalue us and fail to protect us. Knowing your worth means being very clear about when to pick your battles. Knowing your worth means being able to stand on your own two feet even when your back is against the wall. Knowing your worth means that you are able to realize that these careers are so lucky to have you and you deserve to be cherished, respected and fully supported. The biggest lesson I have learned in my career thus far is that it is okay to walk away when things no longer suited me. It is okay to take a detour and I had to learn that a detour is not terrible reflection of who I am or my value. I have learned that being happy and mentally fortified takes precedent over being successful. All success isn’t good for you, or good to you, as all successes come at a cost. If you know your worth, it is easier to determine success on your own terms. The success you need and deserve will come, even if it looks different from what was initially imagined.

Q: What more can be done to inspire women to pursue a career in STEMM?

A: In order to inspire more women to pursue a career in STEMM, we must fundamentally change the structures that both train women, but also the various career paths in which women could end up. Girls and women should not have to defend themselves against gender-bias in their schools and careers. We should focus less on telling women how to survive a tainted system and focus more on how to throw away and completely transform the system, so it is adequately suited for them.

Lauren Edwards was speaking to Molly Campbell, Science Writer for Technology Networks.
Namandjé N. Bumpus, PhD
Chair, Department of Pharmacology and Molecular Sciences
E.K. Marshall and Thomas H. Maren Professor of Pharmacology and Molecular Sciences
Johns Hopkins University School of Medicine

By Laura Elizabeth Lansdowne

Namandjé N. Bumpus is an American pharmacologist. In 2020, she was promoted to director of the Department of Pharmacology and Molecular Sciences for the Johns Hopkins University School of Medicine, making history as the first African-American woman to lead a department at the university. She is the only African-American woman in the US currently chairing a pharmacology department.

Bumpus explores the genetic differences between people and how these variations impact drug metabolism. Outside of the lab, she works to elevate awareness of the challenges that people from historically marginalized groups face in science, drawing on her personal experience.

Q: What motivated you to pursue a career in science?
A: When I was young, I always liked figuring out how things work. My parents gave me a chemistry set when I was about seven years old, and I enjoyed working through the experiments. After that, I wrote a letter to the American Chemical Society, asking them what careers were available for chemists. They sent me back a whole packet of information about all sorts of interesting careers for scientists with expertise in chemistry. From then on, I knew I wanted to be a scientist. I chose to attend Occidental College in Los Angeles and after taking a couple of biology courses I decided to be a biology major. A benefit of attending a small college was that I could get involved in research early on and started out doing research in ecology and plant physiology. I found that I deeply enjoyed scientific research and wanted to apply that interest to human health. For that reason, I sought out a summer undergraduate research fellowship in pharmacology at the University of Michigan; I have been working in the field of pharmacology ever since. I graduated from Occidental College in 2003 and went on to earn a PhD in pharmacology in 2007 at the University of Michigan, Ann Arbor, MI. I completed two and a half years of postdoctoral training at The Scripps Research Institute in La Jolla, CA and then joined the faculty at the Johns Hopkins University School of Medicine in 2010 as an assistant professor.

Q: Could you tell us more about your current research interests and area of expertise?
A: My research lab focuses on drug metabolism, pharmacogenetics, and the application of mass spectrometry, to understand at a mechanistic level how drug metabolism influences drug outcomes.

My laboratory strives to apply state-of-the-art transdisciplinary approaches in order to facilitate the rational selection and dosing of drugs. We have particularly focused on drugs used to treat and prevent infectious diseases. The work in my laboratory is performed through the lens of seeking to understand the impact of drug metabolism on the concentration and three-dimensional distribution of drugs at their target site(s). Drug metabolism is the process by which an enzyme within a living organism biochemically modifies
a drug, usually resulting in the conversion of the drug (which tends to be lipophilic) into a “metabolite” that is more hydrophilic and therefore, more readily excreted from the body. When drugs are taken orally, they must pass through the liver, which contains an abundance of drug-metabolizing enzymes, prior to entering the systemic circulation. As such, for a majority of currently marketed oral drugs, this process controls the concentration of drug that ultimately reaches the target site and thus, controls the magnitude and the duration of pharmacological action. When I began my research program in 2010 there was a paucity of data available regarding the molecular pathways that regulated the metabolism of several widely prescribed antiretrovirals used to treat HIV. In addition, insight into how the metabolites of antiretroviral drugs might contribute to the pharmacology and toxicology of antiretrovirals was lacking. With this in mind, my group began to systematically examine the metabolism and distribution of antiretroviral drugs with the overarching hypothesis that through integrating a mechanistic understanding of the metabolism and three-dimensional distribution of antiretroviral drugs in cells and tissues we can predict both desirable and undesirable drug responses in a given individual. We continue to work in this area and along the way have discovered naturally occurring genetic variants that may influence drug response. A major focus of our current work is to apply mass spectrometry-based proteomics to understand the distribution of drug-metabolizing enzymes across cell types and tissues.

**Q: What would you consider to be your long-term career aspirations?**

**A:** My ultimate goal is to create opportunities within science and in higher education more broadly, for others. Part of this means that I aim to elevate awareness of the challenges that people from historically marginalized groups face in science and in academia. I believe that I have a responsibility to lend my voice to try to create an understanding of where improvements need to be made to make science and academia at large, more inclusive.

**Q: For women who are just beginning their careers in STEMM, what skills would you encourage them to develop to help them on their journey?**

**A:** Strong communication skills are crucial. It is important to be able to communicate your science to others in a compelling way and to be able to communicate your professional needs so that you can advocate for yourself. In working to develop as a scientist, my advice for students would be to find challenging course work wherever you can and take it. Get involved in research as soon as you can so you can figure out if you like it. And don’t be daunted by your own or others’ perceptions of what a scientist looks like or what his or her background should be. If you want to pursue a life in STEMM, go for it.

My general philosophy is that I don’t internalize other people’s opinions of what I am (or am not) capable of accomplishing and contributing. At each step of the way in my scientific career I have been told that I would never get to the next step. As an undergraduate, I was told I would never make it to grad school. In grad school I was told I didn’t have a future in academia. And once I was a faculty member, I was told I would never earn a leadership role. You must tune it all out and stay true to who you are and the contribution that you want to make to the world. You own your career. No one else does.

**Q: How can we inspire the next generation of women in STEMM?**

**A:** As the saying goes “if I can’t see it, I can’t be it”. In order to develop a personal identity within STEMM it is important to be able to see yourself reflected in those in STEMM careers. This builds confidence, and confidence gives self-esteem in the context of STEMM a place a grow. We need diverse representation at all levels of STEMM, including in leadership. That is important. To effectively strengthen the future of STEMM, we need to remove the barriers to leadership roles in STEMM for women. This will help to ensure that there are opportunities for all in STEMM.

Dr Namandjé Bumpus was speaking to Laura Elizabeth Lansdowne, Managing Editor for Technology Networks.
Sunetra Gupta, PhD
University of Oxford
Royal Society Wolfson Research Fellow

By Tiffany Quinn

Sunetra Gupta, professor of theoretical epidemiology in the Department of Zoology at the University of Oxford and a Royal Society Wolfson Research Fellow, is a true inspiration to women in all walks of life – not just the STEM subjects. Gupta’s contributions to our understanding of the evolution, maintenance and dynamics of parasite population diversity earned her the 2007 Scientific Medal by the Zoological Society of London and the 2009 Royal Society Rosalind Franklin Award. In addition to her role as a passionate and accomplished scientist, she is also an acclaimed novelist, essayist and translator; her fifth novel, So Good in Black, was longlisted for the Women’s Prize for Fiction and the DSC Prize for South Asian Literature in October 2012. In this interview, Professor Gupta discusses her academic journey and kindly shares her experience as a woman balancing a career in science and literature.

Q: What led you to pursue a career in science?

A: I was always fascinated by the natural world, as well as literature and the arts. As a child I devoured books with titles such as ‘Tell Me Why’, as I was always very curious. In school I had an interest in the sciences, but I wasn’t particularly interested in mathematics. This changed at the age of 14 when I moved schools and had the benefit of extraordinary teachers that made me realize maths was so much more than the manipulation of numbers and percentages. I became fascinated by applied mathematics – in other words, how I could use maths to answer the questions I was always interested in. This led me to physics which is essentially an application of mathematics used to help us understand the physical world. I decided that I wanted to study physics and mathematics, despite having a strong interest in the creative arts and still wanted to carry on with my creative interests without cutting off my options. When I got to Princeton University, which had a nice liberal arts curriculum, I was able to study a lot of different subject areas. I found that you could apply mathematics to study biological systems, which was really the point at which it all clicked – when I decided I would do this as a profession.

Q: You are currently a professor of theoretical epidemiology at the University of Oxford. Could you talk us through your area of research in more detail? When and why did you decide to focus your research on infectious disease and how has this field evolved since the beginning of your career?

A: I studied a course in animal behavior and realized, to my delight, that you can use maths to understand animal behavior (e.g., optimal foraging, natural selection and evolution). My interest in these areas led me to theoretical ecology and within that area was a rapidly growing field known as theoretical epidemiology – the use of mathematical models to study infectious disease systems. Interestingly, infectious disease is classed as epidemiology, as these systems are in fact ecological systems; they are the result of an ecological interaction between at least two species (the host and parasite or the host and pathogen). That is how I got into infectious disease research and considering I had always been interested in medicine and
public health issues, I saw this as a good way to combine all my interests.

At the time, the use of models was quite novel, although it did have a history. One of the first mathematical models that had a similar structure to the ones we use now was developed by Ronald Ross for Malaria in 1911. He discovered the life cycle of the parasite and went on to write a model which described the interaction between mosquitoes and humans. Yet at the time I was studying, models were certainly not part of everyday thinking in the context of infectious diseases. At Princeton, my mentor Robert May put the study of infectious diseases on a platform using theoretical and ecological methods. He and Roy Anderson did a lot of work to demonstrate the utility of this tool.

I then came to London to do my PhD with Roy Anderson and that coincided with the HIV pandemic, so I worked quite a lot on this disease and the way that sexual networks and the population influenced its spread. Yet, my main area of research was the evolution of diversity in pathogen populations and in hosts (including humans). The population genetics of the pathogens and humans have been strongly affected by this interaction. An example of this is the influenza virus which has an ability to change regularly to avoid host immunity – this is an evolutionary process which we can observe – which leads to the diversification of the pathogen population. We have also evolved at a much slower scale to resist pathogens; many of the genes that we carry are present because they give us protection against infectious disease. My aim is to understand how this battle – occurring at an individual level and a population level – shapes the evolution of host and pathogen populations. I have developed theories which can be translated into tangible gains. For example, from a theory I developed on the evolution of influenza, we have been able to patent and license a new type of universal flu vaccine.

Q: In addition to your work as a scientist, you are also an acclaimed novelist, translator and essayist. How have you found balancing a career spanning science and literature, and do you find it challenging balancing your work-life balance?

A: Everyone always asks, “How do you find the time?” and of course this is a challenge – especially when you are trying to balance a career as a scientist, being a mum and writing. In terms of managing a career in science and writing, it was never that difficult for me as they are both incredibly pleasurable activities that come from the same place; I am responding to a problem, whether that is the evolution of influenza, or the narrative structure of the novel I am writing.

One impediment is that, currently, you must spend a lot of energy being visible; advertising yourself, networking – all things that were not the case in the 80s or 90s. I do not think that the conditions are there now for people who want to just get on with the work and not indulge in these kinds of activities. I do enjoy doing interviews, giving scientific talks and readings, as this is all part of the process. However, I do not like that you are obliged to do heavy levels of administration as it is difficult to survive in these systems where there is a lot of pressure when applying for grants or trying to secure funding for your next postgraduate student. This pressure is certainly present in the literary world too, which can be detrimental to creativity.

Q: How have you found being a female in your career as a writer and an academic?

A: In the last few months with the COVID-19 situation and my role in it, it has been the first time in my life where I have wondered if the way that people have dealt with me has something to do with me being an Asian woman.

But overall, I have been very fortunate. In the Zoology Department at Oxford, we were certainly much further ahead than other departments and facilities, creating an environment whereby women and anyone else with caring responsibilities found a very supportive, welcoming and positive atmosphere. It was a very good place to for me to be. For example, Dick Southwood, the Vice Chancellor, set up a nursery where my children went. Paul Harvey – another head – was very supportive of women and gave us a lot of flexibility in our work patterns, so I never felt that was an issue.

Q: Could you tell us more about your project Shooting Stars. Why is this important to you and what do you hope to achieve from it?

A: In 2009 I won the Royal Society Rosalind Franklin award and I ended up spending all the prize money on a project for Women in Science with a wonderful illustrator called Ted Dewan – who is also a scientist. Ted and I put together an illustrated book for children that brought the lives of women scientists to their attention in an interesting way. We settled on an online format, whereby people could read about their stories in an appealing way.

Q: What is your proudest professional achievement to date?

A: Taking an idea to a mathematical model with testable hypotheses and then testing these hypotheses to arrive at a new pipeline for a universal flu vaccine. It is incredibly rewarding to translate an idea that far.

Q: What do you love most about having a career in science?

A: I think it is the sheer excitement of generating testable hypotheses and making sense of explanations for all the different bits of data in front of you. For example, you can
obtain data on patterns of disease, the age distribution of disease, the virus or parasite itself and all its molecular machinery as well as how the immune system responds to the pathogen. When you put this all together to come up with a coherent framework, you have a hypothesis which can open up the door for further experiments.

Another really rewarding aspect of a career in science is watching people go from being your post doc students to independent scientists. For example, Craig Thompson is someone that played a central role to our work on the flu vaccine, and he is now running his own lab.

Q: Do you have any advice for young females aspiring towards a career in any of the STEM subjects?

A: Firstly, I would encourage everyone to follow their passion. Whilst you are young, you should use your time to experiment and find what makes you happy. There is an enormous buzz and it really is life-affirming. If you don’t have a job that you really like, it can be difficult to face the world; it is worth taking risks, being patient and finding something that you really feel happy about getting up and doing. It doesn’t have to be extraordinary – science is often done with teamwork – therefore finding and working within the right team is key. I would never have been able to achieve what I did with the flu vaccine if I hadn’t have collaborated with the people that I did.

Worry less about whether you are the person that is going to be seen as the one who has done something amazing or not. That is much less fulfilling than seeing (or making) something happen as a team. It is very easy to think “What am I going to be known for?”, but the most exciting thing to do is to make something happen within a team and share the credit together.

Prof Sunetra Gupta was speaking to Tiffany Quinn, Custom Content Manager for Technology Networks.
Junie Paula Warrington is an assistant professor in the departments of neurology and neurobiology and anatomical sciences at the University of Mississippi Medical Center. She also serves as co-editor-in-chief of the *Journal of Neuroscience Research* and social media editor of Stroke. Warrington recently published a commentary on her career journey as part of a *special issue* of the *Journal of Neuroscience Research* focused on women in neuroscience.

**Q: What motivated you to pursue a career in the sciences?**

**A:** A career in science was not something that I envisioned for myself growing up. I actually stumbled on it. When I first came to the United States to pursue my studies, my goal was to be a psychologist. I worked a lot with the youth and high school-aged students in Dominica, my home country, and I desired to give back and help them, by being a counselor to them. When I started doing my coursework as a psychology major, my biology professors were like, “You should change your major to biology.” But at that point, I was still set on pursuing a career in psychology, so I ignored their suggestions.

Then, a little closer to graduation, I was exposed to research during the summer at my undergraduate university in the areas of animal science and plant science. I thought that being able to do experiments in the lab was really interesting and enjoyable. And so, I decided to take optional elective courses in biology. That was where the journey to a career in science really began.

Another motivating factor, which is really weird, is that I applied for PhD programs in psychology and got several rejection letters and at that point I had to do something. I found out that the University of Oklahoma Health Sciences Center had a running application schedule for a PhD in neuroscience and so, because I thought that neuroscience is the closest field to psychology, I applied. I got rejected again. Literally two weeks before classes were to begin, I received an email saying, “Hey, are you still interested in our program?” and I got invited for an interview and the rest was history.

Of course, once I started the program, I felt like I could see myself doing medical science research for the rest of my life.

**Q: What are you currently researching in your lab?**

**A:** My laboratory works on understanding the mechanisms that contribute to cerebrovascular abnormalities in preeclampsia, a pregnancy-specific condition characterized by new onset hypertension along with additional end-organ symptoms including neurological symptoms such as headaches and blurred vision.

Some women with preeclampsia go on to have seizures during pregnancy and we do not know what causes some women to have seizures and others not to. In our laboratory, we use animal models to try to understand what mechanisms contribute to seizures and cerebrovascular abnormalities during pregnancy. We also
have ongoing studies focused on the postpartum period because epidemiological studies show that women with a history of preeclampsia are still in the danger zone in that they are more likely to develop vascular dementia, and again, the mechanism is not known.

So we are trying to determine what factors are elevated during pregnancy and whether or not manipulating these factors during pregnancy will prevent these long-term effects.

Lastly, we are interested in uncovering the impact of preeclampsia and acute seizures on the offspring’s brain development, since they too go on to have increased risk for a lot of neurological abnormalities.

So in a nutshell, we use various genetic mouse models to get to the exact mechanism contributing to these abnormalities in the mother and offspring’s brain.

Q: What advice would you offer to other women beginning their careers in science, particularly women from minority backgrounds?

A: First, know what you want and pursue it! Do not let anything stand in your way. I hear many students say that they are not aware of the opportunities in science, just like I wasn’t aware of those opportunities. Early exposure through outreach efforts by those of us currently in the field will empower students to pursue such fields of study. I think that outreach is very important because you can’t pursue what you don’t know exists.

Second, be open to trying out different things until you find that one thing you’re passionate about.

Third, seek mentors! Many people wrongly think that they have to stick with that one mentor in high school, or that one person in undergrad or grad school. You should never limit yourself to just your immediate surrounding.

Fourth, build a network of people around you. Finding mentors who can help you navigate the tasks ahead - teachers, professors, other professionals and even peers who have been where you are trying to go is important. These mentors can give you advice along the way to help you become more successful and increase your chances of excelling.

Once you have gotten to your goal, it doesn’t stop there, you have to continue expanding your network, getting additional mentors, not just those for your research area of interest, but those who will help you navigate life as well. There are people who are great at telling you, “Do this experiment this way,” and others who could really help you with life decisions such as, “If you’re planning to have a family, consider XYZ.” There are so many different aspects that we don’t think mentors could help with and so find multiple people who can give you advice on different aspects to really help you succeed.

Fifth, don’t sell yourself short. Seek out opportunities for awards and grant funding. A lot of people think, “I don’t qualify for that. Why should I even try?” Especially for minority women or minorities overall, there are many
diversity-specific awards and grants out there. Some think that some opportunities are not good and are bad because they are just for diversity. Why should I apply for that? I should just compete with everybody else. Well yes you can, but at the same time, if there are resources that are specific to you, that increases your chance of success, go for it and do not wait until you have dotted every “i” and crossed every “t” to apply.

Apply from where you are. Put yourself out there! Embrace that failure in academia is inevitable and common. Never give up!

Q: As someone working in women’s health, what’s your opinion on how attitudes to the funding and importance of these issues have changed?

A: I think that today, there is an increase in awareness for the importance of sex differences, and sex-specific research. In the past, studies were done in males because males were “easier”, “less complicated.” That’s what they thought, and so women were excluded from clinical trials. Females were excluded even in animal research, leading to information that is biased, outdated, and in some cases, irrelevant to women. I think that some of our funding agencies have done an excellent job in mandating that investigators consider sex as a biological variable in our research. I feel that this is a step forward.

In terms of women-specific health issues, there are private organizations and foundations with women-specific focus on topics such as preeclampsia and pregnancy. Those organizations have really helped bring awareness to numerous female-specific issues. Going forward, more funding opportunities should be made available for health issues with a female bias. For example, two-thirds of people with Alzheimer’s disease today are women and it is still not clear why women are more affected by Alzheimer’s disease. From my research, I think that pregnancy or pregnancy complications partly contribute to the increase in these late-life sex disparities in neurological abnormalities.

Just having the statistics and data available to see that these conditions are affecting a disproportionate number of women is important. Therefore, we need to move more funding over to research in these areas.

Overall, we are going in the right direction, but still do not have adequate funding for female-specific health issues that plague our societies.

Dr Junie Paula Warrington was speaking to Ruairi MacKenzie, Senior Science Writer for Technology Networks.
Historical Women in Science

Throughout history, countless women working within science, technology, engineering, mathematics and medicine (STEMM) have made groundbreaking discoveries that have revolutionized our understanding of these fields.

In honor of International Day of Women and Girls in Science, we present a shortlist of women in STEMM who – despite not receiving a lot of recognition – made a significant impact.

LISE MEITNER 1878–1968

Referred to as the “Mother of Nuclear Power”, Lise Meitner earned a doctorate degree in 1906 after studying physics at the University of Vienna.

She later teamed up with chemist Otto Hahn, with the most notable of the duo’s discoveries including nuclear fission. Hahn was awarded a Nobel Prize in 1944 for this work, however Meitner was not recognized for her role, despite being regarded by many as an instrumental scientist in the field.

CHIEN-SHIUNG WU 1912–1997

Dubbed “The First Lady of Physics”, Chien-Shiung Wu was a nuclear physicist who contributed to the Manhattan Project, during World War II, and earned many accolades throughout her career.

Wu worked alongside two male theoretical physicists – Tsung-Dao Lee and Chen Ning Yang – to disprove the hypothetical law of conservation parity. In 1957, both of her colleagues received a Nobel Prize for this work, with Wu’s contributions remaining unrecognized. When reminiscing on this at an MIT symposium in 1984, she remarked, “I wonder whether the tiny atoms and nuclei, or the mathematical symbols, or the DNA molecules have any preference for either masculine or feminine treatment.”
As the first African-American woman to reach space, Jemison is an accomplished scientist. After graduating with a bachelor’s degree in chemical engineering from Stanford and a medical degree from Cornell, she served as a medical officer for the Peace Corps in Sierra Leone and Liberia before transitioning to NASA’s astronaut training program in 1987.

Following a year of training, she became the first African-American woman astronaut, working as a science mission specialist — a role that required her to conduct crew-related scientific experiments on the space shuttle. In 1992, she became the first African-American woman to travel into space.

As the first woman in America to receive a medical degree from New York’s Geneva Medical College in 1849.

She spent her life fighting against discrimination and championed medical education and careers for women in medicine, establishing the New York Infirmary for Women and Children in 1857, and a medical college in New York in 1868.

A pioneer in surface chemistry and engineering, Katharine was the first woman to earn a doctorate from Cambridge University in the UK, and the first female scientist at the General Electric research lab.

Katharine developed the first system for non-reflective glass, and improved lenses used for cinematography. During the war she worked to improve the effectiveness of smoke screens and the development of a device to measure humidity significantly impacted the field of meteorological sciences.

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Dr Vivian Li is a biologist dedicated to the study of stem cell and cancer biology in the gut. After obtaining her PhD at the University of Hong Kong in 2008 and completing her post-doctoral research training with Hans Clevers at the Hubrecht Institute in the Netherlands, Vivian established the Stem Cell and Cancer Biology Laboratory at the Francis Crick Institute. Vivian was the winner of Cancer Research UK’s Future Leaders in Cancer Research Prize in 2018 and the British Society for Cell Biology’s Women in Cell Biology Award Medal in 2021, in recognition of her contributions to the development of organoid technology and the molecular understanding of intestinal stem cells and cancer. In this interview, Vivian tells us about her experiences as a female scientist and discusses some of the steps that could be taken to help more women to progress and stay in science.

Q: How did your interest in science originate? Were there any role models that inspired your career?

A: Biology was my favourite subject since secondary school. I was always intrigued by the complexity of human physiology and went home after school every day to tell my mum what I’d learnt. I still remember the announcement of the human genome draft in 2000, that was the year when I had to choose my university subject. I felt like we were just beginning to understand how our body works, and there is still huge potential to make use of the data to advance our understanding of human health and diseases. That was the reason that I selected a molecular biotechnology program as the start of my scientific journey.

My role model was my PhD supervisor Prof. Suet-Yi Leung at the University of Hong Kong. She is a pathologist dedicated to the study of human gastrointestinal tract cancer. It is not easy to juggle between clinical duty and science for clinicians, it requires great enthusiasm and determination. Most importantly you need to love what you are doing. That’s what I’ve learnt from her. She showed me that women can also be ambitious and aim high in academia if you want to, and she encouraged me to apply for a fellowship to pursue my postdoctoral training abroad. I am very grateful to have such an inspiring female mentor during my early career.

Q: Could you tell us more about your research interests and area of expertise? What lead you to work with organoids in particular?

A: My longstanding research interest is bowel cancer. My lab utilizes a wide range of state-of-the-art experimental approaches, ranging from biochemistry to genetic mouse models and organoids to investigate how stem cells are maintained in a healthy gut, and what happens when cancer develops. We focused on one molecular pathway called Wnt signaling, which is a network of proteins that function together to promote cell growth and maintain a healthy stem cell population. However, cancer cells often hijack this pathway to keep it permanently on, leading to uncontrolled cell growth and eventually tumor development. We have been working hard in the past few years to understand better how Wnt signaling is controlled in healthy gut and in cancer, aiming to find new drug targets to treat bowel cancer.
During my postdoc training in the Netherlands, my host laboratory developed organoid technology, which is one of the major scientific breakthroughs in recent years. Organoids are stem cells growing three dimensionally in a dish, which form little ball of cells resembling the structure and function of the organs in our body. They are also called “mini-organs” because of the potential to grow and mature into various cell types to carry out different functions, just like the real organs in our body. For instance, “mini-gut” contains cell types that carry out digestive, absorptive and mucus secreting functions. Organoids are highly versatile and regenerative, which can be used for human disease modeling, drug screening and regenerative medicine. When I first established my lab in London, I decided to incorporate organoid technology to our research program to study bowel cancer and small bowel regeneration. We have since published a number of papers using organoid-based research and have attracted lots of collaborations using this state-of-the-art technology.

Q: Can you tell us a little about your current role as group leader? Did you encounter any gender inequalities along your path to this position? From your experiences, what advice would you give female scientists embarking on their career?

A: As a group leader, I run the Stem Cell and Cancer Biology Laboratory at the Francis Crick Institute to study intestinal diseases. My role is to manage the whole lab and drive the research in the right direction. This involves research program design, student and postdoc recruitment, supervising individual research projects and also managing the lab budget to ensure that we have sufficient funding to run the lab. Apart from managing my own lab, I also have duties for the wider institute and scientific community. For example, I am a member of many Crick internal committees to support the science and operation at different levels. Externally, I also help review manuscripts and grant applications regularly, and serve the advisory board for some scientific journals. I also present our research data in various meetings and conferences to disseminate results and foster collaborations.

Fortunately, I did not encounter serious gender inequality in the past, but I did experience some issues related to gender. In my early career, I often had similar research ideas as my other male colleagues, while the credits usually went to the male colleagues. Looking back now, I realized I did not speak out as loudly as my male colleagues to make myself visible and heard. Being a junior female scientist in a male-dominated scientific community, sometimes it could feel intimidating. But I’ve learnt over the years that you just need to be confident, believe in yourself and forget about the gender difference. Being a scientist, all you need is curiosity, determination and resilience, none of these are gender-related. I should say that the research environment nowadays is very different from 10 years ago, thanks to the Women in Science advocates in the past. The community is a lot more supportive to encourage women to pursue science.

Q: As a mother yourself, do you have any tips for managing a healthy work-life balance? What further support do you think would help more women stay in science after starting a family?

A: It is challenging to juggle between your family and work. Although my job is demanding, it is important to have a healthy work-life balance. Being a mother of two, I make sure that I prioritize my family as soon as I am off work. While I used to work at the weekend before, I now reserve the whole weekend for my family. In fact, having kids makes me work more efficiently during weekdays. I do tend to work in the evening after putting my kids to bed. You just need to find a routine that works for you and your family.

The science community is very supportive nowadays for women with young families. For instance, many funding organizations and institutes (such as the Crick) offer extension of contracts or funding opportunities to women depending on the number of children they have. However, everyone is different, some women may prefer to stay home longer with their children before going back to work. More funding opportunities could be given to support women at different career stages getting back to science after maternity leave, which will help encourage women to stay in science.

Q: What do you find the most rewarding aspects of having a career in science and what would you say are your proudest achievements?

A: As a scientist, we set out research questions and hypotheses, then design experiments to address them. This often takes a good few years to achieve. It is extremely rewarding when we finally make some major discoveries in the project that we have been working on for years. And being a biomedical scientist, we also have the privilege to do preclinical studies which may benefit patients in the future. This is my main driver and motivation going to the lab every day.

So far, our lab has made some interesting findings that may possibly benefit patients in the clinic. First, we found a new tumor-specific drug target called USP7, which may target the majority of bowel cancers with minimal toxicity (Novellasdemunt et al., Cell Reports 2017). We are continuing to study the therapeutic potential of this target in preclinical models. More recently, we also managed to reconstruct human small bowel grafts in a dish using organoids generated from intestinal failure patients (Meran et al., Nature Medicine 2020), which may offer a safe alternative to traditional donor transplants in the future.
Q: You were a member of the Crick Institute’s Gender Matters in Science Committee. Can you tell us about the aims of the group? What difference do you think groups such as this can make to women pursuing a career in science?

A: I was a member of the Crick Gender Matters in Science Committee before rotating off. The group has been trying to work at different levels to promote gender equality in science. For instance, they promote training, such as subconscious bias, to make people aware of potential gender or race bias that may occur in the workplace. They also organize events for occasions such as International Women’s Day to gather female scientists across all disciplines and career levels to share their experience and success in science. There are representatives from all career levels in the committee, from students and postdocs to group leaders and science administration to cover gender-related issues at all levels. I believe that groups such as this are important to ensure that women’s voices are heard and to provide appropriate support to women in science.

Q: What do you think are some of the main factors contributing to the gender pyramid seen in science and what could be done to enable more women to reach the top of the pyramid?

A: I think the gender pyramid is a historical problem that will take time to resolve. There is often an equivalent number of men and women at PhD or postdoc level, which drops significantly when moving up to group leader level. This is likely caused by a number of factors, such as the long-established academic culture and social cliché. Just around 10 years ago, the science leaderships were still overwhelmingly dominated by men. However, since the global initiative for women’s empowerment in recent years, the scene has changed quite significantly in the gender pyramid in science. We see a lot more women climbing up the academic ladder and the number of women at group leader level continues to rise. Of course, there is still a lot to do to promote women in science. The first step is to offer equal opportunity to both genders at higher management level, which I believe is happening across the scientific community. But let’s not forget about the social cliché of the gender roles, which may take a much longer time to change. In reality, there are always fewer female applicants than male applicants at group leader recruitment, which indicates that less women are ready to put themselves forward to the leadership job as compared to men. I believe this will slowly resolve over time when more young women are encouraged to pursue science, and society as a whole is more accepting to the idea that any gender can be the leader or breadwinner. Meanwhile, it is also important that we emphasize equal opportunity to all genders, not just women in science.

Dr Vivian Li was speaking to Anna MacDonald, Science Writer for Technology Networks.
Winnie Courtene-Jones, PhD

evXpedition Science Lead and Post-Doctoral Research Fellow
School of Biological and Marine Sciences
University of Plymouth

By Karen Steward, PhD

Winnie Courtene-Jones is a plastic pollution expert. A post-doctoral fellow in the School of Biological and Marine Sciences at the University of Plymouth, her research focuses on quantifying marine plastic pollution and identifying waste sources, their path to the ocean, fate and impact once they enter the marine environment. Her work generates vital evidence to support plastic waste management solutions.

Within her academic post, Winnie is the science lead for eXXpedition, an all-female not-for-profit organization looking to address the ocean plastic crisis. Their multidisciplinary team have most recently been sailing around the world, gathering samples and data relating to marine plastics and raising awareness of plastic pollution issues in the locations they visit. Whilst Winnie and the team are able to perform some of the analyses at sea, other samples must be brought back to the laboratory on dry land where she and her collaborators are able to perform more extensive tests. This latest voyage set out to bring together 300 women from around the world, providing first-hand experience of the challenges posed by plastics and helping to spread the word.

Q: What motivated you to pursue a career in science and in particular to focus on microplastics research?

A: I have always been fascinated by the natural world and spent much of my childhood outdoors either on the beach exploring the rock pools or walking in the woodlands with my family. During my third year of studying for a BSc in zoology with animal behavior at Bangor University, I learnt to scuba dive, which really opened my eyes to the incredible world below the waves. In 2013 I went on to study an MRes in marine biology at the University of Plymouth. During this course I took a module on “human impacts” where we were able to choose a topic for independent research and I chose to investigate the relatively new topic of plastic pollution. At this time there was little research into the impacts of plastics and microplastics on the world around us and I became keen to learn more and to explore some of those currently unanswered questions. After completing my master’s degree, I moved to Belize, Central America, where I worked for a non-governmental organization. I spent part of my time living at a remote island field camp, surrounded by coral reef and jungle, yet every morning plastic litter – bottles, shoes, fragments etc. would wash up on the beach, despite the area not being heavily populated. I found the issue of plastic so evident around me, yet the topic was poorly studied. I wanted to know more and be part of driving this research forwards. After a little over a year, I moved back to the UK and started a doctorate degree, researching microplastic pollution in the deep sea, at the Scottish Association for Marine Science.
Q: How did you come to be involved with eXXpedition? What, as a scientist and as a woman, do you feel the project brings to you personally?

A: After completing my PhD I applied for the eXXpedition science lead position at the University of Plymouth; after a few rounds of interview, I was offered the job. The role encompasses many aspects that I am extremely passionate about. Firstly, I am able to contribute to pertinent research questions that develop our understanding of plastic pollution in the world’s oceans and provide evidence to drive forwards solutions to reduce plastic in the environment. I work with a multidisciplinary team and gaining these different perspectives is extremely valuable both within the work that I do, but also on a personal level. I am also lucky to be able to spend time at sea; with little technology (i.e., phones, internet) to distract you from the present moment you learn a new appreciation for the vastness of the ocean around you, the privilege to see whales, dolphins and seabirds, the beauty of every sunrise and sunset and the value of good conversation with your crew mates. Life is much more simple. Finally, I value the ethos of eXXpedition: to support and form a network of women, from different backgrounds, professions and nationalities, who are united by a common goal to make a positive impact on the world around us. I have long supported and participated in initiatives that encourage women into STEM subjects, so I have gained a personal fulfilment in continuing to do this within my current role.

Q: What do you think are the main barriers for women entering and staying in science? How important do you think initiatives like eXXpedition are for encouraging women to pursue careers in or aligned to science who may otherwise be deterred?

A: The image of a “scientist” often congers up outdated stereotypes but the professions encompassed by the umbrella term “science” are as diverse as the people occupying these roles. That being said, this diversity is not always very evident. I think that part of the problem preventing young women and girls from pursuing scientific career paths is the lack of diverse role models in the public eye to aspire to. While there is still work to be done, I am glad this narrative is somewhat changing, with well-known contemporary female scientists including CRISPR-Cas9 developers Prof. Emmanuella Charpentier and Prof. Jennifer Doudna, NASA astronaut Dr Mae Jamison and the host of women involved in the development of COVID-19 vaccines including Prof. Sarah Gilbert, who are getting the praise and attention they deserve. For me, an extremely important aspect of eXXpedition and the work I do is being a role model and challenging stereotypes around science, adventure and sailing, which are typically male-dominated. eXXpedition is a fully female team, from our boat captain to those who manage the logistics behind the scenes and the wonderful diverse crews that come on-board. Any tasks, big or small, including boat maintenance, collecting and analyzing scientific samples etc. are all done by women. I hope that those who have been following the voyage can identify someone similar to themselves, see that anything is possible and are inspired to pursue whichever career path they set their mind to.

Q: Is there more that could be done to support women in science?

A: Many early career scientists are women, especially within biological sciences which is the field I work in. However, as you progress up the career ladder, it is here that the retention rate often decreases. There is an incredible pressure on scientists to publish research, write grant proposals to secure funding for the continuation of their job or their employees, on top of teaching students and other responsibilities. All of these tasks are incredibly time consuming and in the case of funding, hard to secure. The pressure to have an unbroken record of accomplishment often does not lend itself to taking a break from science to have and raise children. There could be more support given to women taking or returning from career breaks. I would also like to see a shift in science as a whole, where the same value is placed on teaching, mentoring and professional development, as there currently is on publishing and winning grants.

Q: What advice would you give to other women thinking of developing a career in science?

A: My main piece of advice is to follow your dreams and passions. I know it is a cliché, but it is so important to do what you love. Science careers are generally not very glamorous or well-paid and you often work long hours; but if you are passionate about what you do, then this career path can bring immense satisfaction and personal fulfilment. To those starting out, I’d recommend getting involved in different opportunities. It is sometimes the surprising ones that bring the biggest rewards, or that broaden your knowledge and contact base. Finally, build a network; science is not done in isolation, instead you are working as part of a multidisciplinary team, often spread across the world, therefore establishing links is vital for this career path and it also provides a supportive network to learn and grow professionally and personally.

Dr Winnie Courtene-Jones was speaking to Dr Karen Steward, Senior Science Writer for Technology Networks.
Diane Turner, PhD, FRSC
Senior Consultant and Director, Anthias Consulting Limited
President of the Royal Society of Chemistry Analytical Division Council

By Karen Steward, PhD

Diane Turner has numerous roles in the world of analytical chemistry, both in industry and academia, primarily as a senior consultant and director of her own company, Anthias Consulting Limited. Diane has developed analytical chemistry methods, given support and provided high-quality training for companies in most industries around the world for more than 20 years.

A Warwick University graduate, Diane completed her Masters in analytical chemistry and started her career in environmental chemistry, later gaining significant experience as an applications chemist. She went on to focus on disease diagnosis during her PhD studies at The Open University. Diane is president of the Royal Society of Chemistry Analytical Division Council, only the third woman to hold this position since 1875, chair of the Analytical Chemistry Trust Fund and involved in expanding analytical chemistry capabilities and skills in the developing world.

Q: What inspired you to pursue a career in science? Have there been any key role models in your life that have inspired your career path?

A: I grew up on the Isles of Scilly where my father worked for Natural England (and its previous names) from the late 1970s, looking after the paths and the wildlife. He had lots of scientists visit to study everything from plankton, Zostera marina and cup corals, to seals, spittlebugs and butterflies, to sand dunes and lichens. I did my first official survey on seagrass (Zostera marina) aged only eight years old and was still involved until only a few years ago. My interest in science went from there. At our very small secondary school on St Mary’s, chemistry was half taught by the physics teacher and half by the biology teacher, I loved the fact that it is such a central science and so went on to study it further. I’ve had a few role models since starting work in industry, who have encouraged me to progress my career over the years and get involved with the Royal Society of Chemistry (RSC).

Q: Can you tell us a bit about your current roles?

A: I have numerous roles at the moment and frequently attend events with multiple hats on, which is always really interesting as you approach the subject and people in quite different ways - asking different questions and seeing how the conversation can evolve in different directions.

I am the current president of the RSC Analytical Division Council (ADC) which started in July last year and I’ve been an elected member since 2016. The Analytical Division enables the community to stay informed of developments in the field and provides a forum for analytical chemists and scientists to exchange information and ideas. This is achieved by organizing and supporting events including the annual Schools’ Analyst Competition (SAC),
providing travel grants, recognizing outstanding contributions to analytical science through our prizes and awards program and producing technical briefs. We meet (at the moment online) three times a year and we’re currently seeking input from our members to update our strategy and ensure that we support all members no matter what career stage they are at or what their background is. As president of the division, I’m involved in a wide range of committees, from providing input into wider RSC activities to being a member of the Government Chemist Programme Expert Group.

As an elected member of the RSC ADC, you also become a trustee of the Analytical Chemistry Trust Fund (ACTF). Hence, as the president of ADC I am also the chair of the ACTF. The ACTF provides funding for numerous RSC AD, Analytical Science Network (ASN) and Community for Analytical Measurement Science (CAMS) activities, including the School Analyst Competition, fellowships, outreach and developing world scholarships, overseas conference travel grants and summer studentships. We also meet three times a year to discuss these grants and other trustee matters.

I am on the Industry Advisory Board (IAB) and Training Management Panel (BEAM) for CAMS. CAMS is an industry-led initiative aimed at promoting world-class analytical measurement science training, research and innovation by bringing together a network of industrial and academic partners with interests in these fields. I attend quarterly meetings for both of these which addresses how to meet the strategies of the community and support its members. I attend as the representative from my company which is an industry member, however it is very useful with both my ADC and ACTF hats on too!

My main role is director and senior consultant of my company Anthias Consulting Ltd. I incorporated my company nearly 16 years ago, with the aim to provide high quality training and consultancy in analytical techniques. Alongside running my company, I am very much hands-on, spending lots of time developing and troubleshooting methods, analyzing samples to write white papers, teaching virtual and face-to-face training courses (due to COVID-19 these are only on our customer sites at the moment, with no face-to-face scheduled courses) and providing consultancy advice including as an expert witness. I mostly work on gas chromatography (GC) and mass spectrometry (MS), with my colleagues looking after other techniques. The majority of our training courses are approved by the RSC for continuing professional development (CPD), which involves a lot of work to put together all the documents for peer-review.

I am also a consultant and a visiting fellow at The Open University (OU) where I have been working since 2006. As well as looking after the vast array of analytical instruments in the laboratory and training PhD students and post-docs, I work on research projects, some of which are continuing from my PhD which I completed part-time with Dr Geraint Morgan. The OU also host Anthias’ scheduled and bespoke training courses for a number of techniques, alongside providing instrumentation for applications, research and some sample analysis.

Finally, I am a trustee of the Recycling Organisation for Research Opportunities (RORO), which recycles redundant scientific instrumentation and redistributes it to academic institutions in the developing world. We regularly meet to discuss applications for the donated instruments and who they should go to. RORO works closely with the RSC Pan-Africa Chemistry Network (PACN) who provide training courses on gas chromatography mass spectrometry (GC-MS) and liquid chromatography mass spectrometry (LC-MS). I’m involved with PACN through Anthias too, with my colleagues teaching some of the courses in Africa and writing some of the course materials. I was also one of the authors and the editor of the book to accompany the GC-MS course “Gas Chromatography-Mass Spectrometry: How Do I Get the Best Results?”.

For all of my roles I give presentations or am a chair, from virtual seminars to conferences, including teaching short courses. Sharing my knowledge and enabling others to do the same is one of the roles that I most enjoy.

**Q:** What have been your proudest achievements in your career so far?

**A:** One of my proudest moments is when I printed out my PhD thesis for submission and my children looked through it in awe. I had started it part-time in 2009 with The Open University, then had three children including twins within two and a half years of starting it. Alongside running a small business, it took a long time to complete. There were many evenings and weekends when my children pleaded with me not to “write my book” that day, but I made it, submitting exactly the maximum number of words and graduated at Ely Cathedral in 2018 with my family there watching.

**Q:** Chemistry has traditionally been a male-dominated environment, how do you feel this is changing and do you think further change is required?

**A:** Yes, I do think that chemistry is becoming more balanced, particularly in the early career stages,
but there is still a long way to go in the established career stages, both in academic and industry, where senior and management roles in general are still very male-dominated. The balance is also very industry related. I work in a very wide range of industries and there are definitely some which are still very male-dominated at all career stages whereas in other industries that seem to attract more females, the balance has gone the opposite way. One of the barriers is inflexible working conditions, making it very difficult for women to return to their role after having a family, especially if their partner is in a similar position and has no flexibility either. More flexible work is improving in many industries, but it still has a long way to go in chemistry in many industries. One of the reasons why I started my own business was to have more flexibility which I couldn’t see happening in my previous role. I work a lot of hours but if needed I can work these around my family.

Q: What advice would you give to other women thinking of pursuing a career in science?

A: First, there are so many different roles in chemistry, I didn’t know or understand a fraction of them when I started my first chemistry degree, they extend in many different directions than just wearing a lab coat. If you have an interest in chemistry or another science start with a broad foundation, from there you can focus your interest with an MSc or PhD or a certain role in industry. Try to network as much as possible and in as many areas of your chosen science as possible, find out what other people do in their roles, which can give you ideas. Studying chemistry gives so many desirable skills that, if at the end of the day you decide to go in a different direction, nothing will have been wasted. My main advice is to do what you enjoy and don’t let anyone put you off or get you down.

Dr Diane Turner was speaking to Dr Karen Steward, Senior Science Writer for Technology Networks.
Kristen Radford, PhD
Senior Research Fellow, Cancer Immunotherapies Research Group Leader
Mater Medical Research Institute, University of Queensland

By Laura Elizabeth Lansdowne

Kristen Radford joined the Mater Medical Research Institute in 2001 and currently leads the cancer immunotherapies research team there. She completed her PhD in 1997 from the University of Newcastle, New South Wales (NSW) and received the NSW Young Australian of the Year award in 1998. She then undertook a postdoctoral position focused on developing novel strategies for cancer immunotherapy at the Imperial Cancer Research Fund, London (now known as Cancer Research UK).

Q: What motivated you to pursue a career in science? 
A: I have always been curious and fascinated by biology and medicine and enjoyed science from a young age. The opportunity to pursue a career in an area that I am excited and passionate about, is challenging and that has the potential to allow me to make new discoveries and a meaningful and positive impact is an enormous privilege.

Q: Could you tell us more about your current research interests and area of expertise? 
A: My research interests lie in understanding how the body’s natural defense, the immune system, can be used in the fight against cancer. We identified a rare subtype of an immune cell that is highly specialized in its ability to train the immune system to recognize and fight cancer. Our research focuses on obtaining a better understanding of these cells so that we can develop new more effective treatments for cancer. Our discoveries have enabled the development of new vaccines for cancer that so far look very promising in the laboratory and are now being developed further to enable them to be investigated in a clinical setting in cancer patients.

Find out more about Associate Prof. Radford’s research here.

Q: What would you consider to be your long-term career aspirations? 
A: To perform high-quality cutting-edge research that will contribute new knowledge and make a positive impact on the lives of cancer patients. To inspire and support brilliant young minds to address key challenges in creative and innovate new ways.

Q: For women who are just beginning their careers in STEMM, what skills would you encourage them to develop to help them on their journey? 
A: It is never too early to start developing leadership skills. Leadership training develops skills in communication, networking and negotiating that build confidence to enable you to obtain the support you need to progress your career. It will also help you to develop key skills to manage projects, time and people, up and down. Find great mentors to inspire and challenge you, bounce ideas off of, help you to develop your vision – set goals and be your own champion.
**Q: How can we inspire the next generation of women in STEMM?**

**A:** At least in medical research we don’t have too much of a problem in attracting women to embark on a career – but retaining them as they progress to more senior levels is a major issue. We need to continue to challenge the gender bias in our systems that forces many highly skilled and talented women out of the field, at a time when their career trajectory should be growing. We need to develop and promote new initiatives to change culture and practices to support and retain women at this vulnerable stage in their careers in efforts to bridge the gender gap.

*Dr Kristen Radford was speaking with Laura Elizabeth Lansdowne, Managing Editor for Technology Networks.*
**Leena Tripathi, PhD**

*Director of the Eastern Africa Hub of IITA, Dar es Salaam, Tanzania*

**By Rebecca Corkill, PhD**

Leena Tripathi has worked in the International Institute of Tropical Agriculture (IITA) in Nigeria, Uganda, Kenya and Tanzania for over 20 years. She is now the Director of the Eastern Africa Hub of IITA based in Dar es Salaam, Tanzania. Her work is based on the improvement of several staple food crops in Africa and has pioneered genetic engineering of banana in Africa to have resistance to diseases. Leena and her team have established the Genetic Transformation and Genome-Editing Platform in IITA, which aims to develop modified and genome-edited products.

**Q: What motivated you to pursue a career in science?**

**A:** I grew up in a family of engineers, where science was always encouraged. Since childhood, I have heard stories from my father about scientists, particularly female scientists such as Marie Curie. The story of Marie Curie inspired me. Fortunately, I was good at my studies, and my favourite subjects were science and maths. From a very young age, I started dreaming of becoming a medical doctor to save human life. I took biology, chemistry, and physics in my higher secondary school but after finishing school, I decided to pursue my science career so that I can do research and make discoveries and develop award-winning technologies. I took chemistry, botany, and zoology courses for undergraduate. Then I did a Master’s in Molecular Biology & Biotechnology and then a PhD in Plant Molecular Biology to understand the molecular basis of the biological activities in plants.

**Q: Your work is based on the improvement of several staple food crops in Africa. Why is this work needed and what changes have you seen in this area since the beginning of your career?**

**A:** My work is based on the genetic improvement of important staple food crops such as banana, cassava, and yam for controlling diseases and pests to enhance their production. These crops play a significant role in food security, providing more than 15% of the daily per capita calorie intake for millions of people in developing countries. Besides feeding millions of people they also generate income as cash crops, particularly in tropical and sub-tropical countries. These crops present several common challenges, such as pathogens, pests, and slow breeding methods. As they are clonally propagated rather than with seeds, yield-reducing pathogens and pests build up over time. Using disease-resistant varieties mitigates the negative impacts of pathogens on their production. Advances in new breeding techniques have the potential to accelerate the breeding of these crops bypassing the natural bottlenecks of traditional breeding. Intensive efforts using genetic modification have been made to develop improved varieties with resistance to biotic stresses. My team has pioneered the genetic engineering of banana in Africa to confer resistance to the deadly bacterial *Xanthomonas* wilt disease, threatening banana production and the livelihoods of smallholder growers in East Africa.

Recently, CRISPR/Cas9 based genome editing has emerged as the most powerful tool for crop improvement...
to create precisely targeted changes in plant genomes. A robust CRISPR/Cas-based genome editing of banana and yam has been established in our laboratory, which has been applied for developing disease-resistant and improved-quality varieties. My team has successfully established a robust Genetic Transformation and Genome-Editing Platform at IITA – the only one of its kind in Africa – to develop genetically modified and genome-edited products. This platform is also instrumental in transferring technologies to national agricultural research systems in sub-Saharan Africa and beyond. I have seen two significant changes since starting my career in this field. The first is that the facilities for plant transformation are becoming available in more laboratories and the second change is that genetic engineering is fast evolving, and more advanced tools are available now for crop improvement.

Q: You are the Director of Eastern Africa Hub of IITA. Can you tell us about how you came to this role, and what your duties involve?

A: After obtaining a PhD, I began a career as a Research Scientist at the University of North Carolina, Greensboro, in 1999. Since then, I have worked for about 21 years at the International Institute of Tropical Agriculture (IITA) in Nigeria, Uganda, Kenya, and Tanzania. IITA is one of the International Agricultural Research Centers under the auspices of the CGIAR. I have been promoted through the several ranks to my current position as the Director of the Eastern Africa Hub of IITA based in Dar es Salaam, Tanzania. I am also the leader of the Biotechnology program at IITA. My current duties involve providing leadership to scientists and specialists to implement the IITA strategy and oversee the management and operations of the East Africa hub of IITA. I supervise and provide leadership to over 40 multidisciplinary and multicultural Scientists and more than 350 staff and students based in five different countries (Kenya, Uganda, Tanzania, Sudan and Madagascar) in East Africa Hub of IITA.

My duties also include overseeing plant biotechnology research programs, providing leadership to multidisciplinary and multicultural teams, project management, leading the genetic improvement of staple food crops using modern biotechnological tools like genetic engineering and genome editing, developing strategies for fostering global collaborations, team building, recruitment and retention of scientists, annual review of professional achievements of staff, and providing scientific leadership to external institutions and professional societies. I lead the facilitation and coordination in the hub to ensure significant contributions to the achievement of the long term IITA strategy. I am developing strategies for fostering collaboration with external organizations. I also guide, support and monitor all research programs for the high quality of research, publications in high-quality peer-reviewed journals and project linkages. I establish and implement standards, criteria and procedures to assure high quality staff performance. I advise senior management for resolving issues arising from program operations including staffing, governmental matters, and donor relation.

Furthermore, I supervise graduate students, mentor postdocs and early career scientists and create an atmosphere that encourages motivation, innovation, teamwork and high performance. I manage budgets, technical and financial reports and contract renewals. Besides, I mobilize resources, finalize budgets and management plans and am responsible for communication and outreach.

Q: You have been a scientist in many geographical locations in your career. What do you believe are the greatest obstacles that women face when working in STEMM and do these obstacles change depending on your location?

A: I have experience working in India, USA, Nigeria, Uganda, Kenya and Tanzania. The greatest challenge a woman faces when working in STEMM is work–life balance. A woman has to put a lot more effort, particularly in her early career, to prove herself and earn a reputation. Most of the women have had to sacrifice caring for their children in order to establish in their careers. On top of it, while changing many locations, the biggest challenge is the spouse job.

Most of the women in the senior leadership positions in STEMM successfully manage multidimensional roles and responsibilities; their biggest hurdle is work-life balance. I am fortunate to be part of IITA, which has a policy on work–life balance with initiatives such as work flexibility, teleworking, leave options, stress management and wellness.

Q: What is your proudest professional achievement and why? What experiences, skills or qualities would you say helped you achieve this?

A: My most significant achievement is the establishment of a robust Genetic Transformation and Genome-Editing Platform at IITA. This platform allowed my team to develop transgenic banana resistant to bacterial wilt and genome-edited banana streak virus using CRISPR/Cas. We are currently using the platform for developing genome-edited banana resistant to bacterial, fungal and viral diseases. My scientific contributions, which were possible due to this platform, have been recognized internationally through several awards and honors, such as excellence awards for outstanding scientist and publications. I have been honored as an elected fellow of the American Association for the Advancement of Science (AAAS) for my distinguished contribution to developing robust genetic transformation platforms for banana/plantain, cassava, enset and yam, and the application of...
genome editing technologies for banana/plantain and yam. I also supervised many students and trained researchers from Africa and beyond in plant biotechnology using this platform. IITA’s plant transformation platform is a certified member of Excellence Through Stewardship, promoting the adoption of product stewardship programs and quality management systems for the full life cycle of agricultural biotechnology products.

My leadership, dedication, hard work, advanced biotechnological experience, regulatory and stewardship, communication skills and untiring support from family allowed me to achieve this.

**Q: Has the COVID-19 pandemic affected your work or your work-life balance this year?**

**A:** The COVID-19 pandemic has a mixed effect on our work. During lock-down, we able to continue our critical activities. After that, the lab remains fully functional, so the research continued. However, there were challenges with funding and procurement. There was no travel during COVID-19, so this has allowed doing more constructive work. I have published many good quality articles in reputed journals, which is very satisfying. Also, I managed to review and edit students’ thesis. However, I have been spending more time on the computer and especially late at night due to many virtual international meetings, and webinars, etc. in different time zone, is so exhausting.

**Q: If you could give one piece of advice to a young female that is considering a career in STEMM, what would you say?**

**A:** Make yourself so strong that nothing can bring you down. Dream high, set your milestones and put all your efforts into achieving them and stay focused. Never get afraid of challenges and obstacles. I also advise a young female to have a mentor and advisor, who can guide and champion her through the professional career advancement.

Dr Leena Tripathi was speaking to Dr Rebecca Corkill, Scientific Content Creator for Technology Networks.
**MERIT-PTAH**
was thought to be an Ancient Egyptian Chief Physician of the Pharaoh’s Court during the Second Dynasty of Egypt.

**Laura Bassi**
was an Italian scientist and the first woman to become a physics professor at a European university and the first to be named a chair of physics at a university.

**Mary Wollstonecraft Motagua**
was an English aristocrat who helped to introduce smallpox inoculation from the Ottoman empire into the UK.

**Mary Anning**
was an English fossil collector and pioneering palaeontologist. Her discovery of several dinosaur specimens challenged the science behind the development of the natural world and paved way for the field of paleoethology.

**Hildegard of Bingen**
was a German Benedictine abbess who was also a visionary, polymath, Christian mystic, composer writer and philosopher.

**Mary Annning**
was an English fossil collector and pioneering palaeontologist. Her discovery of several dinosaur specimens challenged the science behind the development of the natural world and paved way for the field of paleoethology.

**Wang Zhenyi**
from the Chinese Qing dynasty, was a renowned astronomer who also simplified complex mathematical books to help teach beginners.

**Hypatia**
lived in Alexandria, Egypt and was a philosopher, astronomer and mathematician. She was the first female mathematician for which we have a reasonable record.

**Mary En'hedu'ana**
from Ancient Babylon wrote poetry which revealed her astronomical responsibilities as an en-priestess of the city Ur. These included tracking the moon phases and positions.

**Tapputi-Belatekallin**
was the world’s first recorded chemist, she was an author and a perfume maker.

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RITA LEVI-MONTALCINI was an Italian-American neurologist who shared a Nobel Prize in Physiology or Medicine in 1986 for her discovery of nerve growth factor – a substance that stimulates and influences the growth of nerve cells.

1909 – 2012

MARIE CURIE was a physicist, chemist and pioneer of radioactivity. Her discovery of polonium and radium, introduction of X-rays into medical practice and use of radioactive isotopes in cancer treatment, won her the Nobel Prize in Chemistry in 1911.

1918 – 2020

KATHERINE JOHNSON was an American mathematician who conducted trajectory analysis for America’s first human spaceflight and the calculations responsible for placing the first human on the Moon.

1942 – 1980

GRACE HOPPER was a computer pioneer and naval officer, who made significant contributions to the development of computer technology.

1907 – 1964

RACHEL CARSON was an American marine biologist, conservationist and author of Silent Spring, a book that helped accelerate the global environmental movement.

1920 – 1958

ROSALIND FRANKLIN was an English chemist and X-ray crystallographer, who deciphered the atomic structure of DNA and made critical contributions to the discovery of DNA.

1928 – 2016

VERA RUBIN was an American astronomer who worked on galaxy rotation rates and discovered evidence for the existence of dark matter.

1930 – 1994

DOROTHY HODGKIN was a Nobel Prize winning British chemist who advanced the technique of X-ray crystallography. She confirmed the atomic structure of penicillin, vitamin B12 and insulin.

1909 – 2012

HEDY LAMARR was an Austrian-American actress and inventor. She co-invented a radio-controlled defence system which helped torpedo guidance. This technology formed the basis for today’s WiFi, GPS and Bluetooth communication systems.

1914 – 2000

ELSY MACGILL was the first woman to earn an aeronautical engineering degree. During WW2 she headed the production of Hawker Hurricane fighter planes and was nicknamed “Queen of the Hurricanes”.

1910 – 1994

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1867 – 1934

GRACE HOPPER was a computer pioneer and naval officer, who made significant contributions to the development of computer technology.

1906 – 1920

KATHERINE JOHNSON was an American mathematician who conducted trajectory analysis for America’s first human spaceflight and the calculations responsible for placing the first human on the Moon.

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