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69th Lindau Nobel Laureate Meeting: Personal experiences of two young scientists

The annual Lindau Nobel Laureate Meeting is an extremely prestigious 1-week event at which bright young scientists from across the globe are able to meet Nobel laureates to discuss matters of science. These meetings were initiated in 1951 to liberate German scientists from their post-war isolation. The aim was to encourage and cement networks and reduce barriers between nations. Since that time, the meeting has taken place every year in the small Bavarian town of Lindau on Lake Constance, alternating among the disciplines of medicine and physiology, chemistry and physics. An interdisciplinary meeting revolving around all three disciplines is held every 5 years and a meeting on economics is held every 3 years.

This year's meeting attracted 580 young scientists – master's and doctoral students and postdoctoral researchers – from 89 countries and 39 Nobel laureates. The meeting was dedicated to physics, and revolved around topics such as cosmology, particle physics, laser physics, gravitational waves, quantum technologies, dark matter and the graphene flagship programme. Themes were addressed in the form of lectures, panel discussions, master classes and science breakfasts. The motto of the Lindau meeting is 'Educate, inspire and connect'.

In order to attend a Lindau Nobel Laureate Meeting as a young scientist, applications must be submitted to a host institution such as a national academy. In the case of South Africa, this is the Academy of Science of South Africa (ASSAf) which provides travel grants through support from the Department of Science and Innovation (DSI), formerly the Department of Science and Technology. The DSI and ASSAf cover the cost of travel and logistics in South Africa, while the Lindau Council co-funds accommodation and any medical expenses during the meeting. There is a variety of accommodation options, including hotels near the meeting venue and beyond the island, and even staying with a host family in Lindau.

This year, two of the young South African scientists who participated were Valentine Saasa and Nonkululeko Radebe. Valentine Saasa is a PhD candidate at the CSIR and is registered for her degree at the University of Pretoria. She works on the synthesis of nanostructured chemical sensors for non-invasive monitoring of diabetes mellitus. Nonkululeko Radebe is a PhD candidate at the Karlsruhe Institute of Technology in Germany. Her research involves combined rheo-spectroscopy techniques for hydration kinetic studies on cement paste. They respectively describe their experiences below.

Experience of the 69th Lindau Nobel Meeting: Valentine Saasa

The first time I heard of the Lindau Nobel Laureate Meeting was in 2016 at the University of Limpopo when I was hosting and facilitating a women in science communication event sponsored by ASSAf and the British Council. Stanley Maphosa, International Liaison Manager at ASSAf, was telling participants about this opportunity – dedicated to chemistry at that time. I did not fully understand what it was all about, until the 2018 meeting dedicated to physiology and medicine when I followed Edith Phalane's (a 2018 Lindau alumnus) twitter posts on her attendance. I was unsure about applying for the 2019 meeting dedicated to physics, but as my research involves physics and I am supervised by a physics chief researcher at the CSIR, I nonetheless applied.

Unbelievably, I was selected by ASSAf in the first stage and nominated by them to the Lindau Council. I could not believe it and I did not want to tell anyone yet, as I was not sure what was going to happen in the next stage. In January 2019, I received the email from the Lindau Council informing me that I had been selected to attend the meeting! I was excited, and yet nervous at the same time, wondering what I – a biochemist by training – might say to the greatest physicists in the world. But then I learned that there would be Nobel laureates who were biochemists by training but had won either chemistry or physics Nobel prizes. The pre-Lindau meeting with alumni in South Africa, organised by ASSAf, also served to calm my nerves and ignite excitement about the trip.

When we arrived, the meeting venue was breathtaking. It is situated on the island of Lindau. Even though there were many hotels, they could not accommodate all the young scientists and many had to stay outside the island, some with host families as I have mentioned. I was privileged to be accommodated just across from the meeting venue.

The second day at Lindau was remarkable for me, because South Africa, as host of the International Day, opened the ceremony with a Xhosa cultural dance. I felt at home, and it seemed that everyone from around the world was having fun. When your skin colour was noticed and you were asked whether you were a South African, there were many compliments on the opening ceremony. A second highlight of the opening day was when Nobel laureate Brian Schmidt (Nobel Prize in Physics 2011) delivered his keynote address entitled, 'Big questions for society, big questions for research'.

There were different talk formats during the week: lectures at which laureates presented their prize-winning work, open exchanges where questions were asked by young researchers and answered by laureates, and agora talks, rather more interactive and informal, during which the young scientists could ask laureates about their career paths and personal lives. I had the opportunity to talk to Harald zur Hausen, who presented on bovine products as the origin of infections linked to colon and breast cancers. He received the Nobel Prize in Physiology or Medicine in 2008 for his work on the role of papilloma viruses in cervical cancer.

We also had the opportunity to choose either to lunch or walk with a laureate. I had the honour of lunching with Hartmut Michel, together with nine other young scientists with a biochemistry or biophysics background. Michel won the Nobel Prize in Chemistry in 1988 for his work on the determination of the three-dimensional structure of a protein complex found in certain photosynthetic bacteria. We had a very relaxed lunch and conversation

ranged from the personal, the cultural and politics to academia. A take-home message from him was to focus on quality research rather than the impact factor and publish our work in open-access journals because they are the future of science publishing.

Another highlight was the breakfast session with Sir Konstantin Novoselov, who won the Nobel Prize in Physics in 2010 for discovering the material graphene. His work is closely related to mine, and I appreciated that he is very down to earth and approachable. Novoselov spoke on his experience in researching advanced materials like graphene, a single-layered carbon compound which seems to have an endless supply of applications. Graphene is just one of a plethora of new 'smart materials' which react to environmental changes such as pH, temperature or ultraviolet light. They form the basis of many modern sensors and are being used in fields from computing to medicine. Novoselov argues that the application of research is best achieved by commercial companies, not by universities and research institutions. Coming from both a research institute and a university, I couldn't agree more.

Young South African scientists at the International Day hosted by South Africa

How can science change the world for the better? A take home message for Valentine

Given the socio-economic status of our country, I was delighted to hear the Nobel laureates talk about science for society during a panel discussion. Our new White Paper, together with the National Development Plan, has identified science, technology and innovation (STI) as the primary drivers of economic growth, job creation and socio-economic reform. However, it is clear that South Africa is not yet fully benefitting from the potential of STI to address our socio-economic problems. This issue – is science solving societal issues – was addressed in detail by the panellists: Steven Chu, Brian Schmidt, Vinton Cerf, Tim Lauce and 2016 Lindau alumnus and South African Adriana Marais.

It is interesting to me that a scientist would ask how science can change the world for the better, because it indicates that, as scientists, we are uncertain if science is doing what it is supposed to. Schmidt argued that for science to serve all humanity, the issue of income distribution should be addressed. This, in turn, is dependent on science becoming more cooperative on a global scale.

'Scientific knowledge brings understanding, and that understanding can guide and inform how society can meet such great global challenges. So, let's use our scientific powers to be more active politically and in other ways', Chu (Nobel Prize in Physics 1997) appealed. The role of science is great, but in order to rise to the occasion, scientists need to think not only about how science could be done better but also about how its benefits might be felt by all humankind. The importance of curiosity-driven basic research translating research knowledge to technology in order to improve the way we do and communicate science is key to tackling our societal problems. However, according to Cerf, it is not the job of scientists to translate knowledge into technology, but rather the job of engineers and similar companies.

Attending the Lindau Nobel Laureate Meeting was a once-in-a-lifetime experience and I encourage other young researchers to apply. It exposes you to different kinds of research and the best research in the world – as well as a lasting network.

Experience of the 69th Lindau Nobel Laureate Meeting: Nonkululeko Radebe

I had been eager to attend a Lindau Nobel Laureate Meeting since speaking to Balindiwe Sishi, a postdoc at Stellenbosch University (my alma mater), who had attended the 2018 meeting on physiology and medicine. As a polymer chemist by training, I was curious about whether there was a meeting on chemistry. Although an Internet search revealed that the forthcoming meeting would be on physics, I was not discouraged because the boundaries between scientific disciplines are often not clear-cut. As it turns out, a part of my PhD project was based on principles of physics, namely the electromagnetic spectrum and nuclear magnetic resonance. So I applied as an open applicant, went through the two-phase process and was, to my delight, selected to participate in the 69th Meeting. Fortunately, after selection, two sponsors were found for me by the Nobel Laureate Meetings Committee: ASSAf and the Wilhelm and Else Heraeus Foundation; I am very grateful to both.

On my way to Lindau, it suddenly occurred to me that I had not prepared questions for the laureates I wanted to meet. Was I being paranoid or justifiably nervous? Was I under prepared? It quickly became apparent that there was no need to over-prepare. All participants had a specialised programme including talks and activities, depending on their choices during the application process. The majority of the programmes consisted of three consecutive lectures by three laureates or a panel discussion with laureates and senior students working separately on similar themes (i.e. gravitational waves, dark matter and lasers). One such panel discussion was on dark matter, titled 'The Dark Side of the Universe' with David Gross (Nobel Prize in Physics 2004), Adam Riess (Nobel Prize in Physics 2011), George Smoot (Nobel Prize in Physics 2006) and Brian Schmidt (Nobel Prize in Physics 2011). As a non-expert, I went with no expectations; I wanted to learn something on a topic in which I would otherwise have had no interest. Dark matter is anything that does not respond to electromagnetic radiation, which means it cannot be detected. More than anything, I wanted to know why it matters if it is undetectable. It matters because the composition of the universe is 25% dark matter, which is 20% more than ordinary matter. A second part of the topic was on the acceleration of the earth, which is a theory first considered in 1917 by Albert Einstein who later went on to dismiss it as improbable. Einstein allegedly referred to this as his 'greatest blunder'. I left this talk with a newfound interest in astrophysics.

Young South African scientists Sinenhlanhla Sikhosana and Nonkululeko Radebe chat with Nobel laureate Brian Schmidt

Another engaging part of the day's activities were the agora talks. The format was a lecture followed by a 20-min question-and-answer session. This gave a great opportunity to engage with the laureates specifically on the work that won them their Nobel prize. Stefan Hell, from the Max Plank Institute for Biophysical Chemistry in Germany, presented one of the most exciting talks I attended. He received the Nobel Prize in Chemistry in 2014 together with Eric Betzig and William Moerner.

The title of his talk was 'Reaching Molecular Size Resolution in Lens-Based Microscopy: The Diffraction Limit Blown Away' which neatly summarised for what his joint prize was awarded. The talk started with him introducing an image of molecules observed under a confocal microscope during the 20th century. At that time, the resolution was limited to 200 nm. Using principles in physics, they overcame the diffraction barrier to obtain a spatial resolution of 20 nm – 10 times more than that previously possible. I was intrigued by his answer to the question of whether he knew that his research would be awarded a Nobel prize: yes. He explained that he knew that this work was groundbreaking and was in no way surprised when he received the call from Stockholm, where the Nobel Foundation is situated.

Apart from the many scientific talks and presentations, there was time to have more relaxed conversations with the laureates. I had the honour of talking to Vinton Cerf, who was a Turing Award winner in 2005 for his work on Internet protocols. Although a Turing award is not a Nobel Prize, it is considered one of the highest honours for a computer scientist. I caught him in the middle of a conversation with three other students taking about how multinational Internet service providers like Google can help in ensuring the integrity of research that is published on the Internet. I suspect this was triggered by the fact that we live in an era of 'fake news' and anyone can publish content as 'scientific' whether true or not. Another concern raised was on how impact factors of journals are calculated and that they do not reflect the impact of a specific paper. That means it is possible to have an 'okay' paper in a high impact factor journal and after a few decades no one would be the wiser that your paper was in fact not very relevant. We discussed how to measure longevity of research using something more than citations because we all know that it is possible to cite a paper you have not read. Some suggestions were tracking whether the scientific principles used in the cited paper were used in the work that cited it, beyond the section on literature. This was an extremely important, relevant and evolving conversation, to which I will refer for many years in the future.

The biggest obstacle of the week for me was to get over the feeling of being an imposter. I discovered this feeling was not unique to me after conversations with other students, especially those from South Africa. I felt that we needed a workshop devoted to how to own your space and believe in your science as valid and on par with the rest of the world. In retrospect, it was quite bold of me to apply to attend the Meeting because it suggests that I considered myself sufficiently capable to compete with students and postdocs around the world who are pure physicists. I suspect that I was naïve in thinking that the pool of applicants was small and I was surely not competing with the 'cream of the crop'. It turns out, however, that thousands of hopefuls applied and fewer than 600 participants were selected. I am honoured and humbled to have been given the opportunity to be among some of the most brilliant minds of our time.