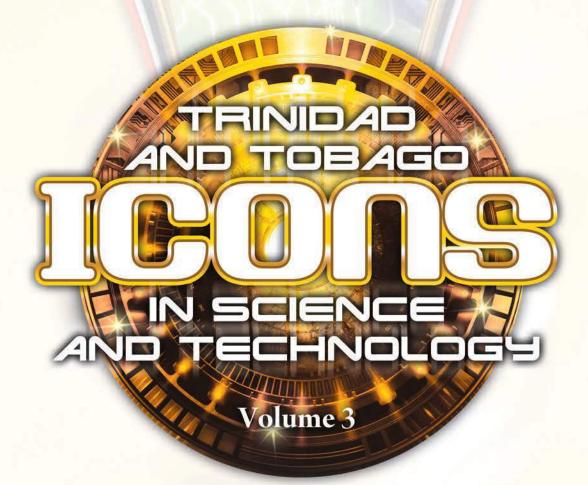








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Foreword

NIHERST is pleased to present this publication of biographical profiles of the 17 Trinidad and Tobago scientists honoured at its 2012 Awards for Excellence in Science and Technology. Thirty-one nominations were received from members of the public, and a panel of international judges evaluated the nominees in accordance with criteria set by NIHERST in the areas of engineering, medical sciences, applied science and technology, natural sciences and junior scientist.

This is the seventh volume in a series highlighting the achievements of Caribbean scientists who have been outstanding in their fields. Most of the scientists are persons born in the region, who worked here or abroad; a few are foreign nationals based in the region, whose work supported Caribbean development and the advancement of science.

The profiles in this book are longer than those in previous volumes. The longer format allowed us to capture more of the background and personality of the icons and to go into greater detail about their particular disciplines and accomplishments. What emerged most strikingly from the additional information about these men and women were the many similarities in their stories – in their personal histories, their character and their approach to their work – despite the varied disciplines they pursued.

Foremost among the common denominators are parents, who might themselves not have had much formal education nor much money, but who sacrificed for and pushed their children towards tertiary education. There was also a precocious interest in some icons in science and experimenting from very early ages. All were academically gifted but also loved school and learning, took pride in excelling and scholarship, and were independent thinkers. Many discovered their gift for teaching and loved mentoring as much as research. Several stressed the importance to them (and to science in general) of working with people in other scientific disciplines to support research and problem-solving in their own disciplines as well as others. And all have a great love for and loyalty to their homeland and deep interest in its progress.

The publications in this series serve several purposes. As Trinidad and Tobago presses on towards the development of a more diversified, knowledge-driven economy to ensure future competitiveness, greater human and infrastructural investment is needed to build capacity in science, technology and innovation (STI) to drive that transformation. Honouring our top scientists and recording their achievements raises their visibility and signals to the wider community the importance of their contribution to society, and the need to preserve and build on our scientific heritage. NIHERST hopes that these books will be valued educational resource material for science students especially, and sources of inspiration for them as they discover the great heights attained by our people and see their own potential reflected in these stories.

We also truly hope that this volume, like its predecessors, will be read with as much pride by all our citizens as we felt in putting it together for current and future generations.

Acknowledgements

NIHERST is very grateful to all persons and institutions who supported the development of this publication.

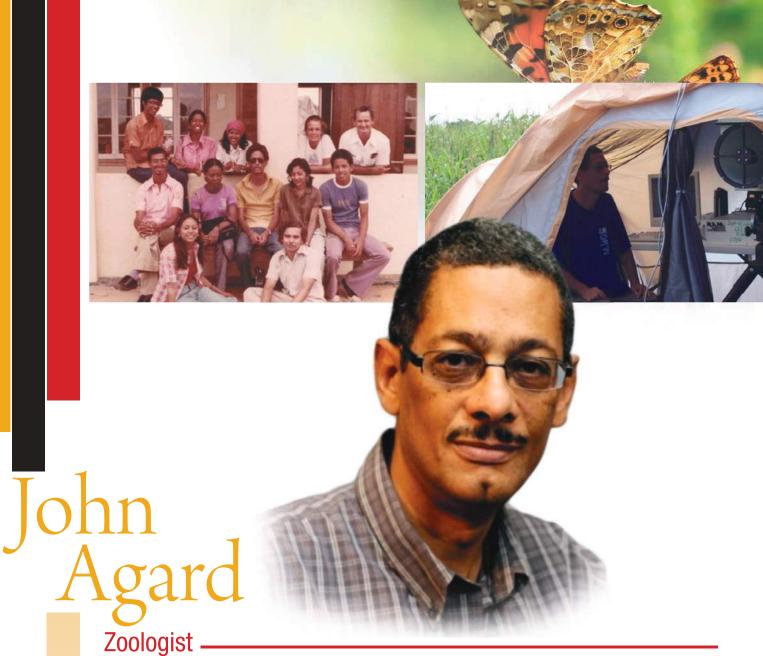
Foremost, of course, are the featured scientists for providing all the biographical material and also for sharing so much about themselves and their lives in extended interviews.

We also greatly appreciate the support of the Ministry Science and Technology for all our programmes and initiatives.

Special thanks to the Caribbean Academy of Sciences (CAS) and, in particular, the executive of the Trinidad and Tobago chapter, for their ongoing endorsement of our activities to recognise and formally honour the top scientists this region has produced.

Thank you also to Dr. Kim Johnson for information on the steelpan.

Finally, we commend the NIHERST team who worked on the publication: project coordinators and researchers/writers, Stacey-Ann Sarjusingh and Sasha James; researchers/writers, Ashley-Anne Elias and David Ramcharan; and researcher/writer, Christiane Francois, who also was editor along with Joycelyn Lee Young.



Scientist for peace and prosperity

John Agard is among the world's top scientists who are the lead authors of the Inter-governmental Panel for Climate Change (IPCC), selected as experts to convene and report on the state of world climate change. In 2007, the IPCC scientists were awarded the Nobel Peace Prize in recognition of their scientific contribution towards improving the environment for the betterment of mankind.

Prof. Agard is renowned internationally for his research broadly foccused on the area of sustainability science, with an emphasis on environmental management methods ecosystems services marketing, and climate change adaptation. In his own words, "Sustainability science is the study of the complex connected interactions between humans and nature, and is driven by concerns about finding the right balance between conserving nature and providing for the needs of society. Its main question is to find a practical model for development which optimizes the tradeoffs required by the longer term thinking necessary to assess the functioning of ecological systems, as opposed to the short-term timeframes typical in human social and economic systems".

Throughout his 30-year career, Agard has contributed to mainstreaming environmental sustainability in development planning at international, regional and local levels. In addition to his work with the IPCC, he has participated in major international integrated environmental research and assessment exercises, aimed at synthesising environmental science to inform policy and decision making. He was a Lead Author in the four







volumes on *Ecosystems and Human Well-being*, published for the Millennium Ecosystem Assessment (MA) in 2005. That same year, the MA authors were awarded the Zayed Prize for the Environment. He also served as a Coordinating Lead Author of *Scenarios Development in the Global Environmental Outlook (GEO-4)*, published by UNEP in 2007. This project coordinated consultations and data collection in five international regions, to project a wide range of environmental and socio-economic indicators under four plausible scenarios for the future up to 2100.

Agard was a Lead Author of the *Small Islands Chapter of the Fourth Assessment Report of the IPCC*. His contribution on small island biodiversity supports the case that Small Island Developing States (SIDS) are among the group of countries most vulnerable to projected climate change. In 2010, he was selected again as a Lead Author in the *Fifth Assessment Report of the IPCC*. He was also an independent advisor on Environment and Sustainability to the Inter-American Development Bank in Washington from 2009-2010.

At the regional level, Prof. Agard was co-leader of the *Caribbean Sea Ecosystem Assessment* (CARSEA), a sub-global study of the Millennium Ecosystem Assessment published in 2007. The policy advice from this study has contributed to the formation of the Caribbean Sea Commission by the Association of Caribbean States, to advance the cause of integrated management of the Caribbean Sea. His work on scenarios development and modelling of plausible future projections in environmental and socio-economic indicators in Latin America and the Caribbean continued with the 2010 publication of the *Latin America and Caribbean Environment Outlook* (GEO-LAC 3) by UNEP. He is also a collaborator with the (CARICOM)'s Secretariat and the Caribbean Community Climate Change Centre (CCCCC) in pursuing a sub-regional sustainable development agenda.

Locally, Agard has directly influenced science in the public domain through the creation of environmental policy, laws and systems. This was his main public service contribution as Chairman of the Environmental Management Authority (EMA) for three terms between 1997 and 2008. During his tenure, he led the development of the National Environmental Policy 1998 and revised 2007; the Certificate of Environmental Clearance Rules 2001; the Environmentally Sensitive Areas Rules 2001; the Environmentally Sensitive Species Rules 2001; the Noise Pollution Rules 2001; and the Water Pollution Rules 2001.

In his own research, Agard has addressed two contrasting questions, viz. What affects biodiversity? (e.g. pollution, land clearing, climate change), and in his view, the more important question: What does biodiversity affect or why is biodiversity important? (e.g. the provision of ecosystem services such as food, water, waste degradation, erosion protection, nutrient cycling, crop pollination and amenities), which are important to human well-being (e.g. nutrition, health, recreation, sense of place).

His tremendous contribution has been recognised by the university through the UWI Vice-Chancellor's Award for Overall Excellence (Research and Public Service), which he received in 2010.

John Agard was born in 1955, in Port-of-Spain, Trinidad, to Winston and Agnes Agard, and was the last of their five children. He grew up in Woodbrook and St. James. Several of the traits and values that define him were received from his parents and honed by his upbringing: his resourcefulness and resilience, his independent spirit and free thinking, his "high regard for education no matter what the circumstances of birth or wealth", and his great love for nature and the outdoors.

He witnessed the sacrifices his parents, and his mother especially, made to improve their lives and provide for their family. When he was five, his mother, who was a beautician encouraged his father to accept a government scholarship to attend the University of Manchester to further his education in public administration and management. Although reluctant, he was assured by his wife that she could take care of the children single-handedly while working, and she did so seemingly with ease. "My mother was a source of great encouragement to all of us. She never conveyed any sense of personal hardship or being burdened in the face of adversity. She simply found ways to overcome obstacles. She only looks at the good things, never the bad, and she celebrates everyone and everything. I have been inspired all my life to emulate her, in personal matters and in my professional aspirations."

When his father returned to Trinidad, he took up an administrative post at the Ministry of Finance and, as a travelling officer, was allowed to stay in government quarters across the country. Agard fondly recalls numerous weekends and family vacations in these remote houses as far as Cedros and Matelot, and his father's passion for "bush and mud" was passed on to him.

As a child, he was interested in building things and also in electronics – an influence from his eldest brother who went on to become an engineer. The family had no television until John was about 17. To entertain himself, he would salvage electronic parts from old radios and appliances to make his own engines, planes, boats, circuit boards and other gadgets. Agard attributes much of his academic success to the fact that he grew up without TV. "It encouraged me to spend my time more wisely – making toys, reading, and spending time exploring outside."

It is no surprise then that this curious boy was also very interested in science and experimentation. He badly wanted the Merrick chemistry set popular with boys at that time but it was initially beyond his parents' pocket. Undeterred and without the fancy apparatus, he started doing his own crude experiments, and was particularly fascinated with the varying combustibilty of different materials.

Agard attended Maria Regina Grade School and later Fatima College. He admits that he focussed more on the social aspects of his school life and was lucky to have had good teachers who made the work easy for him. He became very interested in biology and the environment thanks to his mentor, Fr. Gerald Farfan, who made the theoretical learning come alive through field trips, collecting specimens in the nearby river, hiking and, of course, experimenting. He even accompanied Fr. Farfan as part of a volunteer group on a trip to the remote village of Aishalton in Guyana to help the Amerindian villagers. He recounts having a severe allergic reaction to a fungus that grows on bat droppings, and luckily came out of the village alive. He thoroughly enjoyed this humble experience and saw that one could have limited basic resources like running water, electricity or sanitation facilities and still be very happy.

After secondary school, he was given the opportunity to attend the University of London in the UK and, although urged by his father to attend, decided to stay close to his family and study at UWI, St. Augustine. Agard went on to pursue a B.Sc. in Chemistry and Zoology, and later completed an M.Sc. in Pollution and Environmental Control at his father's alma mater in England. On his return, he worked at the Institue of Marine Affairs from 1981 to 1986.

In 1979, before starting his masters, Agard had taken time off to teach biology and general sciences at Fatima. It was there that he discovered his love for teaching. Emmulating Fr. Farfan, he tried to make his classes exciting with trips to mangrove swamps and waterways, and projects on how to make scales and other items relevant to the teaching syllabus. Parents would often come to the school to meet the teacher who made their children unusually keen on school and learning about science, and his past students still remember his vivid stories to explain concepts.



Consequently, in later years when he was appointed as a lecturer at UWI, he could not have been happier to incorporate once again his two passions - teaching and science. Agard completed his Ph.D. in Zoology while lecturing. He moved up the ranks at the university. In 2008, he was appointed Professor. He was granted a personal chair and became the only Professor of Tropical Island Ecology in the world. In 2010, he was appointed Head of the Department of Life Sciences.

In his early research, Agard focussed on marine biology and eco-toxicology, with emphasis on developing methods for detecting the sub-lethal effects of oil pollution on benthic ecology. He later became interested in the physiological adaptation of organisms to environmental change, such as temperature and salinity. This research informed the development of new treatment methods to reduce the toxicity of effluents from oil refineries.

He went on to look at issues of biodiversity and its importance to human well-being. He considers it fortunate that Trinidad and Tobago still has a lot of its forest and biodiversity but is concerned that, with the current rate of loss, if appropriate action is not taken, within five decades the country could experience Haiti-like conditions of denuded hillsides and severe flooding.



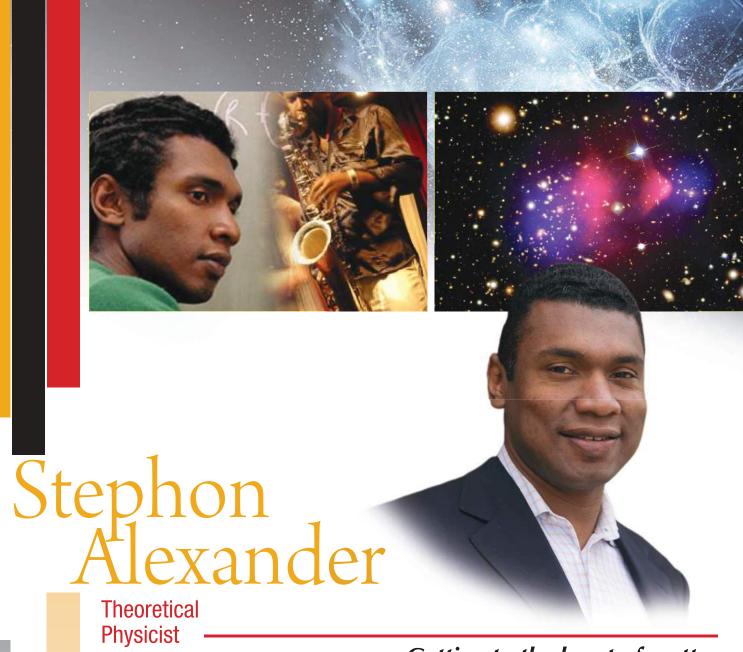


Agard is currently working with research students to develop markets for ecosystem services, with an emphasis on non-carbon markets, and with the ultimate aim of introducing ecosystem services valuation into national economic and planning frameworks. This work is critical for collaborating with the Government of Trinidad and Tobago to mainstream a SIDS industrial ecology paradigm. This attempts to optimise the balance between industrial growth and protecting human health and conserving nature's ecosystem services on which people depend. This sustainability science research focuses on introducing ecosystem services and climate change adaptation as one of the pillars of people-centred development. For his work in this area, he and his team won UWI, St. Augustine's 2012 Award for Most Internationally Successful Research Project.

Although Agard has dedicated all his professional life to protecting the environment and, more recently, to being a champion for slowing climate change, when asked what he thinks is the most pressing problem facing humanity, his answer is poverty and increasing inquality in wealth distribution. He believes that without much greater investment in human capital (i.e. employment, health, education, social protection, etc.) to reduce global poverty, attempts to conserve and develop natural capital and arrest global warming will not succeed. While economic growth focussed on industrial capital is important for cutting poverty, if it is not inclusive, particularly with respect to young people and the poor, it will only increase social instability.

In his personal life, Agard is a devoted father and finds it fascinating to observe how different from himself and his wife, Marguerite, his three children have turned out. In his spare time, he still enjoys being outdoors, camping, hiking, repairing and building electronics and "often fixing things that do not need fixing."

If he has a life philosophy, it is simply that, "We are all here to do something – anything – to improve things for others." He is surprisingly hopeful about the future and about the next generation's ability to make the shift and take the collective action needed to save the Earth. He continues to be motivated to teach and mentor young people in that direction. He knows that all the scientific knowledge in the world is not enough. A "coalition of the willing" is needed, so he patiently presses on "like water dripping on a stone", he says, in whatever spheres he can influence to make it happen.



Getting to the heart of matter

The matter and energy that we are all familiar with – the sort that scientists can measure, experiment with and explain – make up only 5 percent of the estimated quantity of matter and energy in the universe. Scientists do not know what constitutes the remaining 95 percent. They believe 20 percent of it to be dark matter and the other 75 percent, dark energy. These phenomena are as obscure as their names suggest. They do not interact with light, so their properties can only be hypothesised on the basis of how they act, i.e. scientists "know" of their existence by the effects they have on the parts of the universe that can be detected.

Dark matter is deemed to be what is keeping galaxies together and helping to structure form in the universe. In observing how stars form, for example, there is a discrepancy in the necessary amount of matter for that phenomenon to occur, i.e. 95 percent of the matter or mass is missing.

In the case of dark energy, scientists attribute this to the rate of expansion of the universe. Such a speed could only be fuelled by a particular kind of energy which is not among the known forms of energy governing nuclear acceleration.

Saxophone-playing scientist, Dr. Stephon Alexander, is among the many theoretical physicists working in the area of "quantum cosmology" – applying the laws of quantum physics to understand the universe as a







whole system. They are hoping to crack the toughest codes in science, which contain nature's greatest secrets about the origin and composition of the universe, and why the unknown matter and energy exist.

Dr. Alexander was born in 1971 and grew up in pristine Basseterre, Moruga, Trinidad with his parents, Keith, a computer technician and Felician, a nurse. As a child, he roamed the beaches of the south coast of Trinidad with his grandfather, Stephen "Sonny" Belfon. He attended Basseterre RC School, and remembers being an inquisitive six-year-old whose imagination was fired by local stories of the ghostly terrors known as "jumbies". But he was also already getting in touch with his inner scientist. As he played, he wondered why the moon "followed him" when he ran, or what made the stars "light up", or what was the force that animated a worm but not a worm-like dead twig. For him, the world of science and its hidden laws was as fascinating as the magical unseen world of folklore.

When he was eight years old, Alexander's life changed dramatically when his family moved from rural Trinidad to the completely opposite inner city environment of the Bronx in New York City, USA. Young Stephon was unhappy having been wrenched from the home, friends and family he had known, and thrust into a brave, and sometimes hostile, new world. His parents, wanted their first-born son who "loved school and learning", to have the best educational opportunities and to achieve as much as he could academically, and they gave him a lot of freedom and encouragement to explore his scientific interests. When he discovered computers in his early teens, he immediately wanted to know not just how to program them, but what made them work at a more fundamental level: "I discovered that physics was at the heart of computers and realised that I could use physics to understand the universe itself. This realisation came after I discovered a book about Albert Einstein and his theory of relativity."

Under the New York public school system, Alexander was deemed gifted in mathematics and physics. He had math and physics teachers who recognised this talent and encouraged him to pursue a career as a physicist.

He learned to play the saxophone at the age of 12, igniting a deep love for music that not only rivalled his interest in quantum physics but proved to be a portal for him later in his life to explore concepts relating to the origin of the universe and matter. In fact, in addition to considering being a secondary school science teacher at one point, he also contemplated becoming a professional jazz musician, and his only regret in life is that he did not take a year off to completely focus on developing his saxophone playing before finishing his tertiary education.

Alexander graduated from high school with top honours. He received a full academic scholarship to attend the prestigious Haverford College in Philadelphia, Pennsylvania, where he studied physics.

But despite his outstanding academic track record, his time at Haverford was marked by growing self-doubt – a dark and very real jumbie that would cloud the young man's judgment and vision, and trigger an identity crisis that made him question his ability to excel in the study of theoretical physics.

Throughout his life as a student, Alexander had become increasingly aware of his ethnicity, culture and heritage in the world of science. He had few role models in the sciences, and in Haverford, he alone among his fellow students in the physics department "looked, spoke and thought the way he did." He laboured through Haverford, attaining

his Bachelor of Science (BS) in Physics in 1993 and writing his thesis on the Barkhausen effect – the noise produced when a magnet's charge is manipulated. His next stop would be Brown University in Rhode Island, where he pursued graduate studies, attaining his Master of Science (M.Sc.) in Physics (1995) and Electrical Engineering (1996). But his lack of confidence and the pervading sense of alienation dogged him during his doctorate. He was daunted by the growing difficulty of the work before him. To compound it, his peers did not seem to think he was that talented in the subject either. He recounts, "Students formed study groups. To be asked to join one meant your peers thought they could benefit from you more than you could from them. That I was never invited or welcomed into any communicated how my peers viewed my abilities, which was even more demoralising." During the mid-term exams of the notoriously challenging Theoretical Classical Dynamics course, Alexander found himself unable to answer a single question. Downtrodden and considering himself a failure, he packed his things and returned home to the Bronx.

He also took a trip back to spend some time with his grandparents in the comforting places of his early childhood. He went to Maracas Bay often and, after a while, began taking his physics books with him. In that relaxing environment, away from the pressures of university, and reading them at leisure, he went through all of the material necessary for his remaining courses. When he returned to the US, a classmate urged him to at least take the final examinations, which, to his surprise, he passed with almost all As. In 2000, Alexander graduated from Brown with a doctorate in theoretical physics, focusing his thesis on string theory – an ambitious field of particle physics that describes all forces and matter in the universe in terms of continuous, wave-like strands of energy called "strings".

This experience taught him an unforgettable lesson about self-confidence and competition, which he prizes to this day, and it sparked in him a dream he still holds dearly, which is to continue his research in the Caribbean, and personally nurture a new generation of regional scientists.

After earning his Ph.D., Alexander was honoured to have been offered a research position at Columbia University, working with the popularly renowned theoretical physicist, Prof. Brian Greene. However, his heart was set on a chance to experience the world beyond the United States, and he went instead to Imperial College, London, England, as a post-doctoral fellow. He worked with Prof. Lee Smolin, one of the pioneers of loop quantum gravity.

In London, he blended in with the vibrant West Indian community and often worked on his physics calculations at the local Caribbean-styled pubs, with the sounds of kaiso and reggae in the background. He also expanded his musical horizons by joining a jazz group. It was at that time also that he befriended the famous pop/rock musician, Brian Eno, whose philanthropic work with PTSD-afflicted Bosnian children further stoked Alexander to work towards his dream of a Caribbean institute dedicated to basic research that can have a global impact. He is confident that he can make it happen in time, explaining that, "Theoretical work is the bedrock of all future technology and is easier to sustain and fund than experimental work, which can require expensive equipment and larger amounts of space to sustain. Most of the modern physics that our technology is so dependent on is based on quantum mechanics, the physics of the atomic and subatomic realm."

But he also realised that to run a scientific research institute of such stature and repute, he would need experience as an educator in training other scientists and would have to establish himself as a leading international physicist.

After two years at Imperial, Dr. Alexander returned to the United States in 2002, where he continued post-doctoral work at the Stanford University Linear Accelerator Center in California until 2005, when he joined Penn State University in Pennsylvania as an assistant professor. After lecturing as an associate professor of physics at Haverford, he took up an appointment at Dartmouth College in New Hampshire in 2012, where he is the 1907 Everett Just Professor of Natural Sciences and Physics.

Most of Alexander's career as a researcher has been spent expanding his Ph.D. dissertation.



He is working on an alternative to the Big Bang theory, in order to resolve some of the apparent paradoxes that it presents. One theoretical breakthrough of his is a possible explanation for the disparity between the abundance of matter and antimatter in the universe (which should be equal but is not), by showing how secondary phenomena present at the formation of the universe could create more matter than expected. In his words, "The early stages of the universe's expansion could generate ripples in space-time itself (gravitational waves), which could 'stir' (like stirring tea with your spoon) more matter than anti matter out of space. I am proud of this idea because this problem did not have a new solution for decades."

Along similar lines, another of his theories claims that the electrically neutral particle known as the neutrino, recognised for its role in holding matter together, has a similar role in dark matter and dark energy as well.



In early 2013, Alexander began working with fellow physicist, Antonio Machiano, on a new unifying theory that describes the connection between gravitational force and the "weak" nuclear force which is, among other things, responsible for the decay of radioactive isotopes.

Alexander has published over 50 research articles and three famously cited articles.

As a teacher, Alexander trains and mentors Ph.D. students and post-doctoral researchers from around the world. A strong believer in interdisciplinary research, he has drawn on mathematics, computing and biology in conceptualising his own work. His short-term goal involves creating a course at Dartmouth called, "The Music of Physics". It examines the theory that the universe is like a cosmic orchestra – playing "the music of the spheres" first conceptualised by Pythagoras. Each of the quantum fields underlying matter vibrates like a musical instrument. As they all vibrate together, they create the structures in the universe, just as musical instruments produce sound waves. They maintain coherency and order similar to harmonic resonance in musical orchestration. Alexander's exploration of this theory through his saxophone playing is one of the distinguishing and more unconventional marks of his research, and has generated him more than a little Internet fame!

It is this interest that endears Alexander to the research of another icon also featured in this publication, Prof. Brian Copeland. He is elated that Copeland's work focuses on an instrument created indigenously (the steelpan), and he feels this can inspire youths to see it as more than a cultural entity and one whose existence and evolution is a testament to scientific innovation and is relevant to scientific and engineering pursuits. Copeland's choice of an instrument that itself reflects a combination of the local musical traditions from Trinidad and Tobago's African and European heritage is important to someone like Dr. Alexander who is so strongly concerned about the future of science in the Caribbean.

Alexander believes that scientists of the region have a stake in the future of the world, and the privilege of exploring that world in ways that no one else can, and Caribbean youths should be encouraged and trained to take up that privilege and responsibility when their time comes. His words of wisdom to them, rooted in his own life experiences and struggles as a scientist, are, "Follow your own agenda, and don't get psyched out by other people's performance. Follow your passion. Dream big. Seek out good mentors. Develop a strong foundation in mathematics and the introductory materials in your preferred discipline because you will rely on them in more advanced matters. And don't be afraid to ask big questions."



From farm to fork

Most consumers do not spend much time contemplating the vast, complex production systems that supply food to them. The average person takes for granted the fresh produce, the packaged grocery goods, the fast foods, the "street" foods, and the restaurant fare that are abundant in all but the poorest of places, and are usually presumed to be nutritious and safe to eat.

By contrast, there seems to be almost no aspect of food production and consumption that Prof. Neela Badrie has not studied in some way. Prof. Badrie is Deputy Dean of Research and Innovation and Head of Department of Food Production at the Faculty of Food and Agriculture at The University of the West Indies (UWI), St. Augustine. Her scientific work has covered agriculture, processing and manufacturing, and consumer sensory evaluation and perception. While her areas of specialisation are food microbiology and safety, these fields are also varied and her areas of research have included: tropical food processing, food quality, epidemiology and food-borne illnesses, risk analysis of foods, public perception, public health, and food-related diseases such as obesity.

Prof. Badrie's research has supported the development of value-added products derived from locally produced crops, and has also added to the understanding of food safety and consumer knowledge and





practices throughout Trinidad and Tobago. These findings have, in turn, influenced public awareness campaigns on food safety.

One of her main research interests is the creation of sensory acceptable, nutritional and functional value-added products derived from local crops. Examples of this work include:

- the utilisation of the waste of the cocoa pulp in the development of new products such as carbonated beverages, stirred yoghurts and syrups;
- the use of the peel of the golden apple (pommecythere) in the processing of low-sodium hot sauces;
- the production of osmotically dehydrated candied products using local fruits such as carambola (star fruit), golden apples and cashew apples;
- the production of a novel low-calorie christophene jam using various stabilizers and low-calorie sweeteners; and
- the processing of enzymatic treated sorrel calyces into innovative sauces as substitutes for cranberry sauces and wines.

Badrie's research goes further to study the quality issues related to these new products, by understanding the impact of modified processing technologies on the quality of the final product. She has analysed the sensory acceptability and compositional quality of varying levels of cassava and wheat flour blends to produce muffins. She also studied the effects of extrusion processing variables like moisture content and temperature on the properties of cassava-based puff snacks during production.

In the area of food safety and microbiology, she has undertaken research on public perception and consumer, vendor, agricultural and manufacturing practices related to food safety. According to her research, more people are affected by food-borne illnesses to varying degrees of severity than would be commonly known or reported. One of her studies investigated the hygienic practices of street-food vendors of "doubles", while another addressed the public perception and microbiological evaluation of "doubles" and broilers in pluck shops. She also did a survey of the perception, attitudes and practices to food safety among university hall students.

Prof. Badrie's research was also integral in determining the risk and hazard analysis and critical control systems for locally processed foods. Simply put, her research strives to identify disease-causing microorganisms in food and to determine the levels of these microorganisms found in raw and cooked foods. These results can give an indication of whether farmers and vendors adhere to safety standards when dealing with crops and food. An example of research in this area is a study on the effects of local spices and fresh herbs such as chadon beni and neem on native microbiota and food-borne pathogens in selected crops such as pumpkin, sweet potato and lettuce.

Other research in this area included: microbiological and heavy metal contaminants, such as mercury, in shrimps; the prevalence of histamine-producing bacteria in two commercial tropical marine fish sold in Trinidad; and a burden of illness study for acute gastroenteritis, food-borne diseases and pathogens commonly transmitted by foods in Trinidad and Tobago. More recently, she studied food safety on the farm by looking at the postharvest handling and storage practices for tomatoes, pumpkins and sweet peppers, as well as food safety issues in the local school feeding programme.

Neela Badrie was born at her grandmother's home at Old Southern Main Road, Chaguanas, Trinidad. The eldest of five children of Permeshwardath and Cala, Badrie had a simple but, for her, vividly memorable childhood, characterized by Carnival frolics, going to the movies, both at cinemas and drive-in theatres, attending family prayers (pujas) and weddings, and frequent visits to the beach.

She attended Chaguanas Government Primary School where her father was a teacher. She credits him as significantly influencing her interest in science, as he was among one of very few people to have earned a B.Sc. in Natural Sciences from St. Augustine College (now a university), in Raleigh, North Carolina, USA, during that era. Her mother assisted in managing the family's gift and variety store. She took a keen interest in Neela's academic development, often guiding her in school assignments in art, needlework, dress-making and essay-writing. Young Neela was at one point fascinated with the glamour of becoming an air hostess, partly due to the limited career options for women at that time. However, inspired by her father's achievements, she eventually enrolled at UWI to read for a B.Sc. in Natural Science herself.

After graduating, she taught for two years at Queen's Royal College – her first taste of teaching, which she really enjoyed. It was through this experience that she gained confidence and learned how to maintain control of the classroom, a skill she still finds useful as a university lecturer. She also taught for a short time at Chaguanas Senior Secondary School before returning to UWI to start her Master of Science in Food Technology at the Faculty of Engineering.

Interestingly, Prof. Badrie's career at UWI began as a voluntary post, where she offered her services free as a part-time lecturer in 1990 for one semester, in order to gain experience and expertise in the field. She frequently relays this story to her students and emphasises that, "Sometimes you must do things for free, as it can open up opportunities or at the very least it can build your CV."

Badrie received her Ph.D. in Food Science in 1990. Since then, she has served the university as Lecturer and Senior Lecturer and was promoted to Professor of Food Microbiology in 2011. As Deputy Dean, she is responsible for building research capacity – creating an enabling environment for research and innovation, and developing faculty and department research agendas around research clusters to address priority areas. She was also instrumental in the development of post-graduate programmes such as the M.Phil./Ph.D. in Food Safety and Quality and the Diploma/M.Sc. in Agri-Food Safety and Quality Assurance. She has supervised over 125 students.

Over the period 1991-2012, Prof. Badrie published 73 refereed publications and nine book chapters, and has delivered more than 100 presentations in 24 countries. She has also been a reviewer for over 25 international journals including the Journal of Food Science, International Journal of Consumer Studies, the British Food Journal and the International Journal of Marketing Studies. She has served in numerous positions on national, regional and international committees. She was an executive member and Public Relations Officer for the Caribbean Academy of Sciences (CAS), Vice President and Director of Publications of the Caribbean Agro-Economic Society and President of the Caribbean Institute of Food Science and Technology. She was also a member of the Association of Professional Agricultural Scientists of Trinidad and Tobago, the Caribbean Fruit Crop Society, The World Academy of Sciences (TWAS), the Organization for Women in Science for the Developing World, the Institute of Food Technologists, and the International Union of Food Science and Technology. An exemplar in her field, she was awarded the TWAS Young Female Scientist Award in 2001 and the TWAS Fellow Award in 2011.

On her personal time, Prof. Badrie, keeps busy tending to her garden, as well as her six beloved dogs, most of which she adopted as strays from the Trinidad and Tobago Society for the Prevention of the Cruelty of Animals. She also greatly enjoys going on annual family vacations and immersing herself in the cultures of new places.

She would recommend a career in science to young people but is, of course, biased towards her particular discipline, stating that, "Microbiology has many applications in medicine, the food industry, public health, consumer food safety, the environment, agriculture and plant sanitation. It impacts food production, processing, preservation and safety. In food microbiology, a wide variety of state-of-the-art technologies can be applied, from rapid methods and automation for detection, identification and enumeration of food-borne pathogens and microbiological hygiene indicators to immuno-diagnostic assay system and molecular biology systems using polymerase chain reaction techniques with pulse-field gel electrophoresis, DNA sequencer and riboprinter."

She also urges women to strive towards attaining the top positions in their scientific fields, despite – or perhaps because of – what she sees and has experienced as gender bias that persists in research and academia.

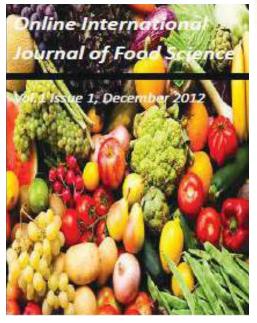
For her own continued development in the field, Prof. Badrie would like to apply more modern molecular microbiological techniques to local and regional food safety assessment. She was able to introduce molecular microbiology to the department, and she hopes to do further research in this specialized area. Described as DNA finger printing of microorganisms, this cutting-edge method is used to identify and quantify microorganisms.

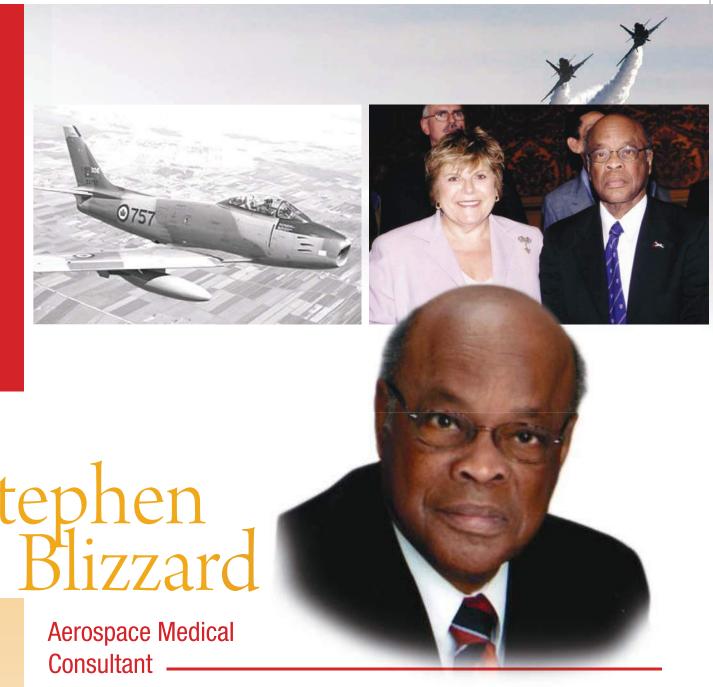
She is also interested in researching the use of innovative non-thermal processing techniques in the creation of a variety of acceptable, nutritious and health-promoting value-added products. She hopes to continue educating the public on the nutrient composition of local foods so that consumers can make healthier choices.

On the hot issue of local food security, Prof. Badrie believes that it is possible to reduce the local food import bill, but because of land limitations and consumer preferences for certain foods, continued importation of food is inevitable. She would, however, like to see increased production of local high value products that can supply global niche markets. She also hopes to see an improvement in public food safety awareness, with an emphasis on education and food safety training.

With the technological advancements in microbiology, coupled with the increasing need to understand the composition, risks, practices and impact of the food we consume, Prof. Badrie's expertise and commitment to research will undoubtedly continue to play a leading role in food safety for Caribbean people.







The flying doctor

How does a young man from the outskirts of Port of Spain ascend to become one of the most respected servicemen and most decorated West Indians in the Canadian Airforce? By determination, focus and self-confidence, Dr. Stephen Blizzard successfully straddled two professions and became a celebrated trailblazer in the little known field of aviation medicine.

Blizzard was an early pioneer in this specialised field, also referred to as flight, aerospace or space medicine, and is one of few persons worldwide, and the only Caribbean national, to combine the fields of aviation and medicine.

Practitioners of aviation medicine study, discover, prevent and treat medical conditions that can affect pilots, aircrew and persons involved in space flight. These conditions arise as a result of the specific and, at times, adverse environments and the flight stresses that these professionals are constantly exposed to, including rapid acceleration, pressure changes and long-term air travel. These can lead to problems with perception and motion sickness. Aviation medicine also studies the impact of fatigue, disorientation and medication on pilot performance. Doctors of aviation medicine, therefore, play an integral role in maintaining the safety and comfort of millions of pilots, air crew and passengers of private, commercial and military aircraft worldwide.





Stephen Blizzard is listed in Cambridge Publishing's 2008 publication, *Top 101 Industry Experts*. He obtained his Diploma in Aviation Medicine from the Royal Air Force Institute of Aviation Medicine in England, and was one of very few persons in the world's Air Forces and Air Arms to have earned the distinction of Dual Designator – Flight Surgeon and Pilot.

While Blizzard is recognized for his work in this area, this was not in fact his first career. He initially trained and practised as a veterinarian. But both the military and medicine had captured his heart as a boy.

Born and raised in Belmont, Trinidad, he attended the Moulton Hall Methodist School, where his father, Egerton, was the headmaster. His mother, Engracia, was also a teacher at secondary schools in Port of Spain. He says he learned self-discipline and good study habits from his father, and persistence from his mother. He attributes his compassion for the less fortunate to growing up in Belmont and attending a "downtown" school in his early life.

Blizzard placed third in the secondary school entrance examination and won a college exhibition to attend Queen's Royal College (QRC). Growing up in a period engulfed in the Second World War, and witnessing the strong presence of British and American soldiers in Trinidad, sparked his passion for aviation and military life. Around the age of 12, he began building model airplanes. He also became the troop leader of QRC's 4th Air Scouts, and later, a corporal in the cadet corps.

When he left secondary school, Blizzard worked for the Treasury as a clerk. While there, he applied for, and received, a government scholarship to pursue veterinary medicine at The University of Edinburgh, Scotland. He earned his B.Sc. in the field and Membership of the Royal College of Veterinary Surgeons (MRCVS) concurrently over the course of five years. He described this achievement as quite difficult, with only 40% of students of that cohort succeeding in the feat. While he was in Scotland, he joined the Edinburgh University Air Squadron, flying Tiger Moths. This would prove to be the first step in his career in aviation.

On completing his studies, Blizzard returned to Trinidad at age 24 to fulfill his contractual obligations. He worked as a government veterinarian for five years and was the youngest veterinarian in Trinidad and Tobago at that time. During this period, he continued to fly with the Light Aeroplane Club of Trinidad and Tobago and obtained a private pilot's licence in 1955.

However, his interest in becoming a medical doctor never waned. It had, in fact, been reinforced after he learned that his father had also once aspired to become a doctor but could not, due to his financial circumstances. Blizzard believes, "He would have been a great doctor because of his empathetic and caring nature, and his attentiveness when interacting with people. He was my inspiration, a great mentor to me, and I owe all my success to him."

The chance to fulfill the dream of both father and son came when he relocated to Canada in 1958 to become a member of the faculty at the Ontario Veterinary College as a graduate assistant in the Department of Surgery. During his time there, he continued to fly by obtaining his Canadian private pilot licence. After one year in this

position, he enrolled at the Medical School of the University of Western Ontario. While in his first year, he joined the Air Force Reserve Officer Training Programme to help pay for his studies. He was selected as one of 60 medical students across Canada to participate in the 45-month subsidization plan. This meant that his education was subsidized on the condition that he would serve as a medical officer for three years after graduating. Out of the 60 students in his cohort, Blizzard was one of six that were selected for permanent commissions while the other students returned to civilian life.

He worked at the National Defence Medical Centre (NDMC) in Ottawa, and upon graduating in 1963, he became the first resident in surgery there. He was then posted to Rockcliffe Base (Ottawa). In 1967, he did a Flight Surgeons course at the Royal Canadian Air Force (RCAF) Institute of Aviation Medicine in Toronto, and it was this that sparked his interest in aviation medicine. That year, he also obtained his Canadian Commercial pilot's licence. Blizzard was then posted to Moose Jaw, a jet training base, as Base Surgeon and Flight Surgeon. He began training to fly two types of jets - basic training on the Tutor and advanced training on the T-33 Silver Star. He describes this period as the most challenging of his career, as he was juggling two professional positions while also working towards his Wings. He succeeded in obtaining his Wings on these two jets as a military jet pilot in 1968, while concurrently performing his duties as Base Surgeon, a feat that to this date has not been replicated.

Dr. Blizzard eventually spent 16 years in the Canadian Armed Forces (C.A.F), first as a flight surgeon/military jet pilot, with promotions to the posts of Senior Medical Officer and, eventually, Deputy Commanding Officer of the Central Aircrew Medical Board. He served at many bases in Canada as well as the Middle East and Zimbabwe. He was also the Canadian representative on several North Atlantic Treaty Organization (NATO) committees. He served on the Advisory Group for Aerospace Research and Development, the Air Standardization Coordinating committee, the Aeromedical Working Party/Military Agency for Standarization, and the Joint Committee on Aviation Pathology.

As a civilian, he spent 12 years in the Directorate of Civil Aviation Medicine, Department of Health and Welfare, serving as a senior consultant, Chief of the Civil Aviation Medical Unit, and a member of the Aviation Medical Review Board. He also wrote two government publications titled, *Flight Times and Flight Duty Times in Canada*, which is still used as a reference in Canada, and *Patient Care in Flight*, which is utilized around the world.

In 1969, Blizzard returned to Trinidad and Tobago, where he practiced medicine privately for six years before returning to Canada. He was also the Aviation Medical Examiner for pilots with licenses from the USA, UK, Canada and Trinidad and Tobago. During this time, he presented the first paper in aviation medicine in the Commonwealth Caribbean titled, "The Aerial Transportation of Patients." He also returned to his boyhood interest and served as Headquarters Commissioner for Air Scouts in Trinidad and Tobago from 1973 to 1975, as well as instructor of the 16th Port of Spain Air Scouts.

Throughout his career, Dr. Blizzard participated in historical or groundbreaking events in the field. He was a member of the medical team on the first airlift of Vietnamese refugees to Canada from Malaysia. He was also the only non-American member of the Aerospace Medical Delegation visiting the Soviet Union in 1990, where they were the first group of aerospace medical specialists permitted to visit the Russian Space Program.

Blizzard has been honoured, both locally and abroad, for his pioneering work in aviation medicine. In 2011, he was recognised with the National Meritorious Service Medal of the Quebec Area of the Air Cadet League of Canada. He



was also presented with a pin for his 25 years' service to the 410 Wing. In 2010, he received Cambridge Publishing's highest honour, "Professional of the Year" in the field of aviation medicine. In 2007, he was the 16th person worldwide to be honored with the Dr. Forrest and Pamela Bird Lifetime Scientific Achievement Award for his contribution to safety in civil aviation. In 2004, he was the recipient of the Dr. Wilbur Franks Award for his significant contributions to the advancement of aerospace medicine and air medical transport. This award is considered to be the highest Canadian accolade in the field of aviation medicine. In 1992, he was made a member of the International Academy of Aviation and Space Medicine.

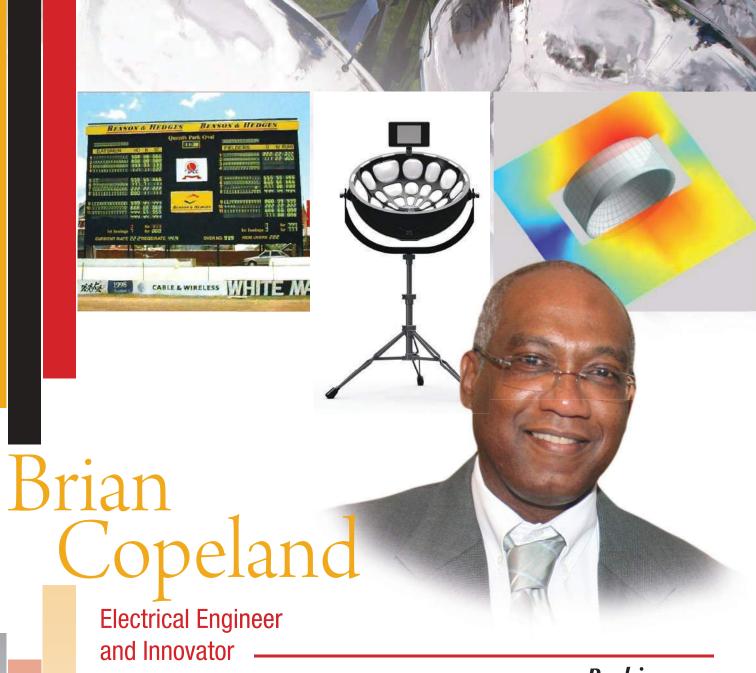
Stephen Blizzard continued flying until the age of 78 when he stopped due to age-related health conditions. But he remained engaged with the Royal Canadian Air Cadets and the Air Scouts in Trinidad. While there are many highlights from the 42 years of his rich and varied professional life, one of the most memorable and enjoyable for him was his role as a flying instructor for five years and Chairman for four years at the Light Aeroplane Club of Trinidad and Tobago. During his tenure, the club gained the reputation as one of the best flying clubs in the world. As flying instructor, he trained students to Canadian Airforce standards and finds it "most gratifying to know that none of them ever had an accident or crash." He also had the pleasure of training the fifth and sixth female pilots in Trinidad and Tobago. At the club, he developed lifelong friendships which he treasures to this day.

In his leisure time, Blizzard's enjoys music, reading widely, writing and, of course, aviation. He believes that aerospace medicine will always have a bright future because it encompasses all aspects of medicine pertaining to that particular environment, including the fitness to fly of aircrew, astronauts, cosmonauts and passengers; the human factors in aircraft accident investigation; and ongoing research into the effects of flight on the human body. With respect to the latter, from a military perspective for example, aircraft will become faster and designed to carry more troops and equipment for longer distances. With civilian flights, travelling non-stop for lengthy periods increases the possibility of faster spread of communicable diseases, which will require controlling. In addition to such factors, he believes that aerospace medicine will become even more important as the boundaries of space are pushed further, given the many advances made in the field since the start of space exploration.

Stephen Blizzard's lifelong passion for his field reflects in his continually seeking opportunities to pass on the benefit of his expertise to today's generation. The wisdom distilled from his experiences and accomplishments is put simply: "To succeed, you have to set goals and work hard towards achieving them. Don't waste time with frivolous activities. There is no substitute for hard work."







Pushing pan

It is a complex technology invented by non-scientists, a complex musical instrument created by non-musicians. These early inventors, and the subsequent generations of iconic "panmen" who shaped its evolution, gifted to Trinidad and Tobago a true national treasure. In turn, the country has bequeathed to world cultural heritage the most significant acoustic instrument invented in the 20th century, and its distinctive sound, which defines this region, has captivated music lovers worldwide, from the United States to Sweden to Japan.

Very few have taken up the challenge of applying the principles and tools of science to making pan a better and more universally enjoyable instrument. One such champion is Prof. Brian Copeland, Dean of the Faculty of Engineering at The University of the West Indies (UWI), St. Augustine, an internationally known control systems specialist and inventor of the G-Pan and Percussive Harmonic Instrument (PHI).

Although Prof. Copeland has spent most of his life in Trinidad and Tobago, his ideas have impacted scientific understanding of control systems even abroad. Yet he remains a consummate and loyal citizen of Trinidad and Tobago, dedicating his expertise to improving the academic experience of those who follow in his footsteps, revolutionising our national instrument, and promoting a more innovative, knowledge-driven society.

Born in 1956, Brian Copeland spent his childhood in Cocoyea Village, Trinidad, in a house he describes as "devoted to mas". His father, Mack Copeland, was an innovator in his own right who won titles for many bands in San Fernando, and was credited with introducing the use of gigantic headdresses and costumes for Carnival kings and queens, and wheels to give them mobility. Like many innovators, his work was not immediately appreciated. When he first introduced this design, it was disqualified. Growing up in this milieu of inventiveness, with a wealth of books lying around the house, young Brian grew to love learning and appreciate the virtue of problem-solving as he observed his father transform creative ideas into designs, and designs into finished products.

He was an outstanding student, from his very start at Cocoyea Government Primary School. His early desire to be a medical doctor may have been influenced by his mother, Etheline, a nurse. She recounts her son, at age six, precociously informing her that he knew "how gravity works" – knowledge Copeland wishes he had retained! He visited the public library on Saturdays to read more about medicine, but by age 12, he had abandoned this dream, deciding that the field was "too messy, with too little structure and system" for his liking.

He won a College Exhibition and entered Presentation College, San Fernando, where he found his true calling – electronics. Through interactions with older students, he took up the popular boyhood hobby of his time: tinkering with radios. These were the early years of vacuum tubes, integrated circuits, transistors and widespread deejaying. He was himself a DJ, with the ironic name, Party Heat Incorporated – acronym PHI. As his affinity for audio systems grew, he began buying parts from repair shops, tinkering with the family Blaupunkt radio to his father's dismay, and eventually repairing radios and building his first amp at 16. This pastime did much to spur his interest in acoustics, which he went on to research and teach.

Finishing his A'Levels in mathematics, physics and chemistry, Copeland won a National Scholarship and started his B.Sc. in Electrical Engineering at UWI in 1975. However, a huge teaching strike in 1976 resulted in him switching from electronics to control systems. He graduated with first class honours, topping the faculty's class of '78 with an average that was unbeaten until the mid-2000s.

He pursued an M.Sc. in Electrical Engineering at the University of Toronto in Canada, focusing on control theory – the science governing the modification,





adaptation and stimulation of dynamic systems used in automation and robotics. The university was involved in aerospace research at the time, and after he left, some of his thesis work was used in developing the "Canadarm" (or mechanical arm) that was subsequently used in NASA's space shuttle programme.

After completing his M.Sc. in 1981, Copeland returned to UWI as a lecturer in the Department of Electrical and Computer Engineering. In Trinidad, he found that his field of choice had limited application locally. By chance in UWI's labs, he encountered "Tessie" Julien, a technician who played pan with Carib Tokyo and who bemoaned the difficulty steelbands had with being heard at Carnival time, having to compete with DJs. Marrying his love for music to training in electrical engineering, he began work on steelpan amplification. Some form of pickup device was required to convert the steelpan note vibrations to an electrical signal that could then be used for amplification. This proved to be quite a challenge as percussive instruments generate an impulsive noise when struck and this is all too easily detected by a pickup. Moreover, attachment of a pickup to the pan essentially transforms it into a large microphone that can be the source of feedback when amplified.

Over the years, Copeland experimented with three types of pickups – two contact types that were attached directly to the pan and a more bulky non-contact type. This LectraPan system, worked brilliantly, allowing bands

to employ much smaller bass pans, thus saving space and making transportation easier. It was launched in July 1987 at the Carib Tokyo panyard. Copeland received three patents for this invention. A few years before that he had published a paper on the "Development of an Electronic Steel Pan" in the *West Indian Journal of Engineering*, unknowingly foreshadowing one of his own future projects.

The problems he encountered in steelpan amplification alerted him to the need for more in-depth research on steelpan technology – a phrase he coined to represent all aspects of how steelpans work. He documented these problems as targets for future research in a letter to the Minister of Culture at the time, in the hope of getting government funding.

Later in 1987, Copeland received a LASPAU/Fulbright scholarship to pursue his Ph.D. in Electrical Engineering at the University of Southern California in the US, focusing on control system algorithm design. He worked with Prof. Michael Safonov on his thesis, beginning a research partnership that would continue after his return to Trinidad and Tobago in 1990. Back at UWI, he shifted his research focus from the theoretical to more application-oriented studies. He introduced MATLAB scientific computing software to the department. Although his undergraduate training in digital electronics had been aborted by the strike, at the urging of then Head, Prof. Kenneth Julien, he taught himself the topic and established a very successful course stream in this area.

Under his tutelage, there was significant improvement in the competence of final year students in digital electronics design and fabrication. His interest in ensuring that students acquired skills that would allow them, after graduating, to engage in innovation and entrepreneurship in complex electronic systems design was stymied by the costly tools and software available at the time for making custom integrated circuits (ICs). A word of advice from a colleague in 1995 provided the answer. FPGAs (field-programmable gate arrays) were very densely populated ICs that could be field programmed, custom-made for clients and "locked" to prevent tampering. They had been used by the microprocessor giant, Intel, to design the first Pentium chip. They provided a means by which engineers in the Caribbean could produce complex integrated circuits for clients in any part of the world, without the need for expensive IC fabrication machinery.

Over the years, Prof. Copeland honed his expertise and provided his students with practical experience in developing various industrial control systems. In 1991, as a consultant in the university's newly formed Real Time Systems Group (RTSG) lead by Prof. St Clair King, he developed a power

demand controller for Trinidad ISPAT – a device that provided power usage warnings at the company's plant to reduce the cost of electricity. In 1995, he co-supervised the design of a Supervisory Control and Data Acquisition System (SCADA) – an automated system for monitoring and regulating the operation of equipment and the collection of data for the Arcadian oil plant in Pt.Lisas and subsequently deployed at TRINMAR. In the late 1990s, he served as the consultant and Project Leader in RTSG for the design and construction of the first electronic scoreboard at the Queen's Park Oval. RTSG was financed from project income as well as funding from local corporations, NIHERST and the OAS. It was through his work at RTSG that he developed a full understanding of the need for a stronger innovative culture to support sustainable economic growth.

In 1997, Copeland became Senior Lecturer and Head of the Department of Electrical and Computer Engineering at UWI. In 1999, with Prof. Clement Imbert and Dr. Derek Gay, also steelpan researchers at UWI, he founded the Steelpan Development Centre, which used the sciences of metallurgy and electronics to explore mechanisms for improving the instrument. In 2001, Copeland started work with Prof. Tom Rossing of Northern Illinois University on mapping the sound radiation patterns of the instrument.

The centre was intended to source funds for collaborative steelpan research and development (R&D) work on existing projects at the Steelpan Development Laboratory. By the time the laboratory was officially opened in 2004, Copeland had already developed the Robo-pan – a mechanism that enabled a computer to "play" a steelpan – and the earliest incarnation of the MIDIPan, a collaborative effort that was a synthesizer whose "keys" took the shape of a steelpan's notes rather than a piano's keys.

Copeland was passionate about the centre because of his conviction that steelpan technology R&D would allow locals to capitalise on their national instrument in ways that



foreigners could not, giving them a competitive advantage in the global steelpan market. His vision was to address the problems he had identified in the Eighties and to engage in R&D to improve the instrument significantly, as a catalyst for the growth of the industry internationally. However, there was little support at the time.

In 2005, when he was about to lose hope of continuing his work on pan, he was contacted by the Prime Minister's office. A grant soon followed to solve one of the steelpan's well documented problems – the tendency of higher notes in the tenor pan to demonstrate harshness or acoustic dissonance. He took this opportunity to tackle other problems he had observed as well, viz. the use of material of unknown quality; the lack of applied scientific knowledge in the process of pan building and tuning; and the pan's tendency to go off-tune over time. The fruit of Copeland's work was the much acclaimed G-Pan, a steelpan made from high quality steel, with reduced dissonance, more resilience, a musical range half an octave higher than an average steelpan which reduced the number of pans in a steelband from 11 to four.

At the same time, Copeland secured additional funding as a grant for commercial development of ongoing activities in the laboratory, most significantly the prototype MIDIpan, which was renamed the Percussive Harmonic Instrument (PHI). As Copeland describes it, "The PHI includes electronics technology never before used in the region. Many thought that a device of this complexity could not be built here. We proved them wrong!"

Copeland became Professor and Dean in 2007. He has been honoured with several awards including the Chaconia Medal Gold of the Order of the Trinity, in the area of Music Innovation (Team Award), and UWI/Guardian Life Premium Teaching Award.

As an educator and scientist, he strongly advocates for changes in the education system to engender more creative thinking in students and more local innovation in science and technology. In his view, "The very survival of our country and the world depends on having a critical mass of scientists, engineers and technicians to solve pressing development problems. But young people are not entering the sciences because there seem to be easier options, and the fields are not presented to them as exciting or rewarding. Many get through the science courses by cramming and therefore don't develop real understanding of concepts. We are ending up as just users of modern technology. This will keep us solidly 'third world'. Students should be encouraged to explore science themselves. There is enough information on the Internet to provide the necessary level of excitement

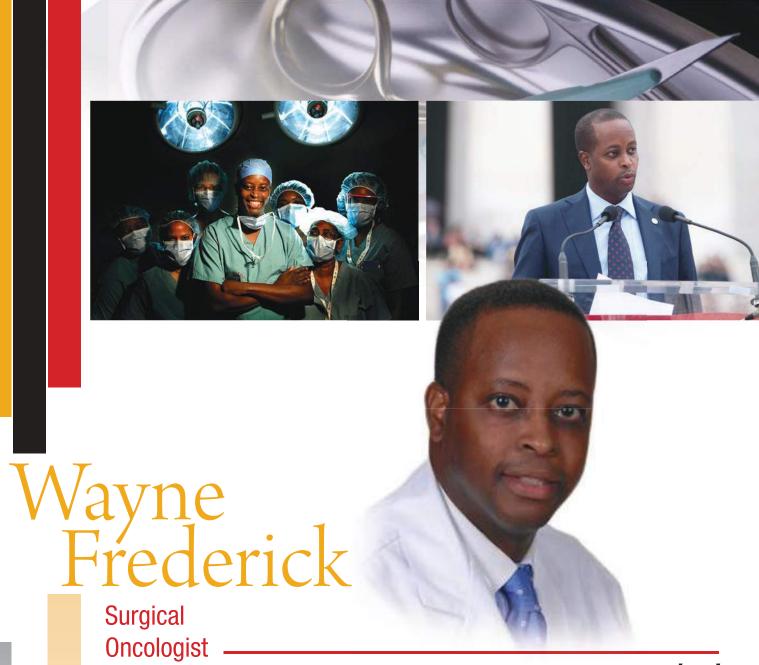
and understanding. And they should play a lot. But the school system must really stop pigeon-holing them in specific areas from too early an age. Everyone should be exposed to a wide array of subjects, even up to CAPE. Heavy specialization stunts mental growth."

Copeland believes that his work on pan "not only underscores the fact that Trinidad and Tobago has the capability to do high-tech inventions, but also clearly reveals the gaps in the region that prevent us going from invention to innovation. This capability is essential for building a high degree of robustness and sustainability in the socioeconomic systems that support development."

Prof. Copeland's drive to enable the region to be better prepared economically has lead to several additions to the offerings at the UWI. One of these is a course on acoustics that trains students in diagnosing and treating acoustic problems. He has also led the development of standards for instructional spaces at UWI and formed the Classroom Technology Support Unit to monitor and implement these standards.

What Brian Copeland does in his spare time is pretty much identical to what he does at work, such is his passion: he assists churches with their acoustics. As he puts it, "Most sound systems in the Catholic churches are pathetic. This work has now become a sort of ministry for me. We have a good template for church sound system design, acoustic treatment for speech intelligibility and installation. And we do all the work for free."





Born to heal

According to family lore, Wayne Frederick decided to become a doctor when he was just three years old! Diagnosed at birth with sickle cell anaemia, an incurable genetic blood disorder that predominantly strikes people of sub-Saharan African descent, he was frequently hospitalised, sometimes four to six times a year, throughout his youth. As his grandmother recounted it, the toddler was riding his tricycle around the porch of the family's house one day when he overheard her discussing his condition with neighbours. He questioned her about it, and, after some explanation, he declared, "Then I will become a doctor and find a cure for it!"

While he did indeed go on to pursue medicine, intending to find a cure for his own ailment, he shifted his focus during a post-doctoral fellowship to surgical oncology. Over 100 types of cancers afflict millions of people of all ages every year. However, as advances in research, particularly into the more common cancers, continue to bring greater understanding around prevention, more effective treatment and cures, many of these deaths can be avoided. Over 30% of cancers can be prevented by healthy lifestyle or by immunization; others can now be detected earlier and arrested. Frederick wanted to be among those striving to confront these statistics and reduce the incidence of cancer, especially among blacks and other minority groups, and to cut mortality rates associated in particular with gastrointestinal cancer – an area of cancer treatment he further specialised in, and which can be daunting since GI cancers have one of the lowest cure rates.

Frederick never allowed the lifelong debilitating effects of sickle cell to stop him from achieving his dreams and goals. Today, he is an in-demand surgical oncologist, a hospital administrator as well as Howard University's Provost, Chief Academic Officer and Director of the Howard University Cancer Center. In these roles, he has responsibility for Howard University Hospital, Colleges of Medicine, Dentistry, Pharmacy, Nursing and Allied Health, and several specialty institutes and centres. In October 2013, he was named Interim President of the prestigious research university Washington D.C.



Wayne Alix Ian Frederick was born in 1971 in Diamond Vale, Trinidad, the eldest of three boys. His father was a policeman who died just before Wayne turned three. Despite a youth impacted by illness, Frederick considers his childhood to have been a rich one. He was surrounded by a deeply nurturing family and first-rate teachers at Diego Martin Government Primary School who, as he puts it, "were proof that 'it takes a village to raise a child.' They were some of the most dedicated people I have ever known. They were not just my teachers, interested in me only within the confines of the four walls of the classroom, but rather teachers who were invested in every area of my life."

The effect of the disorder often meant that he was not able to participate in sports as much as he would have liked, or go to the beach, which seemed to aggravate his symptoms. Instead, he spent most of his free time with books, and reading widely helped give him an edge academically.

He was always certain he would study medicine. His first and most powerful influence was his mother, a nurse and district health officer, who was dedicated to the many ailing people who at all hours called on her at the family home or called for her to go to them. Her young son was often a fascinated witness at many a grim scene, and it amazed his mother that he never flinched at anything he saw. But for him, the real thrill was seeing patients return with gradually healing wounds. "To see someone transition from ill to healthy again was so fulfilling," he explains. "You can get a good understanding of medicine in a technical manner, but to see it before you practically...you can't help but be drawn to it. And I learned so much from observing my mother's sense of service to others, and her work ethic and bedside manner."

> Wayne entered St. Mary's College at age 10 and, having skipped Form 3, finished his A'Levels at age 16. His entry into Howard came about when his best friend, Shaka Hislop, who had enrolled at the university the year before, convinced him to apply as well, largely because of Howard's Sickle Cell Center. Frederick filled out an application and Hislop paid the application fee. Frederick did not apply to any other institution. His mother was persuaded that he should attend Howard because the former Prime Minister of Trinidad and Tobago, Dr. Eric Williams, had ties to the university, having served on its political

science faculty, and also because of the Sickle Cell Center. She paid for the first year

– USD 5000. Frederick earned scholarships for the remaining years.

At age 22, he graduated with a combined Bachelor of Science in Zoology and M.D., and then went on to do his surgical residency at the university's Department of Surgery. This was followed by a post-doctoral research fellowship and a surgical oncology fellowship at the University of Texas MD Anderson Cancer Center. It was during a surgery rotation that Frederick met renowned surgical oncologist, Dr. LaSalle D. Leffall Jr., who has inspired and mentored him. After holding several positions at the University of Texas and the University of Connecticut Health Center, Dr. Frederick returned to Howard University in 2006. He was appointed as an associate professor in the Department of Surgery. From 2006-2011, he served in leading positions, including Associate Director of Clinical Research, Clinical Director, Division Chief of General Surgery, and Associate Dean for Clinical Strategy and Operations. Since 2011, he has been a professor with tenure in the Department of Surgery, and in 2012, he was appointed Provost and Chief Academic Officer of Howard University.

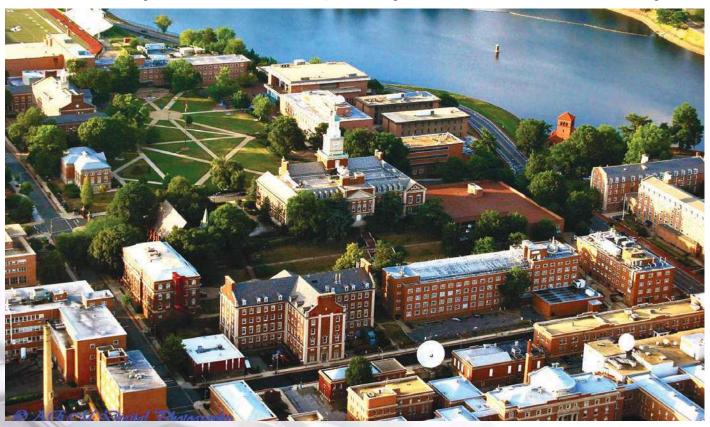
In 2006, he fulfilled a career aspiration to work with Leffall by operating on his last surgery. This opportunity was expanded in 2012 when Leffall asked him to serve as Interim Deputy Provost for Health Sciences.

Frederick has published two dozen peer-reviewed manuscripts. He has also served as the principal investigator for major collaborations with the National Cancer Institute, Johns Hopkins University, as well as local and national minority-serving oncology programmes. This included four clinical trials on cancer drugs.

His special interest in the study of cancers among minority populations was sparked initially by his concern about diseases that particularly affect people of sub-Saharan African descent. He wanted to contribute to further understanding of why certain ethnic groups were predisposed to some cancers; the disparities in cancer-care outcomes between African Americans and the wider population; and how rates could be controlled through education and, by extension, early screenings. He is one of the leading voices for early detection and treatment of breast cancer in minority populations. Under his leadership, Howard's Cancer Center expanded a programme to offer free clinical breast examinations to uninsured patients unable to afford them. In 2006, Dr. Frederick was the recipient of a grant from the Komen for the Cure Foundation as the principal investigator for the Dr. LaSalle D. Leffall Jr. Fellowship in Health Disparities, to address disparities in breast cancer. Howard University was the first institution awarded this grant.

Frederick has approached the practice of medicine by always striving to go beyond treating "test results", and even further than "the whole person". He sees health and illness arising not as a result of isolated factors but as a direct consequence of communities, cultures, lifestyles and the way we interact with our particular socio-economic and natural environments.

He has emerged, as Howard University's 16th President Sidney A. Ribeau put it, as "a trusted leader, revered expert in his field and a champion in his community." Widely admired for his humility, enthusiasm and brilliance as a surgeon, Dr. Frederick is also regarded as a "master teacher" by his colleagues and students. In addition to his undergraduate



teaching, he mentors students and residents in research through three fellowship programmes. He has also worked with many professional societies, such as the Texas Gulf Sickle Cell Association, the National Sickle Cell Disease Association of America, the Society of Surgical Oncology, the National Medical Association and the American Association for Cancer Research.

His achievements have been recognised with numerous awards. He was the 2010 American Caribbean Heritage Award Recipient, and has been honoured with the Resident and Faculty Scientific Research Award presented by Howard University, the Department of Surgery Best Teacher Award (as judged by the students) and the Department of Surgery's Highest Revenue Earner Award. He was named a "Super Doctor" by *The Washington Post* and one of America's Best Physicians by *Black Enterprise* magazine. Locally, he was honoured in 2000 with the Government of Trinidad and Tobago's Certificate of Outstanding Achievement in Medicine, and in 2010, he received the prestigious Vanguard Award from the Institute of Caribbean Studies.

Dr. Frederick describes his career as "a journey with not just one fulfilling destination in mind, but rather a complete obsession with the whole journey of life." So what does a busy surgeon and administrator do when he is away from work? There is at least one particularly fulfilling activity to which he and four friends are dedicated. They

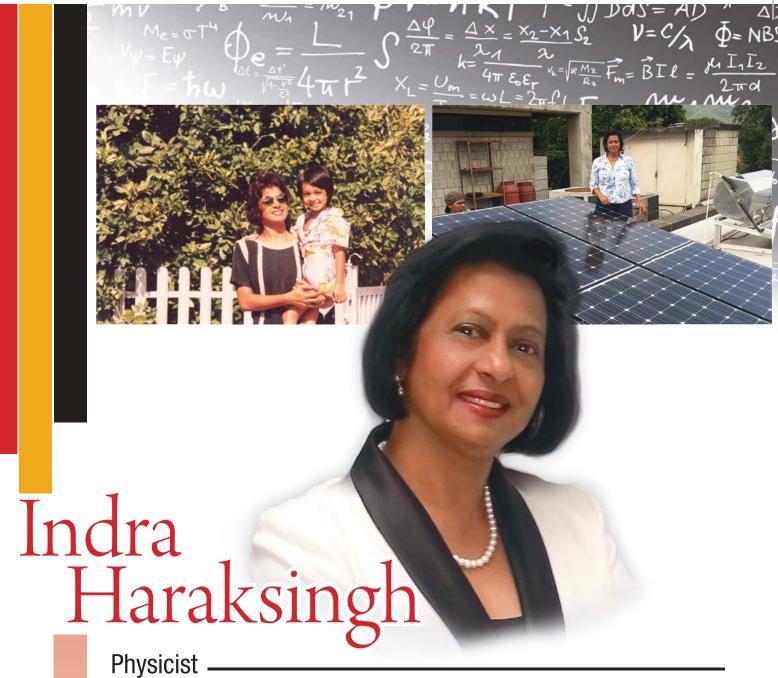
have formed an unofficial club which they use as a vehicle to mentor and raise money for disadvantaged high school students.



His self-awareness of the triggers of sickle cell crises has enabled him to adjust to his disease as an adult. He worries that his kids will inevitably have to make decisions about spousal partners and child bearing as a result of the hereditary nature of his disease. They both have the trait. Notwithstanding this, Frederick plays golf and is a soccer fanatic who does not play regularly but lives vicariously through his young son, Wayne A.I. Frederick II, who does.

Frederick certainly encourages young people to pursue scientific careers. In his view, "If you want to be in something that is going to invigorate and excite you, then science is it. The knowledge and technologies are changing so rapidly. Science is a tool that affects humanity in many ways – in every way – not just health care. Moreover, in this era, science is increasingly merging with or informed by the social sciences, humanities and even law, enabling a more complete rather than fragmented impact on the world. Strive also to be good citizens of society, to act with integrity, to be selfless and to stand for social justice. This should permeate everything that you do."

Wayne Frederick's rise to such success is truly a story of perseverance – the story of a boy's determination to use his own struggles with a challenging illness as a driving force to help others to heal. The disease, which hindered him as a child, was powerless to stem the tremendous dynamism he has had to excel as a surgeon, a university administrator and teacher, and mentor to successive generations of medical students. He hopes his legacy will be his students going on to make even greater contributions to their chosen fields and to the people in the communities they serve.



Energy generation

The future of the world's energy supply is one of the most pressing challenges confronting humanity. While there is ongoing debate and controversy around what the best sources of this supply can or should be, one thing is undisputed: the demand for energy will increase significantly in the coming years, threatening to outstrip supply. This increase is currently projected by the U.S. Energy Information Administration (EIA) to be 56 percent by 2040, not just as world population grows but as world prosperity and consumption do, particularly in emerging economies.

In addition to the urgency to increase supply, the current and potential impact of climate change is generating more pressure and consensus in all countries to move away from fossil fuels and ensure that more of the supply is green, i.e. low carbon and renewable.

While current global usage of renewables is only approximately 10 percent, the growth rate in particular countries is fast, in some cases at double and triple digit increases percentage-wise, in key renewable technologies like wind and solar. However, to match current and projected demand, many hurdles still need to be overcome to make renewables more efficient, robust and cheap to compete with fossil fuels. This requires both greater commitment at the policy level and more innovation with the existing







technologies to drive costs down. Otherwise, according to the EIA, fossil fuels, especially tight gas, shale gas, and coalbed methane, will continue to supply almost 80 per cent of world energy use through 2040.

One local scientist who has been advocating for increased investment in renewable energy throughout the Caribbean for almost 30 years is Dr. Indra Haraksingh. Haraksingh, a lecturer in the Department of Physics at the St. Augustine Campus of The University of the West Indies (UWI), has made a name for herself internationally through her advocacy and research into solar and other renewable energy sources. She is today a leading regional expert and activist in the field.

Like all proponents of renewables, Haraksingh believes that any debate on energy sources must consider the socio-economic impact of energy generation on climate and the environment. In that context, the benefits of renewables are undeniable. While renewable energy has high initial costs, it is worth investing in over fossil fuels because of long-term impact on the environment and climate. Caribbean countries can find alternative solutions through wind, solar, geothermal and biogas. At the Forty-First Special Meeting of the Council for Trade and Economic Development (COTED) on Energy held in Trinidad in March 2013, a regional approach to renewable energy targets was proposed. Most countries pledged to increase their national renewable energy share to meet the regional target of 48 percent by 2027. Most Caribbean countries have high electricity rates, making renewable energy a very attractive option. Haraksingh also stresses that all countries should strive to improve energy efficiency and conservation measures to reduce overall energy demand and further decrease costs.

Haraksingh is active in the widespread promotion of the use of renewables. She works to raise awareness, promote dialogue and influence policy regionally through her appointment to some of the most important agencies and bodies dedicated to renewable energy. She has been recognised for her contribution to training and capacity building throughout the Caribbean and has worked with many agencies, ministries and international organisations to help develop the use of renewable energy. In addition to her membership in the International Solar Energy Society and the World Renewable Energy Network, she is a committee member of CARICOM's Caribbean Renewable Energy Development Program (CREDP) and President of the Caribbean Solar Energy Society. This has enabled her to facilitate open discussion about the future of energy in the Caribbean by bringing together the critical stakeholders. Locally, Haraksingh serves as President of the Trinidad and Tobago Solar Energy Society and is a Cabinet-appointed member of the Renewable Energy Committee of Trinidad and Tobago, through which she played an integral role in the drafting of the renewable energy policy of Trinidad and Tobago in 2009. She also serves as a member of the Renewable Energy Committee of The University of the West Indies, promoting research and development at the highest academic levels. She is involved in collaborations with numerous international universities and organisations.

In 2008, Haraksingh was awarded the International Pioneer Award for Solar Energy by the World Renewable Energy Congress, for her pioneering work in the promotion of renewable energy throughout the Caribbean. In 2002, her publication, *Thermal Performance of a Solar Cooker powered by a Natural Convection Flat-Plate Collector*, earned her

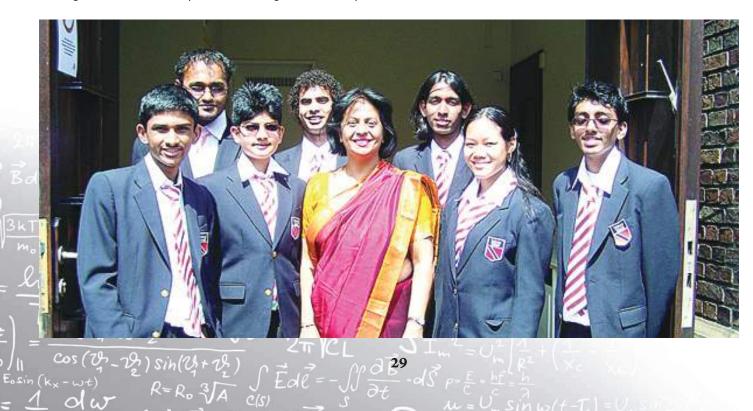
the Outstanding Scientist Award from the World Renewable Energy Congress in Cologne, Germany. Beyond her own research, Haraksingh is helping to steer the future research coming out of the Caribbean through her design of the curriculum for her "brain child", the Master of Science in Renewable Energy Technology programme at UWI, St. Augustine, which came on stream in September 2013. This programme is a first for the region and is also the first Master in Science programme in the physics department at UWI, St. Augustine. Haraksingh is also the primary supervisor to nine M. Phil. students in the department.

But her work in physics and renewable energy is only one half of the equation of Haraksingh's career as a researcher and educator. She is just as passionate about mathematics. A former secondary school mathematics teacher, Haraksingh has remained very engaged in math education at the secondary level, through the Trinidad and Tobago Mathematics Olympiad. She has been involved with the Olympiad for more than two decades, serving as Chair for almost 20 years and as Country Team Leader for the International Mathematics Olympiad (IMO) on many occasions. As Leader, she has witnessed team members bring home one silver and five bronze medals – a great achievement for one of the smallest countries participating in the IMO. One of these members was her own daughter, Rajini, who to date remains the only female IMO medallist in the country.

Haraksingh is a strong believer in nurturing gifted and high achieving students. Students participating in the Olympiad have the opportunity to compete all around the world and, more importantly, to develop a sense of confidence in their own academic abilities. As she puts it, "There is often a lot of focus on the general body of students or on low achievers, but it is very important to pay special attention to high achievers as well. They need to be challenged in order to achieve their full potential. This is particularly important as these students may one day have the capacity to solve some of the most pressing problems facing the world."

Indra Haraksingh was raised in a small fishing village, Orange Valley, Couva, Trinidad. The tenth of 12 children, she had close bonds with her six sisters and five brothers. Her parents, and the kind of family life they fostered, had a strong and positive influence on her life and her own values. Her father, Harrichand and mother, Basdai, owned a shop in the village, in which the children had to help out. But they also emphasised the importance of education to their children and invested most of the family's limited finances towards ensuring that young Indra and her siblings had everything they needed to attend and excel at school. They set high standards and ambitions for their children and were strict in how they brought them up, but also gave them the freedom to select their particular careers. One of Indra's older sisters was the first person in their village to attend university, and Indra would eventually follow in her footsteps.

Her academic journey began at the Waterloo Hindu School where she obtained her primary education. Like most girls from her area, she selected a school near to home as her first choice in the Common Entrance exam and, after placing in the top 100 in the country, she was accepted into Holy Faith Convent, Couva.



Her choice to specialise in the sciences was not because she was better at those subjects. She excelled in many subjects and greatly enjoyed the arts and foreign languages. She was also multi-talented and enjoyed a rich extra curricula life. She was a member of both the drama club and the choir, and played tennis for her school. She also wanted to study ballet and music but her parents could not afford that luxury. Her First Form mistress and mathematics teacher, Maria Moy, was a great inspiration, stoking her interest in math and, in turn, her fascination with science. She recalls doing math past papers in her free time for fun because she enjoyed the challenge. She went on to do mathematics, physics and chemistry at A' Levels, and after passing her exams, she taught for a brief time at St. Joseph's Covent, San Fernando.

Although she enjoyed teaching there immensely, she left when she received a government scholarship to study natural sciences at UWI, majoring in physics and mathematics. Following this, she began teaching these subjects at Chaguanas Senior Comprehensive School, and continued there for almost 20 years. She graduated from UWI in 1978 and, in 1990, went on to obtain her Diploma in Education, focussing on the Teaching of Mathematics.

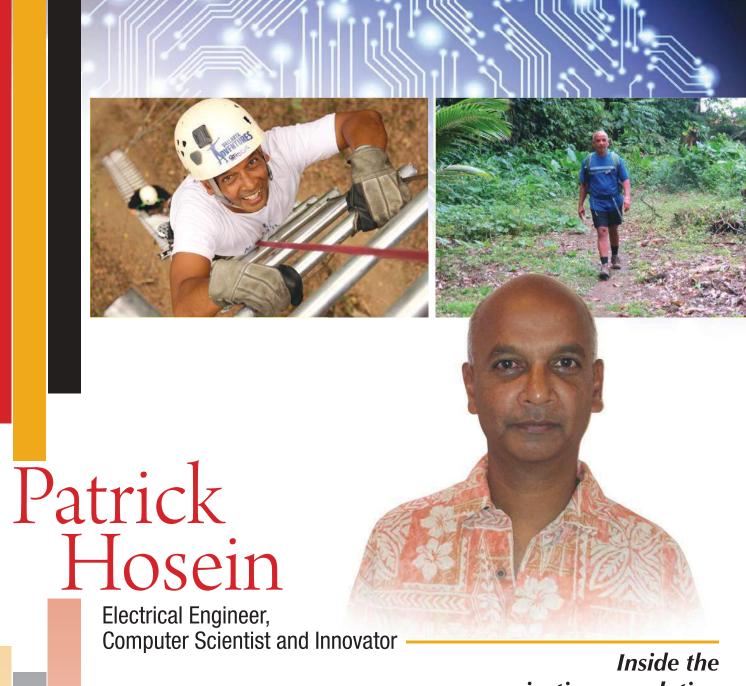
In 1991, Haraksingh was badly injured in a car accident, which drastically altered the course of her career. She left teaching to fully recuperate and, when she emerged again,

she decided to focus on the development of solar energy technologies. She had already been engaged in the field when she had joined the newly formed Trinidad and Tobago Solar Energy Society in 1985, and was appointed the first Secretary/Treasurer, and later, President.

During her recovery period, she went back to UWI to do her M.Phil. and later upgraded to a Ph.D. in physics with a focus on solar energy. She credits her supervisor, Prof. Oliver Headley as being a greatly encouraging mentor to her during this time. She completed her Ph.D. thesis on the design and testing of a Natural Convection Flat-plate Collector Solar Cooker using coconut oil as the heat transfer fluid and heat storage medium. She graduated in 2002 and, shortly afterwards, joined the university as a full-time lecturer, becoming one of only two women in the department of physics.

Harakingh's work commitments and involvement in renewable energy and the Mathematics Olympiad do not leave her with a lot of free time. But she does manage to carve out some space for herself to unwind, exercise and doing some cooking. Family continues to be very important to her. She is a devoted mother to Rajini, herself an outstanding young human genetics scientist, whom she half-jokingly says is her "greatest achievement". She is equally devoted to her husband, Kusha, who has been a source of inspiration and strength to her. She also remains close to her siblings and enjoys the regular gatherings of the not-so-large-again clan. Most of all, she loves spending quality time and going on holiday with her family, traveling to what she refers to as "exotic countries" to learn about and explore their varied cultures.

Haraksingh's vision for the future is "to see a green Caribbean, utilising its renewable natural resources to the maximum and to the benefit of our fragile island states." She is optimistic that, with the right support and guidance, the next generation will take up the many challenges ahead to address key global issues. She is a committed and nurturing teacher and a role model to thousands of students. She encourages young people to apply their education and training "to some of the problems in everyday life and come up with innovative ways of solving them." They would certainly be following the road she herself took when she set out to make a contribution to one of the biggest of these problems and to do her part to help build a cleaner, more sustainable world.



communications revolution

Of all the scientific innovations of the past quarter-century, information and communications technology (ICT) has changed the day-to-day lives of ordinary people around the world in the most dramatic and obvious way. The Internet might be the most powerful driving force of this change, but we have innovations in networking to thank for bringing it to our desks, laps and pockets - the work of a host of pioneers whose innovations help us every day when we use computer and telephone networks to connect to online resources or to each other.

Dr. Patrick Hosein is such a pioneer, one of the many engineers behind the scenes who enabled the phenomenal rise in global connectivity. In the United States, he is best known for his patented work, having spent most of his career developing innovative engineering solutions at internationally renowned laboratories such as Bell Laboratories, AT&T Laboratories and later at Ericsson and Huawei. While at these companies, he used his expertise in a wide range of areas (mathematical optimization, performance analysis, system modeling and simulation, algorithm design and implementation, etc.) to develop novel algorithms for several products, applications and services for telephone networks and broadband cellular networks. For the people of Trinidad and Tobago, his contribution has been both more personal and more direct – he is the visionary that brought the Internet to the country and he continues to manage its .tt domain name.







Born in 1960 in Curepe, Trinidad to Amizool and Merle Hosein, an accountant and housewife respectively, Patrick Hosein grew up with his three sisters and brother. Attending the Curepe Presbyterian School, he began as an average student. However, with the prodding of his strict but effective Common Entrance teacher, Steve Oudit, and the encouragement of his parents, Hosein earned his way into St. Mary's College.

As a teenager, he often visited the house of a neighbour in Crescent Gardens, D'Abadie, who repaired electronics, and whose daughter was his girlfriend at the time. It was there that he first developed his own interest in electronics, prompted in part by his (and her) love of music. With parental funding, he built his first audio amplifier using a Heathkit purchased from the US. His father also gave him the money for speaker components and took him to a local lumberyard where he bought the wood to design and build his own speaker system at the age of 13. Little could they have imagined that the birth of this humble hobby marked the beginning of what would become for Hosein a lifelong fascination with electronic technology and lead to a distinguished career at the cutting edge of developments in this field.

At St. Mary's College, he was taught by academic legends like Frs. Arthur Lai Fook and Pedro Valdez. He was quite the "limer" though, refusing to be left behind when his older siblings attended house parties, with his skill at building speakers serving his DJ friends very well! Though Hosein did well in class, he was not a top performer until his last year of A' Levels when he won the mathematics scholarship in 1979. Not expecting a scholarship, he had not applied to universities abroad, so he was forced to take a year off, during which time he taught at St. Joseph's College. He left for Massachusetts Institute of Technology (MIT) the following year, where he spent the next 12 years, and at the end of which he had attained five degrees: a bachelor of science in mathematics and one in electrical engineering (obtained simultaneously because of the four years allowed by his scholarship); a master of science in electrical engineering and computer science (also sponsored by his scholarship); an electrical engineer's degree (an advanced degree designed for practitioners rather than researchers) and a doctorate in electrical engineering and computer science. These were exciting times, as he was challenged by his work and research, competing with top students from around the world. At the same time, Hosein was becoming a family man, having married Deborah Vincent and having his son, Nicholas, while doing his Ph.D. and his daughter, Patricia, soon after graduation.

At MIT, he twice served as a teaching assistant, and in the summer of 1982 an intern, for the eminent Prof. Amar Bose, who developed the world-famous line of Bose speakers. Hosein was awed to be working under this towering icon – an innovator whose most celebrated creative output had emerged from his dedication to what he loved. Bose was an aficionado of classical music, and his desire to reproduce more faithfully, through electronic systems, the acoustics of a concert hall, led him to create the speakers. The professor echoed the sentiments of his intern's parents when he encouraged Hosein to pursue a field that would bring him the most personal fulfillment rather than the most money.

After MIT, Hosein was employed by Bell Laboratories in New Jersey, conducting research on large-scale optimization and routing problems, thereby aiding Bell with its computer-based telephone switching systems. In 1991, he returned to Trinidad as an assistant professor in the Electrical and Computer Engineering Department of The University of the West Indies (UWI), where he introduced and designed courses for a new Master of Science

(M.Sc.) in Communication Systems. With the aid of NIHERST, Hosein initiated the process for the university to obtain Internet access from the Organization of American States (OAS) via a dial-up telephone connection to Puerto Rico. He quickly became one of the most vocal advocates for Internet access in Trinidad, but unfortunately among many naysayers. At that time, the .tt domain was still controlled by the OAS and managed by the University of Puerto Rico. Hosein ardently believed that Trinidad and Tobago possessed the expertise to manage the domain and, when the OAS asked him (on behalf of Jon Postel, one of the prime developers of the Internet) to manage it, he willingly accepted the voluntary position. While in Trinidad, he formed a team, which included Dr. Feisal Mohammed and students, Kevin Blackman, Ronald Lessey and Jason Arneaud. In collaboration with a team from IBM, headed by Simon Fraser, they bid and were awarded the contract to set up the Telecommunications Services of Trinidad and Tobago (TSTT) as the first Internet service provider (ISP) in Trinidad, writing all necessary software (including accounting and billing software). The competitors for this project were all foreign based which made the success of the bid even more rewarding.

In 1995, Hosein returned to Bell Laboratories in New Jersey, where he worked on routing, overload control, congestion control and load balancing algorithms for AT&T's telecommunications network, including support for the newly proposed Local Number Portability service. He greatly enjoyed his time at Bell and subsequently at AT&T Laboratories, to which he moved after Lucent was spun-off. At both companies, he had the tremendous privilege of collaborating with several world-renowned experts, and acquired the analytical expertise that he would later use in the cellular industry.

Hosein moved to California in 2000. Settling in San Diego, he joined Ericsson Inc. as a principal engineer, working on and leading teams in the design of radio and network resource management algorithms for wireless networks – theoretically similar to his research in New Jersey, but with differences enough that this new posting demanded its share of required study before he could tackle it. His focus was on more efficient utilization of resources for data transmissions, especially when carrying voice information (Voice over IP). At Ericsson, he helped develop cutting-edge cellular technologies, also contributing to the 3rd Generation Partnership Project 2 (3GPP2) standards body which, at that time, was working on global standards for CDMA 3G networks. In 2004, the San Diego office nominated him for the Ericsson Inventor of the Year Award, a true honour in his eyes, considering the worldwide competition.

In 2005, the Chinese company, Huawei, absorbed many of Ericsson's employees after the closure of the latter's San Diego office. Hosein turned down offers to work elsewhere, instead entering employment with Huawei as Principal Engineer. It was a more formal work environment in many ways but, once he proved himself, he was allowed to work from home as he had done at Ericsson. There, he continued assisting with 3GPP WCDMA standards, and developed network and radio resource management algorithms for Huawei's WiMAX and LTE wireless products, even winning the Huawei US Wireless Research Employee of the Year award in 2007. In 2010, Huawei San Diego closed its doors as part of a greater downsizing initiative across the US. Like Ericsson before them, they offered Hosein a job at other locations but, having other personal plans, he turned them down.

He returned to AT&T, where he continued working on next-generation LTE (Long Term Evolution, better known as "true" 4G) cellular technology – which had been part of his portfolio at Huawei – improving the quality of the company's mobile service and the general performance of its LTE networks. However, with his children no longer at home, and with the increasing use of ICT in Trinidad, he decided to return to Trinidad and contribute to its development. With some apprehension, he resigned from AT&T and returned to UWI, where he is a senior lecturer in computer science. His present duties include a complete re-design of the department's M.Sc. in Computer Science degree.



Hosein has authored or co-authored over 75 refereed publications and has 34 granted and 41 pending patents in various areas of ICT. After 20 years, he remains the manager of the .tt domain, although since 1995, he has done so as the founding CEO of the Trinidad and Tobago Network Information Centre, a company responsible for the registration and administration of Internet domain names in Trinidad and Tobago. This company also provides free domain and hosting for all Trinidad and Tobago educational institutions, sponsors scholarships and prizes for UWI students, sponsors many ICT related events (e.g. ISOC, TTCS, the DCIT Computing Bootcamp, etc.), and conferences such as Caribbean DevCA, Startup Weekend, Code Sprint, etc.

Hosein spends the summer period in San Diego with his family. He packs a lot into his spare time – hiking, swimming, biking, running and kayaking. He also enjoys interacting with his UWI students in person but also via social media since, like them, he tends to work at nights. Since he manages the hosting of school sites, he also dedicates quite a bit of time to these schools, which he finds very rewarding. From a professional point of view, he continues to focus on advanced wireless research and is collaborating with a team at Intel on 5G networks. He is also working on more practical projects with more immediate results in areas such as smart grids, ICT in agriculture and open data initiatives.

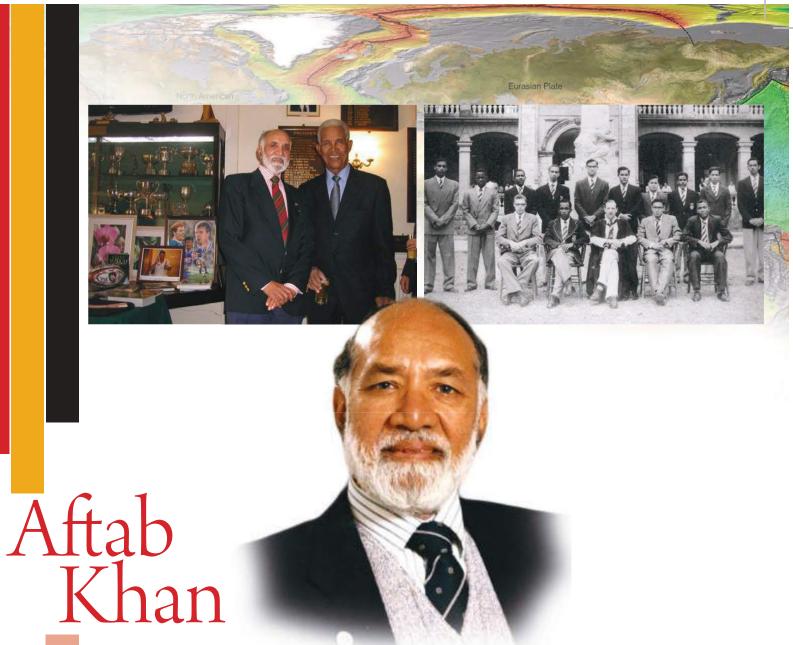
Looking back at his career path, Dr. Hosein affirms that, "I made good educational choices and I truly love my work. I have encouraged my children to do the same and follow careers that they will enjoy. My advice to young people is to determine your passion, obtain the education needed to pursue this passion and the rest will fall into place. In the past, the opportunities for educating oneself outside of the traditional school system were quite limited. Today, one can find resources online to supplement what is taught in school or to even learn completely new areas on your own. Take advantage of these opportunities to find the most efficient







medium to educate yourself since the traditional medium is not optimal for all, and to expand into areas of interest not covered in your classroom. Make the sacrifices now rather than making them in the future by having to work in a boring career."



Geophysicist

Looking into the Earth

The East African Rift System is literally and figuratively one of the world's geological "hot spots" for scientists wanting to understand the process of plate tectonics, and how the world's continents formed by the splitting of a single, supercontinental landmass, known as Pangaea, 200 million years ago. It is the only place on Earth where we may now be witnessing a continent in the act of splitting.

The rift, thought to be the birthplace of *Homo sapiens*, is also the place where Prof. Emeritus, Aftab Khan, has left his most substantial mark as a geophysicist. Described by Prof. Mike Lovell, Head of the Department of Geology at University of Leicester in the UK as "a superb ambassador for geophysics worldwide...with an enormous drive", Prof. Khan has dedicated his professional life to the advancement of this field through his teaching and research, as well as his leadership in the area of seismology.

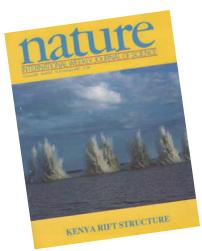
With a career that spans over four decades, he remains enthusiastic and embedded in his work, which has involved groundbreaking geophysical investigations of the Kenyan segment of the African Rift System, as well as the island of Cyprus. His achievements have earned him the high esteem of his peers in the international scientific community.





Geophysics is a major branch of earth science that applies the principles and methods of physics to the study of the Earth's structure and physical properties. It includes seismology, gravity, geomagnetism and geoelectricity, meteorology, and oceanography. The methods of geophysics are vital in the exploration for energy, water, and mineral resources. It is also integral in monitoring environmental impact and change, in the assessment of natural and man-made hazards, forensic science, and in subsurface investigations for engineering and archaeology.

With the emergence of the plate tectonic hypothesis in the early 1960s, and the observation from satellites of rift-like features on other planets, earth and planetary scientists joined forces to investigate the deep structure and origin of the East African Rift. Technological advances since the 1950s were making it possible to obtain high quality information about the Earth's subsurface from geophysical observations on the surface, in boreholes and from ships, aircraft and satellites.



An international team of geophysicists was formed to study the Kenyan segment of the rift in detail. The Kenya Rift International Seismic Project (KRISP) ran from 1985-1995 with Prof. Khan as its Scientific Coordinator. The team of experts with tens of scientists from the UK, Europe, the USA and Africa, equipped with hundreds of portable seismographs, undertook high-resolution seismic surveys, using explosions of up to two tonnes in boreholes and underwater, as well as earthquakes as sources. Seismic waves from the shots were recorded at distances of over 400 km and used to determine the deep structure of the rift down to depths of over 100 km. The success of this sophisticated programme in remote areas of Africa with its huge logistical problems was a substantial achievement. The first results were published in *Nature*, the most prestigious scientific journal in the world and in a special issue of the journal *Tectonophysics*, which was the most cited earth science publication of 1995

The seismic data obtained were combined with gravity observations made over three decades at over 10,000 stations across Kenya to produce the geophysical model of the deep structure. The team concluded that the rift was formed by the rise of hot material beneath it, resulting in uplift, faulting and extensive lava flows from large volcanoes. It revealed the process responsible for the breakup of Africa starting 30 million years ago with the opening of the Red Sea and Gulf of Aden, which are two junior oceans. This process is continuing today into Afar in Ethiopia, which was investigated by another international project in 2000, EAGLE (Ethiopia Afar Geoscientific Lithosphere Experiment) in which Prof. Khan participated as the manager of the shooting teams.

Another significant output from KRISP was a gravity map of Kenya, which provides information on the density and composition of rocks at various depths and is utilized in the exploration for oil, minerals, water and geothermal energy. Kenya is the first African nation to utilise geothermal sources for power, and this venture aims eventually to provide 25 percent of the country's electricity needs.

Prof. Khan also conducted research on the island of Cyprus, which is a wedge of the deep ocean floor thrust above sea level by the forces closing the Mediterranean Sea and forming the Alpine and Himalayan mountain chains. It is one of the best places in the world to see what the mantle below the sea floor comprises. For 30 years, he carried out surveys, comparing these findings against theories about the mantle. The culmination was the large scale IANGASS (Investigations Around North Troodos from Gravity And Seismic Surveys) project, which confirmed that the seismic structure of Cyprus was the same as that beneath the oceans.

He has also experimented with geophysical methods of exploration for minerals, notably in Cyprus, which literally means "copper". The deposits there were formed at an ocean ridge by the interaction between seawater and hot material rising from beneath the ridge. For many years, he took undergraduate and Ph.D. students there for field training, testing and developing electrical and electromagnetic methods of exploration.

Prof. Khan's contribution to education in geophysics was also pioneering. He is commended for introducing in the 1960s the first university B.Sc. degree course in geophysics in the UK, within the new Geology Department at the University of Leicester. This led the way for similar programmes being introduced in 12 UK universities, with Khan serving as the external examiner for most of them. By the time he retired in 1998, he had developed prestigious teaching and research programmes in geophysics, been Head of Department twice, and served on the major university boards and committees. In the last decade, he was also involved in the initiation of the highly successful geoscience degree programme at The University of the West Indies (UWI) in St. Augustine, and was its external examiner for the first five years.

He has served as Chairman of the British Geophysical Association and was a Vice-President of the Royal Astronomical Society. At the international level, he was the Managing Editor of the Geophysical Journal International; Chairman of the Governing Board of the School of Cosmic Physics of the Dublin Institute for Advanced Studies; co-leader of UNESCO Project 400 on the Geodynamics of Continental Rifts; and Scientific Coordinator of the British-USSR Seismic Verification Project, which showed it was possible to use seismology to detect and identify underground nuclear explosions and distinguish them from earthquakes, and thus verify a Comprehensive Test Ban Treaty.

Khan has written and co-authored over 100 scientific papers; supervised 25 research students and has obtained over 20 major grants to support his research. One of his most cited papers is on the use the anisotropy of magnetic susceptibility to determine rock fabric. In 2000, he wrote a geophysics textbook with his colleague and friend, Alan Mussett, entitled, *Looking into the Earth*, and is working on a second edition. In 2006, he was the recipient of the Royal Astronomical Society's prestigious Award for Services to Geophysics. The Society described him as "a stalwart servant of UK Geophysics for over 50 years ... who has been singularly devoted to the promotion and promulgation of his science to all facets of our society."

Aftab Khan's long journey as a scientist began in Trinidad. He was born in Rio Claro in 1933, the third of seven sons of Abrahim Khan, once a poultry farmer and later an insurance underwriter, and his wife, Ayesha. These young intelligent parents had not been able to access good secondary education themselves, but they worked hard and made many sacrifices to ensure that their sons went even beyond secondary to tertiary education and, indeed, six eventually attended top universities abroad. The difficulties that financial constraints brought did not stop the brothers from enjoying the loving and stable family life their parents provided as they were growing up.





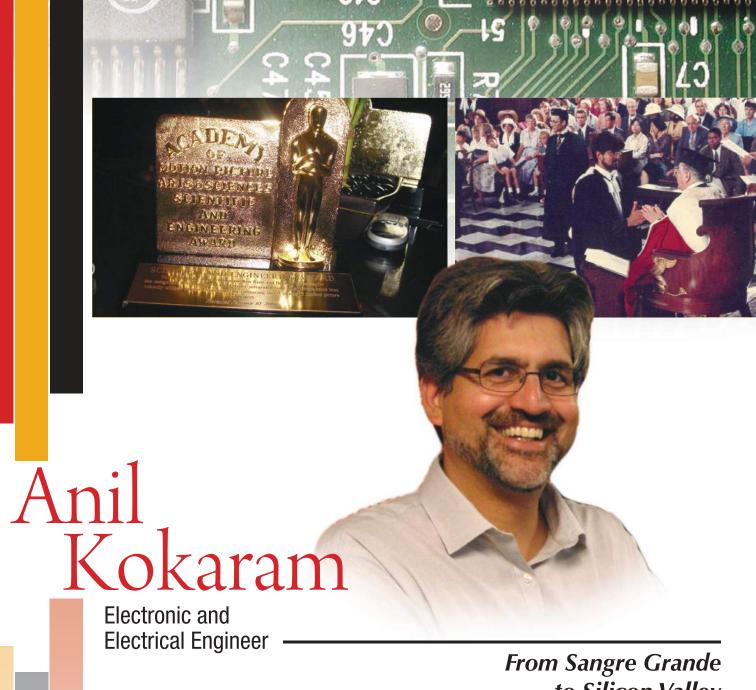
Khan was an excellent student from the outset. He attended Curepe CM School and was usually near the top of his class. In 1944, he passed the entrance exam for Queen's Royal College. In the School Certificate Examination taken in Form 5, he won the school mathematics prize and placed fifth in the island, winning a house scholarship, which enabled him to complete his secondary school education for free. He studied physics, mathematics and chemistry at A' Levels, and was fourth in the stiff competition for the one national science scholarship offered annually. This was good enough though for him to be offered a scholarship to attend university in the UK, funded by the Trinidad Petroleum Development Company (later BP), where he had spent nine months learning about the exploration and production side of the oil industry.

He enrolled at the University of Birmingham in 1953, to do a degree in petroleum engineering in which he also had to study geology, a new subject which fascinated him. He was inspired by the lecturers – geologist, Prof. Donald Griffiths and physicist, Roy King, and switched from engineering to geology with physics and mathematics, with the intention of pursuing a career in geophysical exploration for oil. However, on completing his degree, Khan was offered a place at the university to pursue a Ph.D. in palaeomagnetism, under the supervision of the pre-eminent Prof. P.M.S Blackett, the 1948 physics Nobel Laureate and President of the Royal Society. Blackett was interested in the origin and history of the Earth's magnetic field and particularly in the reversal of polarity. Khan was directed to investigate the magnetic properties of the tertiary igneous rocks of the Isle of Skye, where there are over 40 well-preserved lava flows. He found they were all reversely magnetised, i.e. in the opposite direction to that of the present day magnetic field. This supported the controversial hypothesis that the Earth's magnetic field had reversed spontaneously in the past from time to time due to electric currents in the molten metallic core. When asked about the future of geophysics, he cites from an education report of his: "With the growing demands of industry and government service, there is a severe shortage of trained UK graduates with geophysics skills. The population in the industry is aging while the number of students enrolling in programmes is falling and, in many instances, courses are being discontinued. If the current rates of decline continue, there will be no geophysics undergraduates by 2030. The problem is global."

"Ambassador" Khan therefore seizes every chance to encourage young people not just into his particular field but to understand the sciences generally. "Science involves solving problems daily. There are scientific, mathematical, computing, logistic, financial, legal, safety and administrative problems associated with working in remote areas. One has to be patient and understanding. Everyone should have some natural science and mathematics in their education. Conversely, scientists and engineers need to appreciate the arts and literature. Balance is very important."

He certainly practises what he preaches, and it was, in fact, through his interests in theatre and music during his time at Birmingham, that Khan met his wife Diana, an actress whom he describes as his greatest supporter and mentor. He is a past president and Life Vice-President of the Leicester Literary and Philosophical Society (founded in 1835), which serves to advance education in literature, science and the arts for the benefit of all people. In his remaining free time, he potters around his garden, plays golf and listens to classical music – grand opera especially – at home or at concerts as often as he can.





to Silicon Valley

Anyone who has not heard of Anil Kokaram will discover, within seconds of searching for him online, one striking fact: he is an Academy Award winner. Clearly it is hard to tell his story without rushing to mention this. After all, the Hollywood mystique is compelling. But there is an added charm in Kokaram's case because most people do not associate scientists with those red carpets.

Yet as far back as 1931, the Academy of Motion Picture Arts and Sciences has recognised many scientists and engineers for their contribution to advancements and milestones in the development of technology for the motion picture industry. In 2007, Kokaram became the first and, to date, only Trinidad and Tobago national to win an Academy Award. Currently Research Manager at YouTube/Google's Video Processing Group, Kokaram is an internationally recognised master in the field of digital signal processing, and particularly motion estimation. He and his colleagues, Dr. Bill Collis, Simon Robinson and Ben Kent at The Foundry, one of the world's top software development companies for post-production visual effects, were awarded a Scientific and Engineering Award for their breakthrough work on motion-based special effects for the film industry. The FURNACE program they developed was a truly revolutionary compositing and editing software suite for video processing in post-production. It allows the user to perform automatically tasks which were not possible previously even with manual editing. By harnessing Kokaram's ideas about







making "pictures between pictures" i.e. creating new frames, users can add, remove and manipulate characters and objects in scenes, remove "dirt" and even restore old footage.

The effects in *The Matrix*, for example, are not possible without motion estimation. Actors are surrounded by a ring of cameras which record at the same time, so that at any instant a picture is taken from many different points of view. It is not possible to place the cameras together close enough to make the "Matrix effect" look smooth. The smooth effect is created by synthesising new pictures as if they came from cameras that were virtually "in between" the ones actually there. To build these new frames requires estimating the motion between existing frames. Kokaram developed algorithms to solve problems like these and the Foundry team was able to build those ideas into FURNACE. At the time of the award, FURNACE had been used in a host of blockbuster films including *The Matrix*, *Casino Royale*, *X-Men 3: The Last Stand*, *The Da Vinci Code*, *Charlie and the Chocolate Factory*, *Batman Begins*, *King Kong*, *The Lord of the Rings* and many others.

Behind the glamour, the Academy's science and engineering nominees are subjected to rigorous scrutiny during the assessment by two panels of judges made up of academics and representatives from the film industry. "Almost like a police investigation," Kokaram jokes. But while he says he was surprised to have won, others who know him well may not be. Kokaram has always been an outstanding achiever, whose life has been studded with scholarships and prizes.

He was born in Sangre Grande, Trinidad, in 1967 to Richard Kokaram, a former principal of Hillview College, and his wife Lynette, also an educator and a past principal of Tacarigua Presbyterian School. The family relocated to Curepe, where Anil and his three siblings grew up. He has particularly fond memories of their many family vacations in his father's hometown of Fyzabad.

He was intrigued by science from an early age and, with his boundless natural curiosity, found many avenues to explore and stoke this interest, which was greatly encouraged by his parents. He became a big fan of the documentaries of astrophysicist, Carl Sagan, and naturalist, Sir David Attenborough, and was struck by the realisation that it was possible to make a career – and on TV! – out of research. He was an avid reader of science fiction and also immersed himself in his home chemistry set.

His passion for experimenting grew as he left his primary school, Curepe Presbyterian, for Hillview College, where he made new friends also interested in science. At 13, with one of these friends, he took up the hobby of building model rockets and aircraft – a surprisingly hazardous undertaking that involved jumping fences and dodging stray dogs to retrieve his models wherever they had crash landed. His desire to perfectly predict and control the flight and fall of his creations, by measuring wind speed and setting trajectories, enabled him to see more concretely that science was not only an interesting pastime, but a practical field with real-life applications, and that "physics and mathematics could solve any kind of problems – even though in practice it never worked with my rockets."

Already enamoured with research, Kokaram performed well in science at school. Mathematics, on the other hand, required extra effort. He says, "For some reason I was pretty bad at math until about half way through secondary

school. I even failed at one point. Around age 13, my dad had a 'discussion' with me about this and magically my math grades changed! I still consider myself not great at it, but I have ended up in a pretty math-heavy discipline. I think many people are turned off math because they just see numbers and abstract 'stuff' with no real purpose. But I was lucky in that I was able to see what it was good for and I still motivate myself to study it because I know it helps me make cool cinema effects." He certainly did get over the hurdles as, in 1985, he won an open national scholarship, coming fourth in the science group with his A' Level results in mathematics, physics and chemistry, and also staying on to teach mathematics at Hillview for a year.

He then took up a Tate and Lyle scholarship to pursue electrical and information sciences at Cambridge University in England. His was a balanced academic life with time allotted for hard work, cricket and socialising with the many people he met through the sport. In his final year, he collaborated with a friend, Graham White, who was studying zoology at The University of the West Indies (UWI), to build a recognition system for frogs in Trinidad. They used digital recordings of the croaks, applying concepts normally used for human speech recognition. The idea was to enable scientists to automatically inventory large areas by just recording sounds in a field. This project ignited his interest in digital signal processing (DSP), a discipline that lies somewhere at the intersection of electronics, computer science and statistics. Kokaram says, "You could go directly from the mathematical analysis of a problem to a working system that interacts with the real world, all without having to actually build electronic circuits and, in fact, just by writing the ideas into some software."

DSP originally arose from the study of improving the reliability of digital communications. The foundations of the work were established during the Second World War when Norbert Weiner, the celebrated mathematician and philosopher, and "father" of cybernetics, helped to design circuits that made radar echoes "cleaner", and therefore made it easier to spot enemy aircraft. As Kokaram explains it, "DSP has evolved to become the study of extracting useful information from measurements. For instance, when you watch a video over the Internet, a computer program is measuring the bandwidth available to you, and when that drops, it alerts the video server to switch to a different video file, which will play at that lower bandwidth. The estimation of what bandwidth is available is done by applying DSP methods."

In 1989, Kokaram graduated with his combined Bachelor of Arts/Master of Arts, Electrical and Information Engineering Sciences Tripos (with honours), winning two Churchill College Cambridge Prizes for Academic Merit along the way, and spent the next four years pursuing his doctorate in signal processing. He wrote his thesis on applying those techniques to movie restoration and correcting video defects, notably filling in holes in pictures. Though he did not know it at the time, that research would lay the foundation for his groundbreaking achievements later on with

respect to motion estimation.

After graduation, he stayed on at Cambridge as a Research Associate and Fellow at the Signal Processing Group of Cambridge University Engineering Department. During the mid-90s, he became the first researcher to develop techniques for film restoration that successfully used a statistical construct called Markov Random Fields, which describes the idea that small patches of pixels tend to have the same colour. This is now a common tool in post-production houses worldwide. In 1996, he published Motion Picture Restoration - Digital Algorithms for Artefact Suppression in Degraded Motion Picture Film and Video, a book on movie restoration that remains a key reference among professionals in the field to this day.

In 1998, Kokaram left Cambridge and made three decisions that would change the course



of his career – he accepted the position of Lecturer at the Department of Electrical and Electronic Engineering in Trinity College Dublin; founded the College's Signal Processing Media Applications Group (Sigmedia); and began building links between Sigmedia and The University of the West Indies (UWI), St. Augustine, sponsoring several Caribbean students to study at Trinity. In the years that followed, Sigmedia would host an array of projects, applying signal processing to digital cinema, multimedia information retrieval, video over wireless, surgery, underwater video enhancement and atomic scale microscopy. Kokaram has raised over two million euros in competitive funding for research and, since 2000, has led that team through more than five large EU projects.

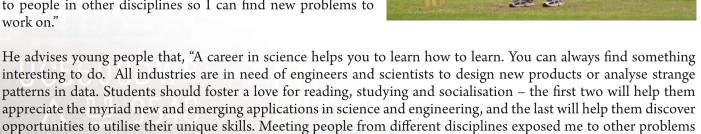
During the post-production of *The Matrix* (which was released in 1999), someone Kokaram had met at Cambridge in 1995 was working on the movie, and he approached Kokaram for DSP assistance with a problem they were having with one of the effects. It was then that Kokaram developed the new techniques for motion estimation that became an industry-changer. His successes won him further work on the *Matrix* sequels, and also led him to establish his own start-up motion picture restoration and video processing company in 2004 – Green Parrot Pictures.

Between 1999 and 2007, Kokaram consulted widely in the area of video processing, working with Daimler-Benz and Cambridge Consultants as well as The Foundry, with whom he developed a range of new tools. This work ultimately culminated in the FURNACE program with Collis, Robinson and Kent. In 2011, the Internet media giant, Google, bought Green Parrot Pictures and contracted Kokaram and his team to help the company improve the quality of the vast video archives – 72 hours of video uploaded per minute, as of 2013 – stored on their YouTube servers. His team is responsible for helping YouTube achieve a balance between compressing the video down to manageable bandwidths, and still keeping it looking great. They also work with other teams in Google. In April 2013, YouTube launched the SloMo effect in their editor which was created by Kokaram's team.

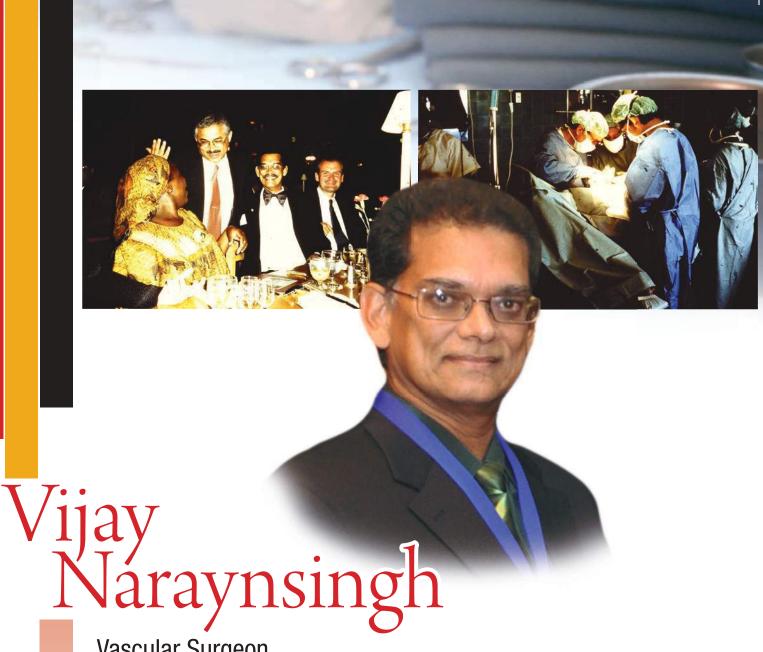
Prof. Kokaram has published over 100 papers in signal processing. Between 2002 and 2006, he served on the editorial board of the *IEEE Transactions on Image Processing*, the most important journal in that field. He also continues to supervise Ph.D. students at Trinity while maintaining links to UWI, St. Augustine, where he has helped to create a new course in video processing. He has worked with NIHERST on science popularisation and takes every opportunity to speak about his field, running workshops at conferences in the UK, USA, Trinidad and Tobago and his home base of Ireland.

Along with the industrial and commercial applications of Sigmedia's research, Kokaram also has a personal interest in applying his work to a lifelong passion – cricket, viz. creating effective automated highlights packages to fill the large demand produced by the growing number of cricket matches being televised globally.

Despite his work load, Kokaram still manages to find the time to "read a lot, watch too many old movies, play cricket and talk to people in other disciplines so I can find new problems to work on."



and sometimes I was able to help. And in the course of doing that, you invent something new."



Vascular Surgeon

Excelling at two callings

Prof. Vijay Naraynsingh is perhaps best defined by his unquenchable thirst for knowledge. It is this passion for learning – about everything – that has influenced him at every step of his life and driven him to the high achievements and expertise for which he is widely recognised, both locally and abroad. Among these accomplishments are his status as a pioneering surgeon, his international name as a researcher, and his reputation as a dedicated teacher.

He was born in Tunapuna, the same community that his great-great-grandfather settled in upon his arrival from India. There, the young Vijay and his three siblings were raised by their shopkeeper parents, Siew and Ramdai, and the supportive network of their extended family, who influenced many aspects of his life, including his choice of profession. Today, Prof. Naraynsingh still extols the virtues of the traditional family structure and laments the modern movement away from those values.

He attended the preschool of "Teacher Tiny" who, he reports, was something of a local legend in Tunapuna. It was there that he first began to distinguish himself as a star student, and, as a result, his grandfather marked him out as a future doctor. In primary school, he was ready to sit the Common Entrance Examination by age eight, but was not allowed to do so before age 11. In 1960, at 10 years old, he sat the college entrance





examination for Hillview College and accepted a place there, where he stayed until he completed his O' Levels. As Hillview did not offer science subjects at A' Levels, he transferred to Queen's Royal College to study chemistry, botany and zoology.

Although Prof. Naraynsingh clearly owes some of his exceptional performance to natural ability, his enthusiasm for learning undoubtedly aided him in his schoolwork, as it led him to be an avid reader and, very likely, the most regular patron of the Tunapuna library. He eagerly devoured as many books as time allowed, often reading a book a day. While many of the works he perused were related to his school subjects, his inquisitive mind led him to explore books as varied as Agatha Christie novels, chess manuals and even Emily Post's book on etiquette! But he was not just a "bookworm". Taking after his father, an active sportsman who played both football and cricket for East St. George, Vijay represented Hillview College at these two sports as well, and went on to play championship level cricket at university.

It was during his secondary school years that Naraynsingh discovered his affinity for teaching. As he describes it, "I loved teaching. In fact, I spent my Saturdays tutoring younger students after class just because I enjoyed it." When he was accepted to study medicine at The University of the West Indies (UWI), Mona in 1967, he came close to turning it down in order to become a teacher. It was his father who persuaded him to accept the offer by observing that he could always teach medicine after he had finished. And indeed, Naraynsingh got the opportunity to do so even before graduating, when the university engaged him to teach undergraduates part-time, while completing his medical degree.

When he returned to Trinidad and Tobago for his internship, he started with a rotation in surgery studying under Dr. G.O.D. Busby, a leading local surgeon. Dr. Busby turned out to be "both an outstanding teacher and a tremendous friend" and recognised at once Naraynsingh's gift for surgery. In 1974, Naraynsingh received what was only the second distinction in surgery that the university had awarded since its opening in 1948. Yet, even then, he was not inclined to pursue surgery because he was not certain it would offer him many opportunities for research. However, when he began specialising at the Royal College of Surgeons in London, England, he was exposed to the many areas for research in the field. It was not until 1982, however, when he went to study vascular surgery at Albany Medical College in New York, USA, that he honed his skills as an academic writer, under the tutelage of the distinguished vascular surgeon, Trinidad-born Prof. Allastair "Al" Karmody. Nararynsingh presented papers at conferences in both the UK and the US, under Karmody's guidance.

Since those days, he has published over 200 articles in distinguished peer-reviewed journals, authored two book chapters, published over 100 abstracts, and delivered over 125 presentations to scientific gatherings around the world.

While Naraynsingh has established his name internationally as a researcher, he is more widely renowned in Trinidad and Tobago as a surgeon. He is a fellow of the Royal College of Surgeons of Edinburgh, the International College of Angiology, the International College of Surgeons, the American College of Surgeons, and Past President of The Caribbean College of Surgeons. He was also granted Fellowship of the Royal College of Surgeons of England where he served as an examiner.

His areas of specialisation include general, plastic, vascular, paediatric and urology. He pioneered many operating procedures and surgical techniques, which have been documented in numerous international surgical journals. Among them are: the lateral approach to the profunda femoris, rectus repair for abdominal hernias, simple repair, delayed repair and late delayed repair for fractured penis, and swiss roll operation for giant breast lumps. In addition, he has been credited as the first surgeon in the Caribbean to conduct vascularised free tissue transfer, mycocutaneous flaps for breast reconstruction, laparoscopic cholecystectomy, retroperitoneal aortic surgery, minilaparotomy cholecystectomy and carotid endarterectomy for stroke.

Despite his demanding schedule as a researcher and practitioner, Prof. Naraynsingh has contributed significantly to the development of many of the region's young surgeons. He credits his own mentors, Dr. Busby and Prof. Karmody, with providing the model of mentorship that he would emulate with his own students. Naraynsingh recounts the story of his first major presentation while studying at Albany: "I remember how scared I was when I was going to the Mayo Clinic to present a paper on in-situ saphenous vein bypass in front of the men who had pioneered it. I came to Al and I remember that he told me, 'I don't care where you present it or who you present it to, but when you get up on that stage, you need to know more than anyone else in the audience. There's no other way to do it.' That weekend, I flew to the Mayo Clinic to present my paper and, as I got up on stage, I looked down and sitting in the front row of the audience was Al. He had flown all the way from New York to hear me present my paper."

Prof. Karmody's protective behaviour towards his "junior" is one that Naraynsingh tries to mirror with his own protégés. He reports that when his juniors present papers, they are forced to rely on their own knowledge instead of deferring questions to him. He will, however, intervene if he feels they are being taken advantage of because "you don't allow anyone to rough up your juniors."

Alongside his distinguished career as a surgeon and researcher, Prof. Naraynsingh has also held several top administrative positions at UWI, St. Augustine, since 1997. He has served as Senior Examiner as well as Acting Dean of the Faculty of Medical Sciences, and is currently Head of Department of Clinical Surgical Sciences and Professor of Surgery. However, he by no means forgot his "first love", teaching, and lecturing to both postgraduate students and final year medical students remains one of his greatest joys. He is also so confident in these students, he says he would happily choose any as his surgeon if the need ever arose.

Although the physical decline that accompanies aging will eventually force him to retire from surgery, Prof. Naraynsingh says he will never truly retire from teaching. In recent years, he has gone beyond teaching medicine to hosting a "How to Study" workshop for students aged 14 to 23, and he is currently putting the content of the workshop into a book on



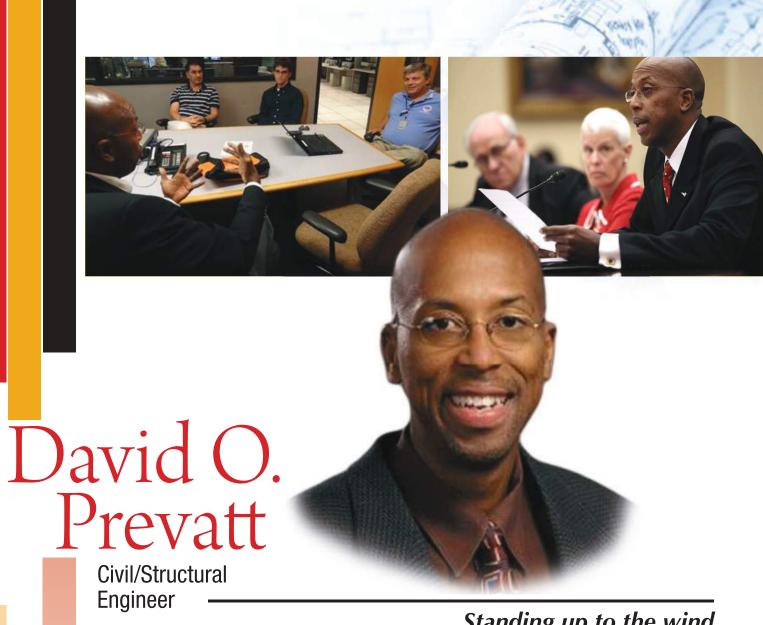
studying and studentship. His guide focuses on more than memory techniques or time management and, instead, utilises a more holistic approach to learning. It addresses the importance of nourishing the whole student by nurturing their physical, mental and emotional well-being.

While Naraynsingh's love of learning means that he "has never worked a day in his life", he has been rewarded with more than just job satisfaction. He has earned many accolades for his work. Nationally, he was the recipient of the National Chaconia Gold Medal in 1991 for long and meritorious service to Trinidad and Tobago in the field of medicine. For community service, he has been recognised by local organisations as varied as the St. George County Council, the San Fernando City Council, the Lions and Rotary Clubs of St. Augustine, the Trinidad and Tobago Medical Association and the Hindu Community of Trinidad and Tobago. At the regional level, Prof. Narayansingh received the Caribbean Health Research Council Award (1999) and the UWI Vice Chancellor's Award for Excellence in Research (2011), and, in 2001, was made an honorary member of the Caribbean Urological Association for Outstanding Contribution to Urology.

For all his achievements and lifelong desire for more knowledge, Prof. Naraynsingh does not see success and happiness in life as springing from "having it all". The constant striving for more is, in his view, a road to perpetual dissatisfaction. He instead embraces the philosophy contained in one of his favourite poems by Priscilla Leonard entitled, "Happiness". The poem depicts happiness as a crystal sphere that has shattered into many pieces such as honour, wealth and love. It warns against the insistence on trying to obtain happiness in all aspects of life and, instead, recommends treasuring each "fragment" and being thankful for one's share. Prof. Naraynsingh highly recommends the message of the poem to all who wish to find true contentment in their lives.







Standing up to the wind

We have all seen dramatic footage of tornadoes powering across the landscape, destroying everything in their path within minutes. These gigantic, rotating columns of air can produce wind speeds in excess of 200 mph and can be as much as a mile (1.6 km) wide. While most tornadoes travel for only one or two miles, some can continue for more than 100 miles. The most deadly occurrences of tornadoes are the so-called tornado outbreaks in which hundreds of tornadoes may be spawned in an area within a 24-48 hour period.

On average 1,200 tornadoes occur in the United States every year. Tornadoes have been observed in many parts of the world, including Europe, Japan and Bangladesh, but three out of four tornadoes occur in the United States. Tornadoes are formed during atmospheric instability, caused when two air masses - one warm (moist), one cool (dry) impact each other. Along this unstable boundary, changes in wind direction, and an increase in wind speed and height, produce a horizontal spinning effect in the lower atmosphere. Rising air within the updraft tilts the rotating air from horizontal to vertical, which can extend from two to six miles wide. During the spring of each year, conditions in the US are ideal for tornado-formation in the Midwestern states and in Texas. It is hard to imagine how the devastation by such a force of nature can be reduced by humans through technological interventions. But structural engineers like Dr. David O. Prevatt are doing just that. Associate Professor (Structures) at the University of Florida, Gainesville,





in the US since 2007, Prevatt has studied hurricanes for over 20 years throughout the CARICOM Caribbean and in the US. More recently, he has brought that expertise to bear on tornadoes. His research group has investigated post-tornado damage in Tuscaloosa, Alabama and Joplin, Missouri, and well as damage from tornadoes in Florida – the state having the second highest number of tornadoes per capita, after Oklahoma. Prevatt's current research is focused on developing engineering solutions to mitigate the impact of these winds on new and existing structures. According to him, a major proportion of tornado damage to houses is preventable but most residential buildings are not engineered structures designed to withstand specific (quantified) tornadic loads. Until very recently, no reliable estimates of tornado loads existed, which had led to the commonly held misconception that tornado forces are so large that no structure can be economically designed to resist them.

Wind forces act counter-intuitively to most peoples' expectation, in that the wind tends to pull buildings up and away from the ground in opposition to gravitational forces. So, for houses to resist wind loads, they need to have fully-engineered "vertical load paths" consisting of components and connections designed to stay together even under extreme upward suction forces.

The challenging dilemma in mitigating tornado damage is usually the issue of the cost of wind-resistant features. While the knowledge is available to design and construct buildings better able to resist extreme forces of nature, the homebuyer often cannot appreciate the justification for the additional 1 to 2 percent cost increase that would ensure their enhanced safety and reduce damage. Furthermore, building developers are unable to advise homebuyers that solutions do exist, partly because the focus of building codes is more on construction that minimizes loss of life. The low frequency of occurrence of tornadoes reduces the likelihood that a building strengthened to be tornado resilient will be hit. But at the same time, the socio-economic losses from such natural disasters are substantial.

While the loss of life has historically been low, due largely to decades of improvements in forecasting and tornado warnings, 2011 saw a spike in the number of tornado-related fatalities. The cumulative damage from tornadoes from 2000 through 2011 is about US \$19 billion, or 15 percent of the economic loss from hurricanes over the same period. For example, the economic losses from two tornadoes in 2011 amounted to nearly 3 percent of the gross domestic prodcut (GDP) for the states of Alabama and Missouri because the paths of those tornadoes went through densely populated areas in Tuscaloosa and Joplin.

With an ever-increasing population living in "Tornado Alley" (an area in the United States where tornadoes are most frequent), and the effect of changes in climate, it is prudent to improve the structural systems used in housing. Far more is known about wind forces but much less about how those forces are transferred within light-framed wood buildings. Dr. Prevatt believes more investment in research would bring the reward of reduced annual tornado losses. To ensure a building can resist tornado-induced loads, all connections between the main structural components must be strengthened. He explains the concept by comparing structures to chains, which are only as strong as their weakest links. For typical houses, the roof covering must be fastened to the roof rafters, which, in turn, must be securely anchored using metal straps to the structural member along the top of the walls. The walls must be firmly connected to the foundation using steel bolts and, in the case of wood-framed construction, large, stiff metal washers. Dr. Prevatt is a recognised expert on wind hazards, forensic engineering and the structural performance of low-

rise buildings and building envelope systems, i.e. that part of a structure forming the exterior skin of the building and separating the interior from the external environment. The damage from extreme wind events predominantly affects low-rise buildings. Houses by far account for the major economic losses in tornadoes and hurricanes. To determine the tornado-resistance of buildings, Prevatt estimates the strengths of past tornadoes from damage surveys to understand how buildings fail, i.e. what are the weakest connections or components. His research group at the University of Florida reproduces tornado loads within the laboratory to test critical structural components and connections, and structural modifications. The goal is to establish appropriate size and strength ranges for the nailed connectors, metal ties and anchor bolts needed in tornado-resilient construction.

David Otway Prevatt was born to Trinidadian parents, Otway and Zilma Prevatt in Nassau, Bahamas in 1964, but spent most of his life in Trinidad, growing up in Port of Spain, Cocorite and Petit Valley. He became interested in science at a very young age, always curious about building structures and fascinated by the way nature's forces (winds, earthquakes and water) continually changed the physical world. He windsurfed and enjoyed competitive sailing races at the Trinidad and Tobago Yachting Association. This was where he first appreciated that the power of the wind could be harnessed using technology but, at the same time, it could be very destructive if its power was ignored.

Prevatt was also influenced by his father, a land and quantity surveyor, who showed great concern for people and their need for safe and affordable housing. He grew up in a close knit, extended family, with parents who instilled in their children the importance of post-secondary education and having a successful career.

He attended Philips Street Primary School, then Trinity Junior School in Port of Spain, from which he won a scholarship in 1975 to attend St. Mary's College. He says, "I was a good but not a great student at St. Mary's. I did what I had to do most of the time, but I was also easily distracted from studying. The big change for me came in Form 4, when I took after-school lessons in mathematics and additional math from Mr. Martineau in Belmont. He was a great teacher and he helped me appreciate how much fun these subjects were, and in fact, how easy they were. I was able to gain the confidence I lacked to tackle the work, and since then, and I've never looked back."

School was not all work though. He was a member of the Sixth Trinidad Sea Scouts, which fostered in him a sense of duty and service to others, and the benefits of hard work and cooperation. He also represented St. Mary's College in basketball and athletics. Academically, he particularly enjoyed physics, due in large measure to the enthusiasm brought to the classroom by his teacher, Denise Padmanaban, whose approach in the physics labs really opened his eyes to the world of possibilities that scientific enquiry could bring, and the fun of experimentation.

He went on to study civil engineering at The University of the West Indies (UWI), St. Augustine. After graduating in 1985 with his bachelor's degree, he took up a post with the Ministry of Works in the Design and Engineering Department. There, he was responsible for designing structures with careful consideration to building loads, and he worked on the construction and dismantling of temporary Carnival facilities such as the North Stand, Grand Stand and main stages at Victoria Square and Adam Smith Square.



In 1993, Prevatt went to Clemson University, South Carolina, where he completed his M.Sc. and Ph.D. degrees in civil engineering. For his doctoral degree, he conducted extensive research on the wind uplift performance and testing of commercial roofing systems. His work on mechanically-attached single ply membrane roofing systems addressed existing knowledge gaps between how roofs are tested and how they actually behave when installed on a building. Prevatt's research showed that it is necessary to monitor the loads throughout the structure rather than relying only on the surface pressure distribution to predict failure. He established minimum specimen sizes needed to predict in situ behaviour of roofs subjected to extreme wind loads. The work was important given the need for modernised testing protocols within the industry.

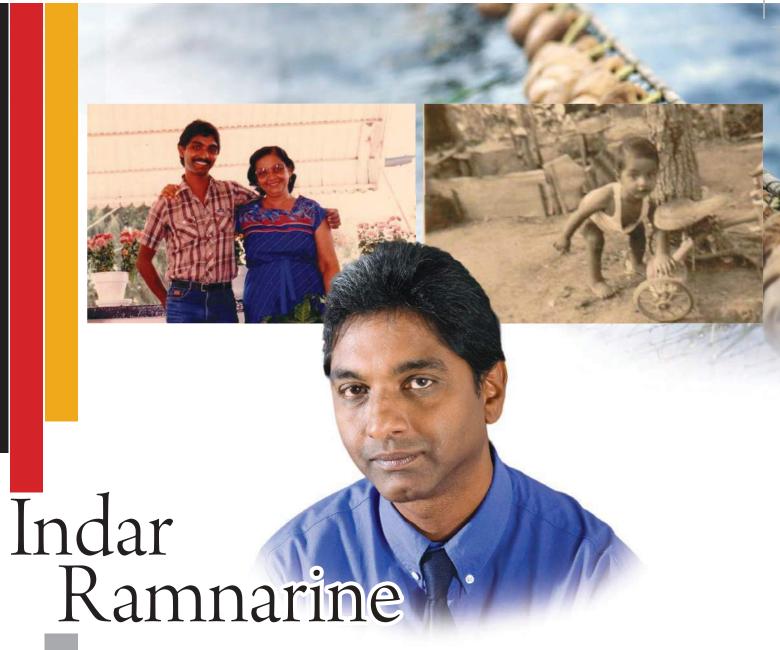
After completing his Ph.D., Dr. Prevatt worked with the Boston-based ENR500 consulting engineering firm, Simpson Gumpertz and Heger Inc. His work there focused on the repair, design and renovations of building envelope systems e.g. roofing, plaza waterproofing, wall systems and fenestration (window design) in historic and contemporary structures. In 2004, he took up an appointment as Assistant Professor of Civil Engineering at Clemson University. His work as a consultant in the years following included: wind tunnel studies to determine components, cladding and MWFRS loads and pedestrian-level wind speeds for high-rise buildings, hurricane risk assessment, and forensic investigations.

Prevatt has been the recipient of many research grants, totalling over US \$4 million. He has published 18 peer-reviewed journal articles and presented over 35 papers at national and international engineering conferences. In January, 2012, he was awarded the prestigious Faculty Early Career Development (CAREER) award by the National Science Foundation, to study and develop tornado-resilient residential communities. His damage surveys following the tornadoes that devastated Tuscaloosa and Joplin provided useful information for assessing whether or not wind-resistant building practices adopted in Florida against hurricanes could be applied to mitigate tornado damage in other parts of the US.

As a teacher, Prevatt has taught structural analysis, experimentation and instrumentation, steel design and wind engineering. He has also taught forensic engineering which enables engineers to determine the causes of failure of structures. He is a member of the American Society of Civil Engineers (ASCE); the ASCE 7 Wind Load subcommittee and the Wood Structures committee, and he serves as Director of the American Association of Wind Engineering (AAWE). He has testified before the United States congressional subcommittees on three occasions, on behalf of ASCE and AAWE.

In a world that is increasingly in need of engineers to help solve technological and socio-economic problems, Dr. David Prevatt naturally encourages young people to enter a field that has been exciting and rewarding for him professionally, enabling him to tackle the challenges of the built environment and particularly in the fight against natural disasters. For him, "Civil engineering is a unique profession in which one is able to take an idea for a building, engineer it through calculations, draw it to produce a blueprint and then eventually have this design become a reality. It is a most satisfying feeling to know that a building once represented by mathematical calculations or sketches on paper, will now serve a community of people well into the future." His simple advice to those just starting out is that, "Life is short, so work hard and follow your passion."





Ichthyologist -

Thanks for all the fish

The world's fisheries are in crisis. Oceans and seas are being overfished, and it is predicted that, by 2048, virtually all fisheries will be depleted if appropriate and timely action is not taken to reverse this trend. The FAO's State of World Fisheries and Aquaculture 2012 report indicates that 58 percent of global fish stocks are fully exploited and 30 percent over-exploited or depleted, with just 12 percent still under-exploited. Harvesting of marine fish has decreased from 80.2 million tonnes in 2006 to 78.9 million tonnes in 2011. This is largely due to overfishing, but increasing marine pollution and habitat degradation are also important factors. Studies conducted locally by the Fisheries Division of the Ministry of Food Production have indicated that many of our fish stocks are either fully exploited or over-exploited. Examples are kingfish, carite, flying fish, shrimp, croaker, salmon, yellowedge and sweetlip groupers, blue and white marlin, yellowfin, bigeye and albacore tuna, and swordfish.

One of Trinidad and Tobago's leading scientists, Prof. Indar Ramnarine, has focused his life's work on stemming extinction in the oceans, by meeting the demand for seafood through fish farming and promotion of sustainable fishing methods. He has been involved in aquaculture and fisheries research and studied fish and shellfish diversity (both freshwater and marine) for almost three decades.





In an effort to increase the supply of freshwater fish, Prof. Ramnarine has designed hatcheries and fish farms, and done voluntary work in aquaculture in Trinidad and Tobago, Guyana, Jamaica, Suriname, Bangladesh, Nepal, Cambodia and Thailand. His current work entails the development of urban aquaculture, using the tilapia, a well-known fish in Trinidad and Tobago, which is now the third most popular species reared on farms around the world. He is also heavily engaged in educating farmers on how to cultivate and set up local fish farms for intensive culture.

Indar Ramnarine was born in Carapichaima, Trinidad, where he grew up in a close family of five sisters and one brother, and surrounded by many friends in the village. Living close to the sea and spending a lot of time at his family's beach house in Mayaro may have encouraged his love for fish so much that, by the age of 10, he had started his own business rearing ornamental species for sale. Although enterprising, he laments he did not make much money since he often gave away many fishes to his friends and neighbours, who all promised to pay but never did!

His interest did not stop there. When his mother bought live cascadura, commonly called cascadoo, and blue crab at the Chaguanas market, he would beg her for one so that he could try to revive it. Little did he know then that, years later, he would be rearing and conserving species on a large scale and become one of the first persons to study the cascadura, a freshwater native of South America known as the Hassar in Guyana, and to develop methods for its commercial culture. Today, Prof. Ramnarine is considered a world authority on this fish. It is a prized delicacy in Trinidad and Tobago, with its own folklore legend that those who eat it are not just destined to return to the twin islands but to end their days there. The species is now under threat of depletion locally due to over-fishing.

Ramnarine attended Carapichaima ASJA primary school and his performance in the Common Entrance Examination secured him a place at Presentation College in Chaguanas. At high school, he loved the sciences and at first, wanted to pursue a career in chemical engineering. He later considered studying medicine, as his parents had hoped to have a doctor in the family, but limited resources and opportunities at that time did not allow for this. When he decided to study agriculture at The University of the West Indies (UWI) in St. Augustine, his parents were less than thrilled because it was not the sort of career that had envisioned for their son. But Ramnarine recalls also having had an interest in agriculture as a young boy. He had spent much of his early years helping his grandfather plant and reap sugar cane and other small crops, and helping other relatives in their rice paddies.

While pursuing his B.Sc., he became seriously fascinated by fisheries and aquaculture. Prof. Julian Kenny of the Department of Zoology, who later became his mentor, encouraged him to further his studies in the field. After graduating at the top of his class, he went on to do an M.Sc. in Fisheries Biology and Management at the University of Wales, Bangor, where he also graduated at the top of his class. He returned to his beloved homeland in 1985 and promptly registered again at UWI for a Ph.D. under Prof. Kenny. He worked on developing the technology for the culture of the cascadura for his doctoral research. His research was seminal. When he completed his Ph.D. in 1992, he was able to get an impressive eight publications in refereed journals from this study. He also made his mother

proud as she now had "a doctor" in the family! In 2001, he completed an MBA from Heriot-Watt University/Edinburgh Business School, specialising in Human Resource Management.

Today, Prof. Ramnarine is not only well known for his work in aquaculture but also for fish biology and fisheries management. He has studied many local species in addition to cascadura, including tilapia, prawns, shrimp, crabs, oysters and river conch, developing or improving techniques for cultivating and breeding them. His focus has been on the spawning, nutritional requirements, and hatchery development and production of these important local species with the potential for aquaculture. He has developed methods for induced spawning in cascadura and river conch, (which is also at risk of depletion locally), determining the nutritional requirements of both species and also the production technology for commercial culture. Internationally, he has worked on the hatchery and production technology for the Malaysian prawn and has improved methods for the intensive culture of the tilapia. Together with Dr. James Rakocy of the University of the Virgin Islands, he has introduced aquaponics to Trinidad and Tobago and has run several training courses. Aquaponics is the integration of intensive fish culture with the hydroponic method of vegetable production, in a closed, recirculating system.

His research on fisheries has focused on the development of sustainable fishing methods and he worked closely with the Fisheries Division of the then Ministry of Agriculture, Land and Marine Resources (MALMR). With the involvement of postgraduate students, they determined the optimal mesh size for Trinidad and Tobago's fish pot fishery, as well as the optimal mesh size for the local carite and mullet gillnet fishery. They also evaluated the fish nursery function of the Caroni Swamp.

In more recent years, Ramnarine undertook behavioural and evolutionary studies using the guppy as a model. He became interested in this fish when he met Dr. Anne Magurran, a post-doctoral student at The University of Wales. During their collaboration, he realized that the common "drain fishes" (also known as "seven colours"), which he collected as a boy, were excellent model specimens to study evolution, biology and behaviour of fishes. His work yielded numerous scientific papers with collaborative links with researchers from Scotland, Canada, England, Wales, Australia, the USA and Europe.

Ramnarine has conducted surveys in both islands of Trinidad and Tobago to look at the diversity of fish and decapod crustaceans and he co-supervised two graduate students who studied the diversity of these groups. He developed a key for the identification of the freshwater fish of Trinidad and Tobago and conducted a study on the aquatic biodiversity of the Caroni Swamp with emphasis on the fish and shellfish diversity. He is currently part of a research team, led by Prof. Magurran at St. Andrews University, which was awarded a European Research Council Grant for a project entitled, "Biological diversity in an inconstant world: temporal turnover in modified ecosystems". This five year project, which began in September 2010, involves research in freshwater ecosystems in Mexico, the Amazon, Scotland and Trinidad and Tobago.



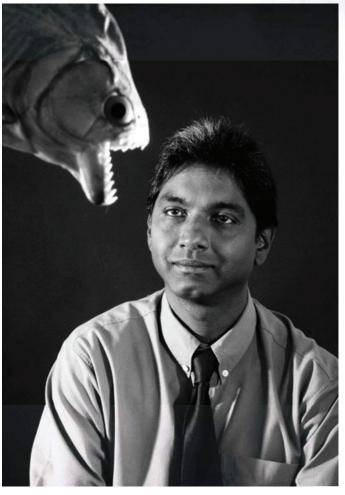
As an expert in urban aquaculture using the tilapia, Prof. Ramnarine has been involved in research on the development of aquaponics, screening local plants and fish species for backyard systems. He is also working with a postgraduate student on the development of a by-catch model for the shrimp trawl fishery in the Gulf of Paria. This study will result in an appropriate plan for the management of the trawl fishery, which is the most valuable fishery in the country. He has played a key role in the development of local fisheries, serving on the Fisheries Monitoring and Advisory Committee of the MALMR as Deputy Chairman, as well as on the National Wetlands Committee. He was also instrumental in leading a UWI team that developed a Policy for the Management of Marine Fisheries of Trinidad and Tobago.

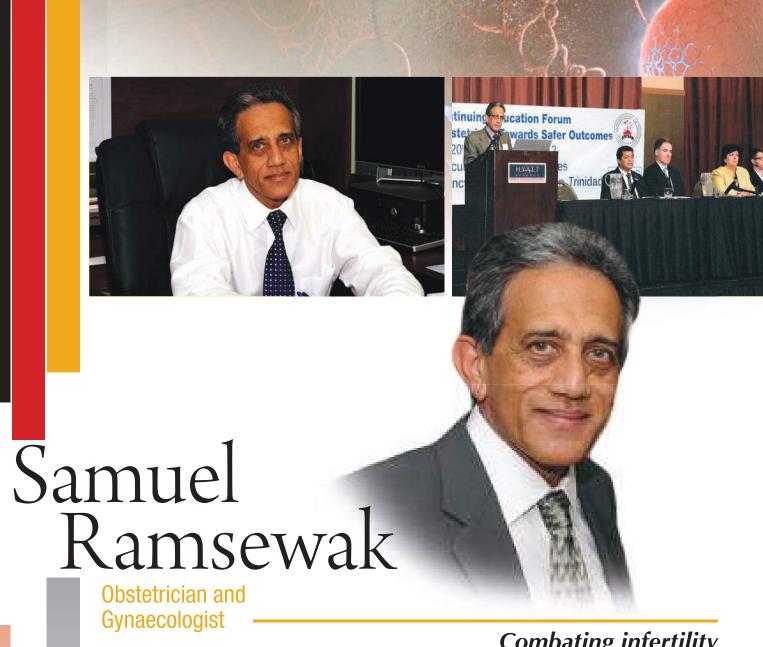
His research has yielded one book, one monograph, three book chapter, 60 publications in refereed journals, 16 refereed conference proceedings, 13 refereed abstracts, 18 workshop papers and 10 technical reports. He has successfully supervised eight Ph.D. and 12 M.Phil. students pursuing higher degrees in fisheries science and management, aquaculture, fish and shellfish diversity, and the behavioural ecology of the guppy. He was promoted to Professor of Fisheries and Aquaculture in 2008 and, in 2012, he was appointed Dean of the new Faculty of Science and Technology at UWI, St. Augustine.

Although not having a lot of free time, Ramnarine enjoys the opportunities he gets to be outdoors – walking, hiking, mountain biking and swimming. His other passion is breeding and showing bull mastiffs, and he owns five of these powerful and intelligent dogs.

In the shadow of growing global concerns, Prof. Indar Ramnarine remains ever more dedicated to scientific research and development, and to boosting education and training in science and technology, including in fisheries and aquaculture. He is committed to helping to build capacity in the sector, within a region of small island states still heavily dependent on their fisheries for socioeconomic activity. Hopefully, the efforts of scientists like him will ensure that our fish populations do not disappear in time – and their legends along with them.







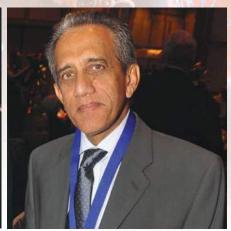
Combating infertility

For women and men wanting to have children of their own, the joy such parents feel when they hold their babies for the first time is like no other. But imagine the often unbearable disappointment of those who had been previously told that they could not conceive. Many people in Trinidad and Tobago have been spared that pain, thanks to the science of in vitro fertilisation (or IVF) and, by extension, Prof. Samuel Ramsewak, who pioneered IVF treatment in Trinidad and Tobago. There is, however, much more to Prof. Ramsewak, a doctor of obstetrics and gynaecology, than the man whose expertise resulted in the first IVF baby conceived and delivered in the Caribbean. A highly regarded professor at the Faculty of Medical Sciences at the St. Augustine Campus of The University of the West Indies (UWI), where he also serves as Dean, Prof. Ramsewak founded the Gynaecological and Obstetrical Society of Trinidad and Tobago, and is an internationally cited researcher in his field, having made an important contribution to the understanding of the role of the bacterium, Chlamydia trachomatis, in female infertility.

Born in 1951, Prof. Samuel Ramsewak recounts with great affection his early years growing up with his seven siblings in Sangre Grande, Trinidad, where he came to "appreciate what real community living was about." His father, Samdeo, was the popular and generous proprietor of "The Atomic Café", a parlour so named because it had been established in the year that the atomic bomb was dropped. In time, and with much hard work, the small business grew into one of the larger establishments in Sangre Grande.







Samdeo Ramsewak's values were instilled in his children through their having to work in the store on weekends and at other busy periods such as holidays. It was through his many interactions with the diverse range of patrons that the young Samuel developed his understanding of human nature. In his own words, "Working in the shop allowed me to develop a sense of service and taught me not to force my own opinions and perspectives upon someone else." These exchanges fostered in him valuable "people skills", which benefited him later on in his work as a doctor, educator and administrator.

Although Samdeo and his wife, Rita, expected their children to help out in the shop, they allowed all of them to follow career paths and hobbies of their own choosing. Young Samuel's interest was captured by the nearby panyard and, from an early age, he joined the Sangre Grande Cordettes Steel Orchestra, playing on weekends and in the long vacation periods. He competed with them in the National Steel Band Festival, which they won in 1969. In school, he was inclined towards the sciences but his academic path in this direction would not be easy. After completing his primary education at Guaico Presbyterian School in 1962, Ramsewak sat the Common Entrance examination and passed for the newly opened Hillview College. His teachers at Hillview recognised his aptitude for science. However, at that time, the college did not offer science subjects at A' Level, so Ramsewak was transferred from Hillview to St. Mary's College in Port of Spain. He was placed directly into the Form 4A Special class, skipping Form 3 altogether. He initially struggled with the new level of work presented to him. Moreover, for the family-oriented boy, the transition was made even more difficult because he and his elder brother had to spend their weekdays away from home, boarding in the capital. He credits the then principal, Fr. Pedro Valdez, with helping him settle in to life at St. Mary's College. While it seemed to him that few administrators recognised the importance of dealing with the students on a more personal level, Fr. Valdez took the time to get to know the shy, struggling student and decided that the best way to help him adjust would be to have him repeat Form 4. Ramsewak remembers that, "At first I felt like a failure, but Fr. Valdez corrected that by not giving up on me. For that, I am forever grateful to him." Ramsewak would go on to repay Fr. Valdez and St. Mary's College for their faith in his abilities by returning for one year after graduation to teach the very subjects he had transferred there to learn.

DICAL ASSOCIATION 56

After spending two years starting a career in pharmacy, in 1972, Ramsewak took his first major step towards his career as a doctor by entering the Faculty of Medicine at The University of West Indies (UWI), Mona, Jamaica, and he knew right away that he had made the correct choice. It had been three years since he had left school, however, and he admits that he probably studied "too hard" at first. Once he realised he was performing well, he allowed himself to relax and, ultimately, he describes his time in medical school as "a fabulous experience." He enjoyed meeting people from a variety of backgrounds, each with their own life experiences to share, and he established many lifelong friendships in Jamaica. He even found time to continue developing his pan-playing skills by performing with the UWI Steelband.

In 1977, Ramsewak graduated with honours in pathology and microbiology and went to Sheffield in England to specialise in obstetrics and gynaecology. He was a Commonwealth Research Fellow at the Jessop Hospital for Women, a leading institution for reproductive medicine, and it was there that he did his first work in in vitro fertilisation. Following this, he worked as a registrar at St. Mary's Hospital in Manchester for one year before returning to Trinidad where he took up the post of Senior Registrar at Mt. Hope Women's Hospital. His talent for microbiology, as evidenced by the honours he received for his MB BS, merged with his interest in reproductive health, when he wrote his postgraduate thesis on the detection of the bacterium, Chlamydia trachomatis in the fallopian tubes of infertile women and in the fresh tissue of ectopic pregnancies (when the fertilized egg implants itself in the fallopian tubes). Unlike earlier research in this area, which relied heavily on paraffinised specimens, Ramsewak's study was distinguished by its use of fresh tissue samples, and helped to prove that Chlamydia was the main cause of the scarring that leads to ectopic pregnancy. While Prof. Ramsewak's thesis is in itself an outstanding accomplishment, his body of work also includes over 50 articles published in a variety of peer-reviewed journals, relating to obstetrics and gynaecology.

In light of his experience in the area of reproductive health and fertility problems, there is little surprise that he gravitated towards IVF – the process by which an egg is fertilised outside of the womb and then transferred to the uterus of the woman. Once the fertilized egg, or zygote, successfully attaches in the womb, the pregnancy then continues in the same way as a natural conception. Prof. Ramsewak combined his experiences working on IVF at the Jessop Hospital with the knowledge gained through his research to help found an independent fertility clinic in Trinidad. This clinic has since been credited with the Caribbean's first IVF baby and its first ICSI baby. ICSI is a form of IVF in which a single sperm is chosen to fertilise an egg. Through Ramsewak's work bringing IVF treatment to Trinidad and Tobago, many women and men confronted with the challenges of infertility now have the chance to start families of their own.

Whether it was for his academic research, his work with IVF, or his career as an educator, in 1998, one year after the delivery of Trinidad and Tobago's first IVF baby, Prof. Ramsewak was awarded the Chaconia Medal (Silver) for his contribution to the field of medicine. Although proud to be distinguished by a national award, Ramsewak considers his research publications and his experiences teaching obstetrics and gynaecology at UWI as the most significant





achievements of his career. In fact, one of the reasons he returned from England was that he wanted to teach at UWI's Medical School, and he notes that he finds great happiness in "seeing people grow in front of you and knowing that you were able to facilitate that process." Prof. Ramsewak believes that his facility with lecturing developed during his early experiences teaching at St. Mary's College. He also recalls his university days where students would teach one another, and he is convinced that "the best way to know whether one really understands something is to teach it to one's fellow students."

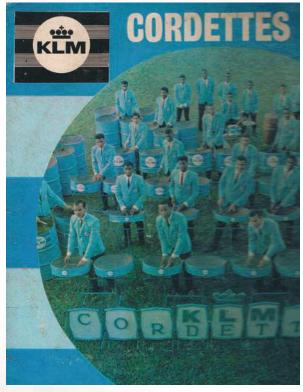
Ramsewak transitioned from teaching into administration when he was invited to head UWI's Department of Clinical Surgical Sciences. He went on to serve as Deputy Dean of the Faculty of Medical Sciences and, in 2007, he was appointed to his current position of Dean. He embraced the move from teaching to administration because he saw it as an opportunity "to have a positive impact on the quality of teaching in the medical sciences, making it more student-friendly and agile." He has certainly accomplished a great deal to be proud of as Dean, and it was under his tenure that the faculty became the first in the Caribbean to be accredited, for a period of five years, by the Caribbean Accreditation Authority for Education in Medicine and other Health Professions (CAAM-HP).

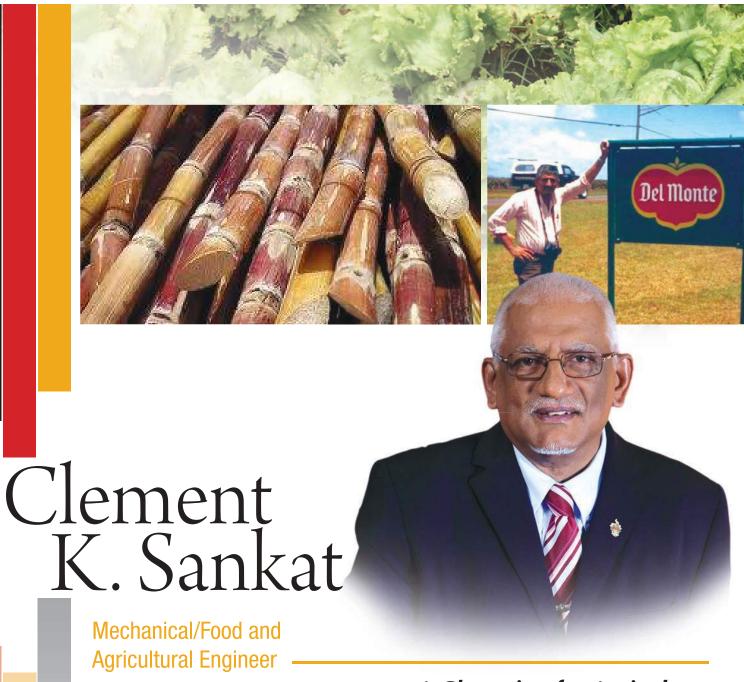
When asked if he would recommend a career in the sciences to young people, Ramsewak is enthusiastic in his endorsement. In his view, "There is so much that one can accomplish for the benefit of others as well as for one's personal satisfaction." But he cautions that, "It is a very demanding arena and students must be passionate and consider the work required of them as the 'worship' in their lives." His own experiences reflect a very rewarding career, enabling him to impact many lives through his work as a medical practitioner, a researcher and an educator. However, he does warn young people to resist as much as possible the pressure to rush through qualifications to get onto the job market. Instead, he advises that they "have the confidence and courage to take the time to ground themselves and develop a clearer sense of what they are passionate about before settling on a career path."

Despite the demands of work, Prof. Ramsewak still ensures he has time to spend with Sherry, his wife of 34 years, and his daughter, Shivaa, who is currently following in his footsteps in studying medicine. He enjoys simple pleasures – cooking at home, outdoor activities like golf and, of course, indulging his fondness for steelpan music. Sadly, he no longer plays but he does keep a tenor pan close to his desk in his home study, so he can reminisce on some of the most pleasurable times in his life and on his youth as a panman with the Cordettes and the UWI Steelband.









A Champion for Agriculture

Talk to Prof. Clement Sankat for even a few minutes about Caribbean development and the conversation will come quickly around to his great concern over the future of the region's sustainability, food security and the need for more indigenous research to develop the agricultural industrial sector. Agriculture is certainly in his DNA. But it is also very much in his heart and that kept him driven throughout his career as an engineer to pioneer research and develop technologies that would enhance Caribbean agricultural production and efficiency, and promote agribusiness. The work he is widely known for focussed on processing and postharvest technologies applied to a range of tropical crops, including the sugarcane, coconut and nutmeg, as well as popular but commercially underexploited fruits, vegetables and herbs like sorrel, breadfruit, dasheen "bush" and "shadon beni".

Today, in an era of increasing global uncertainty over food security, and especially as the impact of climate change is beginning to be felt, Prof. Sankat's emphasis on sustainable agriculture could not be more relevant to Caribbean economies, with the mounting imperative to boost local supply, reduce import bills and earn foreign exchange, tap the demand on international markets for exotic high value foods and to build sustainable agricultural communities.







Clement Krishanand Sankat was born in Berbice County, near the Suriname border, Guyana in 1951. He was one of five siblings whose parents, Henry and Carmen were both primary school principals – hardworking and highly regarded leaders in their community. The children's aspirations were shaped by parental guidance, religious beliefs and the culture of the community. He recalls that, "Looking around, we could always see that the more effort you put in – in labour, in hard work – the more success you reaped. We learned the importance of faith and family, and that education was the key to a better future."

The family was also engaged in agriculture, like many in that rural area, where farming – mainly in rice and cattle – were the primary means of livelihood. Before and after school, his father would put hours into their family's rice fields. His grandfather and uncles were some of the first in the community to invest in machinery (tractors, rice combines, etc.) even before they owned cars. The young Sankat had, therefore, witnessed both the tedious manual labour of traditional farming methods, particularly in challenging environments, as well as the tremendous value and improvements that mechanisation and other technologies and infrastructure could bring to the agricultural sector.

At age 11, he won one of only three places available to students from his county to attend Queen's College in the capital, Georgetown, following in the footsteps of his eldest brother. The long distance required the boys to board during the term, returning home only for the holidays. It was an unavoidable option if they were to have the best secondary education offered in the country. But young Clement found such early and long separation from his parents a very painful experience. That strong emotional attachment to them remained with him in adulthood and was, in fact, the key factor in his choice of undergraduate studies at the St. Augustine Campus of The University of the West Indies (UWI) in Trinidad, as well as his later decision to live in the Caribbean when he had the option to remain in Canada after completing his Ph.D. at the University of Guelph in 1978.

He was naturally inclined to engineering, attracted by the application of design and creativity to resolve challenges. As a boy, he had also been fascinated by the boats and ships that coursed Guyana's vast rivers, and he at first considered pursuing naval architecture. But that would have required him to leave for Southhampton in England and be far from his family. So in 1969, he chose instead to take up a scholarship from the Government of Guyana to do mechanical engineering at UWI.

As an undergraduate, encountering for the first time nationals from other islands, he gained a sense of connectedness to the rest of the British West Indies, which he had not experienced so intimately growing up on the South American mainland, and in a former British colony that had not aligned with the West Indian federation movement. He felt deeply inspired by the rising post-colonial consciousness and effort of nation building, which was particularly strong at UWI, and he was uplifted by the wave of confidence and expansion washing over the institution. He was also greatly impressed by his lecturers – first-rate engineers from the region who were helping to establish the world-class reputation of the relatively new Faculty of Engineering at St. Augustine.

Sankat excelled academically, graduating in 1972 with first class honours and winning the Sir Solomon Hochoy Award for Best Mechanical Engineering Student. It was also during his undergraduate years that his interest in

agricultural engineering was stoked, when he worked on projects with professors, among whom was Professor C.V. Narayan, the developer of the world's first pigeon pea harvester/pigeon pea sheller and coconut de-husker. After a brief stint back home, lecturing part-time at the University of Guyana, he received a post-graduate scholarship from UWI St. Augustine to pursue an M.Sc. in Mechanical Engineering, focussing on mechanical engineering design. He also worked as a graduate assistant at the Department of Mechanical Engineering and a part-time lecturer at the John S. Donaldson Technical Institute. In 1975, a CIDA scholarship enabled him to gain his doctorate in food and agricultural engineering at the University of Guelph's School of Engineering. Fifteen years later, he would return to Canada to take up a Research Associateship in Food Engineering at Laval University, awarded by the Natural Sciences and Engineering Research Council of Canada (NSERC).

On his return from Guelph, Prof. Sankat's long and distinguished career as a teacher, research scientist and administrator at UWI took off. In the Department of Mechanical Engineering, he rose through the positions of Lecturer and Senior Lecturer to Assistant Dean (Research and Postgraduate Matters) and Head of Department. Between 1994 and 2000, he served as Chairman, Campus Committee on Graduate Studies and Research, and Campus Coordinator, School for Graduate Studies and Research. He was Reader in Agricultural and Food Engineering, the first readership in engineering conferred in the faculty. In 1998, he became Professor Personal Chair – Specialisation in Food and Agricultural Engineering and went on, two years later, to serve as Dean of the Faculty for seven years. In 2007, he was appointed Pro-Vice-Chancellor for Graduate Studies and, in 2008, Pro-Vice-Chancellor and Campus Principal.

Over three decades, Prof. Sankat supervised research projects undertaken by many graduate students (M.Sc., M.Phil., Ph.D.), leading to the publication of more than 150 research papers, in leading international and regional journals, in the areas of: processing/storage of tropical crops and food engineering, engineering graphics and machine design, and management of innovation. His research was always focussed beyond academia; some of it, applied in the food and agricultural industries, included:

- machine design and development of processing machinery/systems for tropical crops such as coconuts, nutmegs, sorrel, cassava, peas and cocoa beans. A nutmeg-cracking machine was developed and used in industry in Grenada.
- postharvest processes: crop drying and storage; solar and mixed-mode drying; osmotic dehydration, refrigerated and controlled atmosphere storage of fruits and vegetables (mangoes, breadfruit, papaya, carambola, pommerac, chataigne, dasheen leaves, herbs); storage of root crops, salting and drying of fish; fermentation of cocoa beans; and chocolate manufacture. Solar/mixed mode dryers for use on small farms as well as shrink wrapping for breadfruit were commercialised. Through a number of external research grants, principally from the OAS, he built a specialised post harvest laboratory at the faculty to support his research.
- utilisation of agricultural residues in feed manufacture and other applications, particularly to support the diversification of the sugar industry. Seminal work was carried out by a team he led, applying the research he had done on corn-stover-based feed in Canada, to create a bagasse-based ruminant feed. With funding from NIHERST, small scale trials on sheep were undertaken successfully. The researchers were poised to create a new spin-off business an industrial plant for the feed manufacture from bagasse, to support both cattle and Blackbelly sheep production, utilising an abandoned bagasse board plant at Couva for the feed manufacture. However, the closure of Caroni (1975) Limited and the lack of support for the diversification of the industry killed all opportunity as well as enthusiasm.



In addition to his work at UWI, Prof. Sankat has played a leadership role in the application and promotion of Science and Technology (S&T) for national and regional development, including the shaping of policy. He has served as Chairman of the Caribbean Industrial Research Institute (CARIRI), the Trinidad and Tobago Bureau of Standards (TTBS), the Vision 2020 Subcommittee on Science, Technology and Innovation for Trinidad and Tobago, the Arthur Lok Jack Graduate School of Business (ALJGSB), and the UWI School of Business and Applied Studies Limited (ROYTEC). He was a member of the Board of Governors of NIHERST, The Metal Industries Company Limited (MIC), and CARIRI, of which he was Chairman. He is a member of the Board of Directors of the Commonwealth of Learning in Canada. He was also very influential in developing a first draft policy on STI through NIHERST in 2000.

Prof. Sankat has received more than a dozen awards in recognition of his scholarship, including most recently, Cacique's Crown of Honour (CCH), Government of Guyana, for outstanding service to the CARICOM region in the field of education; and an honorary doctoral degree from the University of New Brunswick. In 2001, he was the recipient of the UWI Vice Chancellor's Award for Excellence.

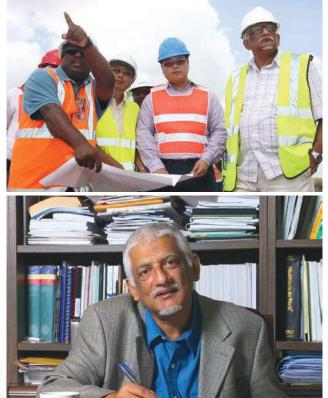
As campus principal, Sankat is aiming to put applied, impacting research at the top of the agenda. His sense of the future of agriculture is that, "Technology is going to drive agricultural production and productivity like never before. It will not be driven by human labour but by knowledge, artificial intelligence, intelligent systems, robots, mechanisation and artificial environments." The university will have to rise to the challenge of preparing researchers and industry for such a high-tech scenario.

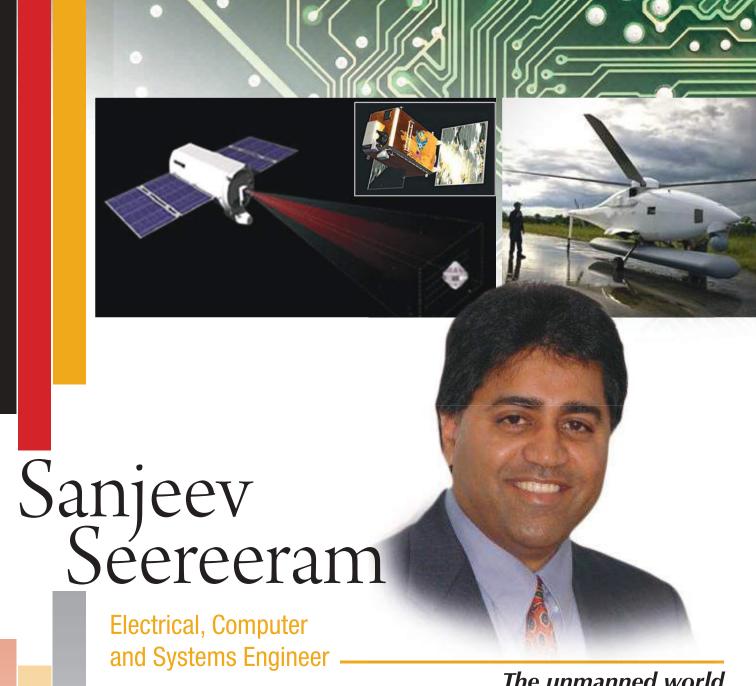
Close to the end of his career, he looks back somewhat satisfied with what he has contributed thus far, but unhappy with the region's repeated failures in agriculture, and the lack of consistent, long-term food policies. The ambitious spirit and work ethic he inherited from his parents remain undiminished and are now channelled into developing the campus – supporting student-centredness, research and development, graduate-level training, building capacity, and promoting quality and accreditation. He is also driven to extending UWI's reach into South Trinidad, with the new South Campus at Penal/Debe, into Tobago and into South America.

On a personal level too, he has few regrets. He admits, however, that he had had to dedicate much time at UWI that could have been spent with his wife, Rohanie, and five children, and perhaps if he had to do it all over again, he would have stopped a little more often to "cultivate his own garden" and smell the flowers with them. He hopes it is not too late to do so.









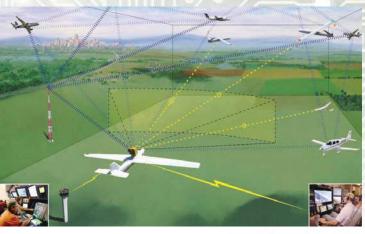
The unmanned world

The idea of automated servants, mechanical or otherwise, has haunted and inspired the human imagination for over 2000 years. In 320 BC, the Greek philosopher, Aristotle, prophetically wrote: "If every tool, when commanded, or even of its own accord, could do the work that befits it... then there would be no need either of apprentices for the master workers or of slaves for the lords."

Since then, artists, writers, inventors and scientists alike continued to dream of, and experiment with, notions of automation.

But it was only with the advent of computer technology in the mid-1950s that the world could witness the phenomenal rise of robotics, and the seemingly limitless potential for the application of artificial intelligence in every sphere of human life. Robots have revolutionised manufacturing, industry and scientific research, performing hundreds of tasks that humans cannot or will not do because of imprecision, difficulty or danger. Increasingly versatile machines have become indispensable, with tens of thousands of them being employed in this century, ranging from high-speed automobile assembly to deep space exploration. In this environment, the work of artificial intelligence researchers and developers like Dr. Sanjeev Seereeram has become invaluable.





Currently Senior Vice President of Research and Development at Scientific Systems Company, Inc. (SSCI) in Massachusetts, USA, Dr. Seereeram has worked at the forefront of the field of advanced robotics and autonomous systems for over 25 years, both on a theoretical level and in advanced prototype development and flight test programmes. Today, his focus is on strategic technology leadership and developing new ideas for SSCI, rather than on building and testing prototypes. Prior to this, as Principal Investigator or Lead for over 20 of the company's projects, he performed strategic technology planning, led research, design, development, integration and tests for an array of advanced, experimental robotics and unmanned vehicle systems. US Government clients include the US Department of Defense – Defense Advanced Research Projects Agency (DARPA), the US Air Force (AFRL) and Navy (ONR) – the National Science Foundation (NSF), the National Institute of Standards and Technology (NIST), and the New York State Center for Automation Technology. Industrial clients include the major aerospace companies – Boeing, Lockheed-Martin, Sikorsky Aircraft and Northrop-Grumman. Perhaps his most exciting work was performed with the National Aeronautics and Space Administration (NASA Jet Propulsion Laboratory, Johnson Space Center), with whom he had worked as a research assistant in 1991 during his graduate studies.

Some of his important design and development achievements include:

- a robotic testbed (a platform for large scale development projects) for in-space assembly of International Space Station truss assembly and habitat modules (living quarters) using cooperative dual-arm robotic technology;
- optimal guidance, navigation and controls strategies for advanced spacecraft to provide for autonomous orbit maintenance and interplanetary trajectory control;
- autonomous trajectory planning for the Space Shuttle Remote Manipulator System ("shuttle arm"), which significantly eases the human operator's task;
- on-board health monitoring, failure detection and reconfiguration technology for the NASA Cassini interplanetary spacecraft. (One of the most exciting assignments of his career!);
- in-space autonomous satellite rendezvous, docking, capture and retrieval technology designed for the Mars Sample Return mission;
- a collaborative intelligent swarm of unmanned vehicles capable of carrying out long-term environmental monitoring without remote human operators; and
- autonomous sense-and-avoid technology to enable unmanned air vehicles to avoid collisions with civilian or commercial aircraft a critical step forward in flight safety for future unmanned aircraft.

Born in Chaguanas in 1963, Seereeram had a natural and driven interest in all things scientific. He was a wide-eyed, six-year old in 1969 and vividly remembers when American astronauts, Neil Armstrong and Buzz Aldrin, landed on the moon. Watching live footage of it on TV, he was transfixed, awed by the ability of humankind to fly, whether by planes or rockets. From then on, he read voraciously about the aerospace industry and dreamed of one day designing and building airplanes and spacecraft himself.

Throughout his childhood, he tinkered with mechanical devices, attempting to take them apart, find out what made them work and put them back together – though he did not always succeed in the last step! This was well in keeping

with the philosophy of self-reliance held by his parents, Harrinath and Hira Seereeram, who encouraged their five children to fix and repair toys and mechanical and electrical items themselves rather than always buying replacements.

In 1974, his family moved to England, an environment that would help transform his childhood fascination into a lifelong interest. At a Royal Air Force show, seeing aircraft up close, with their impressive flight displays, solidified his interest in aerospace technology, which he would go on to pursue single-mindedly. From that day on, he began collecting model aircraft and followed news of the aircraft industry in his spare time. As he completed his primary education in a suburb of London, he took advantage of his relocation to deepen his interest in aircraft through books, and the many museums and libraries in the city.

After returning to Trinidad, he attended Presentation College in Chaguanas, where he completed his A' Level studies in 1981. Always encouraged by his parents and teachers to excel, Seereeram won the President's Gold Medal and National Open Scholarship in mathematics, physics and chemistry in his year.

He went on to attend Brown University in Rhode Island, USA, where he graduated Magna Cum Laude with Bachelor of Science and Master of Science degrees in electrical engineering (1985, 1986). It was at Brown that his interest in robotics was ignited when he completed a graduate-level independent studies course with Prof. William Wolovich, a leading academic researcher in the field. Robotics was rapidly emerging during the 1980s, initially with the manufacturing industries that were aggressively seeking to improve production yields and quality, but its vast, undeveloped potential for application in all sectors was beginning to be explored.

In 1987, Seereeram returned to Trinidad to work as an assistant lecturer in the Department of Electrical Engineering at The University of the West Indies (UWI), St Augustine. While teaching various undergraduate courses was challenging in its own right, he continued to feel that the journey to developing his technology and academic interests was only just starting.

Two years later, he left Trinidad to attend Rensselaer Polytechnic Institute (RPI) in New York, USA, to continue his academic development and exploration of high technology aerospace and robotics fields. At RPI, he pursued a Ph.D. in Computer and Systems Engineering. Under the guidance of Prof. John Wen, he specialised in robotics, linear/non-linear systems theory and artificial intelligence. During this time, he undertook research at the Center for Intelligent Robotics Research for Space Exploration – a NASA-funded University Research Center – developing advanced robotic planning and control technology for in-space assembly of the planned International Space Station.

After completing his Ph.D., he joined SSCI in 1994, which was the beginning of a rewarding career in robotics, aerospace and artificial intelligence development, and the realisation of his boyhood aspirations. The high quality of his work has allowed Seereeram to progress from systems analyst and design engineer to senior technology and executive leadership at SSCI. He continues to work on the development of artificial intelligence for advanced robotics, involving unmanned



land, sea and air vehicles, as well as robotic spacecraft for solar system exploration. He has presented at aerospace and robotics conferences; served on four advisory panels; and published over 50 research papers in conference proceedings, peer-reviewed journals and engineering texts. He is a senior member of the American Institute of Aeronautics and Astronautics (AIAA) and a member of the Institute of Electrical and Electronics Engineers (IEEE).

Today, whatever free time exists outside his demanding work schedule is devoted to family life. He and his wife, Cecilia Mercado, a senior software developer herself, are equally busy raising their two young daughters. The couple also share a love for travelling. On his own, Seereeram tries to squeeze in time to pursue his hobby: amateur motor sports.





Seereeram sees many opportunities for countries in the region to further exploit the economic benefits of high-technology robotics and automation, primarily in terms of productivity improvements in manufacturing, as well as agriculture and food production. As he explains, "Robotics provides for flexible automation, which fits well with the scale of economic outputs of the region's diverse micro and small businesses. The convergence of computing and information systems with automation means that our business processes can become more responsive to changing global demands, while still remaining competitive at smaller scales. As robotic and computing systems become more affordable and ubiquitous, local engineering and science curricula should be developed that stimulate the application of robotic technologies to local needs."

As a corollary, he is also very encouraging to young people who, like him, might hope to pursue scientific and "high tech" careers. From his own experience, he says, "A career in science can be extremely exciting and fulfilling, provided the person has the aptitude, determination and interest. It requires a great deal of preparation (school and university) to succeed at the forefront, so there does need to be a dedication to the basics – math, science and communication skills development – throughout school. However, with the Internet, there is so much more information available at our fingertips that the entire academic



learning process can be made immensely enjoyable and intuitive. My advice would be to stick to your dreams – even if it means slugging it out through the basics. The rewards of a solid math/science education are pretty wide-ranging, once you get to university and beyond."

For Sanjeev Seereeram, Trinidad and Tobago provided that fundamental science and mathematics education background, and enabled him to follow his dreams of becoming involved in aerospace and eventually robotics technology fields. Despite pursuing a career overseas, the land of his birth is still and will always be home, even as he shines his light elsewhere, as one of the many brilliant and successful members of our scientific diaspora around the world.



Zoologist

Spider Woman

While the rich biodiversity of Trinidad and Tobago is well known generally, few people beyond the scientific community would think to apply the term to the country's arachnid population. It may, therefore, come as a surprise to the average person to discover that Trinidad and Tobago is home to an estimated 1,000 species of spiders. Luckily for these spiders, one woman is determined to make a name for them and is hard at work cataloguing not just the spiders of Trinidad and Tobago but of several Eastern Caribbean islands as well.

Dr. Jo-Anne Sewlal, a zoologist at The University of the West Indies (UWI), St. Augustine, was the recipient of the NIHERST 2012 Award for Excellence in Science and Technology for Junior Scientist for her impressive studies to date. She has made it her goal to collect as much data as possible about the spider species in the region. So far, her research has taken her to Anguilla, Montserrat, St. Kitts and Nevis, Grenada, Antigua and St. Lucia, where she has sampled and observed the local arachnid populations, with the aim of creating a thorough record of the species in each island. For many of these islands, Sewlal's research has been the first of its kind undertaken.

Sewlal also conducts similar research in Trinidad and Tobago, though she admits that cataloguing in her home country is a much more daunting task. Unlike the islands of the Eastern Caribbean, Trinidad's





geological link to the South American mainland has endowed it with much greater biodiversity, including more than 10 times as many spider species as other islands.

Loss of plant and animal species can have potentially devastating impacts on ecosystems and, therefore, on human life. In an era of increasing environmental destruction and the effects of climate change, it is imperative for scientists to gain greater understanding of the specific roles and niche value of species in order to ensure balance and safeguard sustainability.

Issues like deforestation, quarrying and a general lack of concern for the environment pose major threats to the region's biodiversity. Although Jo-Anne Sewlal's work recording local species goes a long way towards understanding our biological heritage, the destruction of natural habitats means that many species of arachnid will be lost before they are even discovered. Some of these may have had possible medical applications in terms of their venom.

Spiders occupy intermediate levels in food webs, meaning that they act as food for organisms in higher trophic levels and predators to those in lower levels. Reduced spider abundance and diversity could, therefore, also affect organisms at multiple levels of the food chain, especially lower ones like insects, since spiders are major regulators of insect populations.

The mission of preserving these species and their habitats is heavily dependent on building awareness among the general population and Sewlal has certainly been gaining increased visibility through her research. She is the author of over 40 scientific publications including 30 research articles in international journals relating to: arachnology, biodiversity, ecology, systematics, taxonomy, cytogenetics and biogeography, and over 400 general publications in the area of biodiversity, ecology, entomology, zoology, natural history, behaviour and environmental issues.

Her work has been featured in the media of most of the Caribbean where it has taken place. However, she has also captured the attention of international media. In 2011, she was featured on the Science Channel, a subsidiary of Discovery Communications, demonstrating how to capture spiders in the field and discussing the importance of spider silk and its renowned properties, like its strength and elasticity.

Sewlal also raises environmental awareness through her series of weekly columns for the "Environment TOBAGO" section of *Tobago News*, and through her membership in various environmental organisations. She is optimistic that, "The more people know about the planet and understand the interconnectivity among species, the more they will respect and appreciate it and protect the delicate balance that supports environmental sustainability. Without these natural habitats, my spiders won't be there." Her affection for arachnids, reflected in her reference to "my spiders", springs from childhood and her wider fascination with the natural world, and led to her choice of studies at university later on.

She attributes this early curiosity about wildlife to her home environment, growing up in a household in which there was always an interest in nature. Her grandfather, Hakim Nobbee, often took her for walks to observe creatures like tadpoles, dragonflies and butterflies, while her father, Jonathan, nurtured her appreciation of larger animals on their frequent visits to the Emperor Valley Zoo.

Her first encounter with a spider as a small child suggests her passion for them was truly love at first sight: "I remember one day when my grandmother, Ayesha Nobbee, was doing the housework, a spider dropped down on a dragline of silk. It was the first time I had seen a spider. She told me if I touched it, it would go up and then after a little while, it would drop back down. So she left me playing with it and testing the spider to determine if her words were true. After a few minutes, she heard me whimpering and jumping up, trying to get at the spider, which had now climbed beyond my grasp, and she said, 'Oh oh, you want to play with it.' So she promptly took a broom and brought it down and handed it to me. My grandmother was fearless of animals, so it was always strange to me when people hear what I study for a living and ask me why, as a female, am I interested in spiders and not scared of them."

From this anecdote, the difference between Sewlal and the average little girl is immediately clear. While most children on the whole would recoil, Sewlal gravitated towards the spider. Whether this response was the result of her grandmother's encouragement or some nascent attraction to arachnids, her inquisitiveness and fearlessness were qualities Sewlal ultimately brought to her work as an arachnologist. She adds, "My mother, Enid, was responsible for developing my analytical skills, when she mentioned how the spider fauna in houses had changed over the years. She said that, growing up, it was very common to see the large flat hairy spiders, locally called 'machak' or 'money spiders', which were replaced by tiny spiders with prominent black bodies of the family Scytodidae (spitting spiders). These, in turn, have now mostly been replaced with those with long skinny legs often found in webs in the corners of rooms commonly known as 'Daddy long-legs' of the family *Pholcidae*."

Unlike the vast majority of Trinidad and Tobago students, Jo-Anne Sewlal was homeschooled for the duration of her primary education. She went on to receive her secondary education at three schools: Phillips Comprehensive Educational Institution for Forms 1-3, St. Kevin's College for Forms 4-5, and Princes Town Senior Comprehensive for A-Levels, where she was repeatedly on the Dean's Roll and won the prize for biology.

In 1999, Sewlal started her B.Sc. in Zoology at UWI, St. Augustine and chose to remain there for her M.Phil and Ph.D. also in zoology. The focus of her dissertation was on the contribution of habitat diversity to the biodiversity of the spider families *Araneidae*, *Nephilidae* and *Tetragnathidae* in Trinidad. She explored how vegetation structure, plant diversity and disturbance affected the biodiversity of these families.



While the experience of studying a subject that has long captured her heart is rewarding enough, Sewlal's research has also earned her a great deal of recognition. She has won numerous local and international awards, including a record three time win for the American Arachnology Society's Vincent Roth Award for her work on the spider fauna of the Eastern Caribbean. In 2010, she was also recognised as having been both the first female and the youngest individual to win the Caribbean Academy of Sciences (CAS) Young Scientist Award, which provided funding for her to continue her research on spiders. Still, one of her proudest moments, Sewlal says, was the invitation extended to her in 2008 by the Smithsonian Institute to travel to Washington D.C. to identify their collection of spiders from Tobago.

In addition to awards, Sewlal is a member of several professional and scientific organisations such as the Linnean Society of London, (which derives its name from the father of taxonomy, Carl Linneas); the Royal Entomological Society; Society of Biology (from which she gained Chartered Biologist and Chartered Scientist status); the International Arachnological Society; the American Arachnological Society and CAS.

Sewlal's interests and talents are by no means limited to science and arachnology. As a child, her poetry appeared in local newspapers and she says that, in her teenage years, she was seriously considering a career in computer technology and also dance, since she had been trained in multiple genres. She also plays instruments like the piano, guitar, cuatro, steelpan, melodica and the recorder. Within recent years, she has been taking every course she can find on home renovation. Jo-Anne Sewlal is the definition of a multi-faceted individual who proves that being a Jill-of-all-trades does not exclude you from being a master of one.

For the future, in addition to continuing her scientific research, she would like to write nature guide books on the spiders of Trinidad and Tobago and the Eastern Caribbean, so that people from all walks of life, both Caribbean and visitors, can also learn to identify and appreciate these amazing creatures.











TRINIDAD AND TOBAGO IN SCIENCE AND TECHNOLOGY Volume 3







