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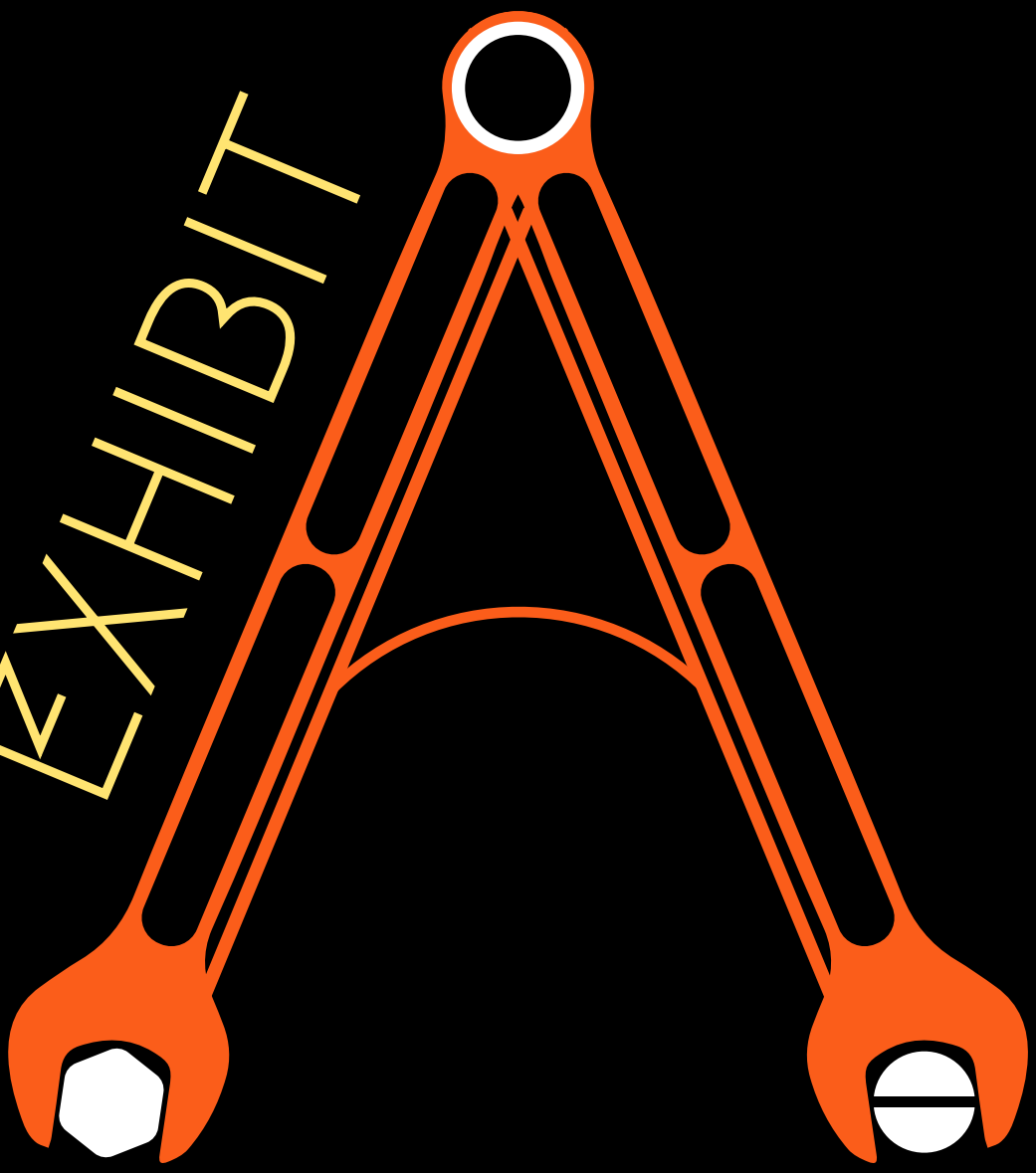
EXHIBIT



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THIRUVANANTHAPURAM

anVesha

Interview with The White Walkers

Earlier this month, Anvesha had the opportunity to interview 'The White Walkers', a team of undergraduate students from IIT Madras that represented India in the 'Tracking Coronavirus' challenge hosted by the New York Academy of Sciences. The participants were asked to 'design a syndromic surveillance network to better understand the current pandemic and/or prevent future Coronavirus outbreaks'. The interview was conducted by Balaram Vishnu Subramani (BVS) of BSMS batch '17. It was transcribed by Akshita Mittal, Shreya Venkatesan and Ravikiran Hegde of BSMS batch '19, and BVS. The team consists of Sivasubramaniyan Sivanandan (Siva) from Electrical Engineering, Pranav Nadimpalli (Pranav) from Biomedical Design, V. Sai Krishna (Sai Krishna) from Electrical Engineering, Prashant Govindarajan (Prashant) from Biological Sciences and Data Science and Burhanuddin Sabuwala (Burhan) from Biological Engineering and Data Science. The following is the transcript:

BVS: Could you tell me about the event the New York Academy of Sciences hosted? What was the highlight of the event?

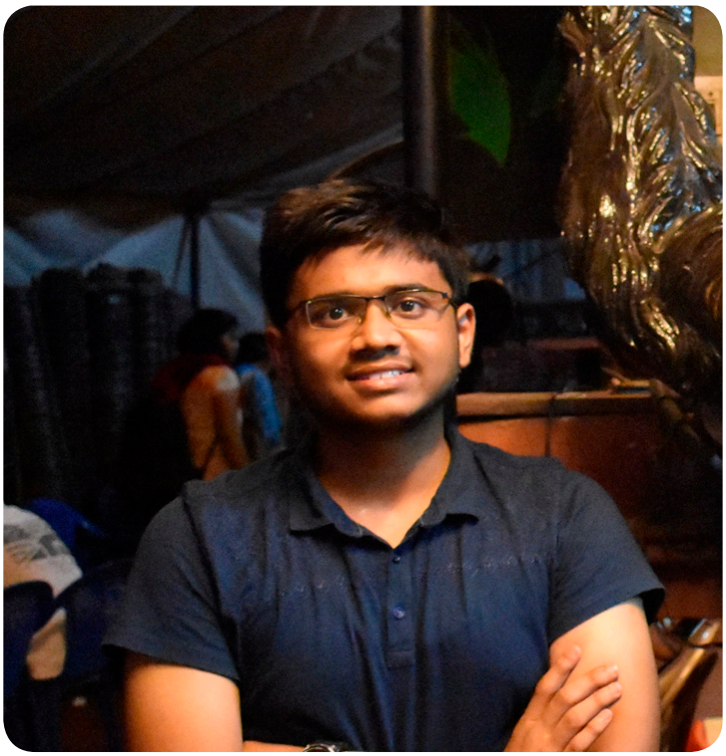
Siva: As I understand, the New York Academy conducts many events like this every couple of months; just before this challenge, there was a *Combating Coronavirus* challenge which was for school students, and this followed immediately. They conduct a lot of events every couple of months which are relevant to the current scenario in the scientific world. This was one of those challenges.

Pranav: We were not expected to prototype or come up with a workable product in time for the deadline since we were only given six weeks. Instead, we were expected to ideate various solutions for the future of pandemic surveillance. When the next pandemic inevitably hits, what kind of systems could we put in place that would make us better prepared to tackle the next pandemic? They could also be applicable to countering the current pandemic. Our project is a marriage of technological and public policy solutions as we felt this would be the future of pandemic surveillance.

BVS: Can you tell us about the project that you presented and break it down for us?

Prashant: You might have read about people developing biosensors to detect SARS-Cov-2 particles, especially in air. There's another team, an MIT based team called *Biobot,* which is working on detecting virus samples in wastewater, but the samples have to be tested in a lab. So our idea was basically to integrate them, to come up with a biosensor that can automatically detect the presence of virus molecules in wastewater. The technology behind the biosensor is also something which has been used previously, called LSPR (Localized Surface Plasmon Resonance). It is widely used for biosensors. It is an optical method. To put it in simple words, that's it.

Sai Krishna: Essentially, they want us to build a surveillance system. When we started working, we had a data-science-based approach, involving collecting data, building an ML (Machine Learning) model using complex algorithms like RNN (Recurrent Neural Network) and finally coming up with a best-estimate model. But we soon realized that it's going to be a difficult task because for COVID-19, the number of asymptomatic patients is high. We don't even have proper data regarding the number of people who are infected. We wanted something that would tackle this particular issue with the virus. That's when we came across the LSPR biosensor as well as the MIT team. The advantage with this method is that even if a patient is asymptomatic, they would still excrete viral RNA particles which can be tested. This provides us an edge over the normal data science approach.



Sivasubramaniyan Sivanandan

Burhan: Our system doesn't require direct contact with the sample. In other systems, the person who is collecting the sample is exposed to the virus. There are a lot of other disadvantages with conventional methods. RT-PCR tests are expensive, and you cannot do real-time monitoring of the highly dynamic situation, which is made possible with our system. There will be a huge scarcity of RT-PCR tests because you are using it on large numbers of patients. Our system automates the process of collecting the wastewater and it can be tested at multiple locations.

Sai Krishna: Our system can also work with bacteria if we use the appropriate biosensor chip, which can be built at a similar scale. Even with LSPR, we can detect

bacteria. A bacterial pandemic is unlikely, but our system will still work if such a situation arises.

Pranav: The important thing to note is that if you were to do contact tracing, quarantining, or make any public policy decisions such as lockdowns, you still don't know which community is infected. So, you just guess it. If a person has travelled from an infected region, they might have the virus. But with our system, we can detect the viral particles directly using our biosensors. It is important to mention here that this is established science. The concept is applicable in not just a laboratory setting but also in the real world. The only thing we need to prepare is an appropriate biosensor for the specific virus. Preparing this would take about a month after a pandemic hits, because we need to identify the viral genetic sequence first. For a novel virus like the SARS-CoV-2, we can't identify unique biomarkers for the virus until we isolate a sample of the virus and analyse it. Once we have the biomarkers, we can easily prepare the complementary genetic strand necessary for producing the LSPR biosensor chip. The physics behind this process is replicable, and there is little risk of reporting false positives.

Pranav Nadimpalli

BVS: Could you brief us on the logistics of this? Where would you install these devices and how would they shape public policy?

Siva: It's important to understand that we're proposing an early warning system here, where we can detect the infection in its early stages, contain it and prevent its spread. This would have been very useful in Wuhan.

Pranav: Essentially, you get a number that represents the situation from severe to not severe based on the SARS-Cov-2 particles present in the sewage samples of a community. Let's just say that you get that number in each community and you install hundreds, maybe thousands of these sensors all across India. Then, in a given state, over a one-week period, despite an initial lag of observation of SARS-Cov-2 particles in sewage water, we can begin tracking coronavirus in the region. Once we get into a later stage, we can further quantify the concentration of the virus in the sewage and act accordingly, but the primary purpose for the biosensor network is to act as an early warning system in order to prevent the pandemic from spreading.

Sai Krishna: When we started working for this competition, people were raising claims saying that the economy is going down, therefore it is not optimal to implement lockdown in every location. The term 'smart-lockdown' started emerging everywhere, and it was being implemented in different countries. To establish a smart-lockdown, we need one factor that differentiates one area from another. Here is how we plan on differentiating these areas: every major city will have multiple wastewater treatment plants, where we can install our biosensors, with which we can collect readings. The lockdown can be relaxed in the areas which show minimal risk which is measured by the biosensors, and the lockdown will continue to be enforced in areas that display readings that indicate a high-risk zone.

Burhan: Biobot, the MIT initiative, has developed a model that can predict how many people are infected based on the number of viral particles present in the sewage water. They now have a model which can be used all around the world as well.

BVS: If a system like this were in place before the onset of the pandemic, how effective would it have been in controlling the spread? Where would we be at this moment in time if this system were in place beforehand?

Siva: We'd like to preface this answer by saying that it is just informed speculation.

Prashant: You might have seen in the news recently that in Italy, they had detected COVID-19 particles in wastewater back in December 2019. These are indications that the virus might have existed long before it was even detected in China. In that sense, a wastewater biosensor would be a good and valuable resource here where we can detect the virus. Let's say the pandemic started in Wuhan, China, where only a few cases were there. Say they had sequenced the genome of the virus, and also knew the severity of the disease. If they had used an early warning system such as ours, and tracked wastewater from the beginning, say in December or January, they could have isolated very specific locations, and then imposed mitigation measures over those locations. That could have been really helpful in controlling the virus.

Siva: The aspect of smart allocation of resources is very important, which is absent in our case. The distribution of testing kits and PPE kits are being done so haphazardly. The system we propose would have enabled us to allocate resources efficiently to high risk zones. Even if the system is unable to stop the pandemic, it would have 'flattened the curve' to a great extent. The spread would not have been so drastic.

Pranav: Imagine how much calmer and more focussed our conversation would be, simply because the 3rd month of the pandemic would not have resulted in a large-scale economic collapse. We wouldn't have shut down borders everywhere, we wouldn't have frantic consumers rushing to stockpile food. All the chaos that we have seen could have been avoided, from the highest levels of government to the lowest, and even in private enterprises. A large-scale measure such as our wastewater sensor system would have been able to prevent this.

Prashant: Take India for example. I think the first one or two cases appeared in February. The only aim was to rapidly increase the number of testing kits available, which proved to be a huge economic loss. A complete lockdown was imposed everywhere. These are examples where an early warning system and smart, effective mitigation strategies could help. It is community-focussed rather than relying on an individual's cooperation.

Burhan: In the last decade, we have seen the emergence of many new diseases, such as Zika and Ebola in Africa and Nipah in India. All of these diseases have been shown to have human to human transmission, and they have the potential to become a pandemic. We got lucky, and the spread was controlled really well. We didn't get lucky with COVID-19. We see a rise in epidemics due to various reasons, so I think this system will be really helpful in the future with the rising number of epidemics and pandemics.

BVS: Did the diverse nature of the team help in approaching the challenge with an interdisciplinary perspective?

Prashant: One thing we all had in common was that all of us were interested in data science and machine learning and initially were totally focused towards building predictive mathematical models with varieties of data and techniques using deep learning and others. We even asked one of our professors from Computer Science if something like this was possible. We later switched to our present idea after hearing about *Biobot* and the development of new biosensors. It was new for all of us. We are from diverse backgrounds, but none of us were exposed to biosensors and their working, so we were starting from scratch. As we read a lot of papers, we were able to segregate work accordingly. For example, Burhan and I were focusing on the biological part of it—how the RNA-DNA hybridisation happens, the kinetics of binding and so on. Siva and Sai Krishna focussed on the number of systems being deployed in practice and how biosensor data can actually be utilised in making an informed decision. Pranav, the design student on our team, helped us with all the presentations and such.

BSV: Did your team face any hurdles because of the purely undergraduate-student-led nature of this?

Pranav: I don't think we have ever pitched to such a panel of thought leaders before this challenge! When we saw the other teams, they were quite experienced. To be honest, the competition seemed well-put-together and professional. So, I think that a large part of the hurdle was probably a mental block because we're just a bunch of students competing with such accomplished people from across the world. While I was pitching during a sound test, I clearly remember my initial reaction to seeing my competition for the first time. They looked like the scientists or business people you'd see in Hollywood movies! That was quite intimidating. But once we went past the mental block, it was smooth sailing. We collaborated really well together; we were able to work with each other's constraints despite the distance between us, completely on Google Meet. It was almost always very productive. We did not face any hurdles there.

Burhan: Initially, we were looking at different other aspects like using data to predict what the new hotspot would be or something like that. At that stage, we got some feedback from our professors that was really helpful in the sense that we could streamline our project in a particular way so that it could be feasible. Data direction is something very tedious and difficult. Our professors were really helpful in streamlining our project in the way to go about thinking about the process and solving this problem.

V. Sai Krishna

BVS: Do you think there is a lack of innovation in the Indian UG community? If so, how do we overcome it and encourage more UG innovation?

Pranav: As a country, it's just been about seventy years since our independence and we're taking the long road to recovery from the damage that colonial rule did to us. So I think it's unfair to compare our situation to the innovation that happens abroad simply because it's easier to innovate when you don't have to think about where your next meal is going to come from or when you don't have to worry about finding a stable job or a stable career so that your kids can have a better life. I think that's where my generation is, spiritually.

I feel that the innovation aspect in UG communities is a direct reflection of the overall attitude towards education as a means to earn, as a means to secure a stable job in our country, rather than a means to create. Innovation can only happen when you take large risks. Especially during this pandemic, at least I was in a position privileged enough to not have to worry about food, or rent. That definitely helped a lot.

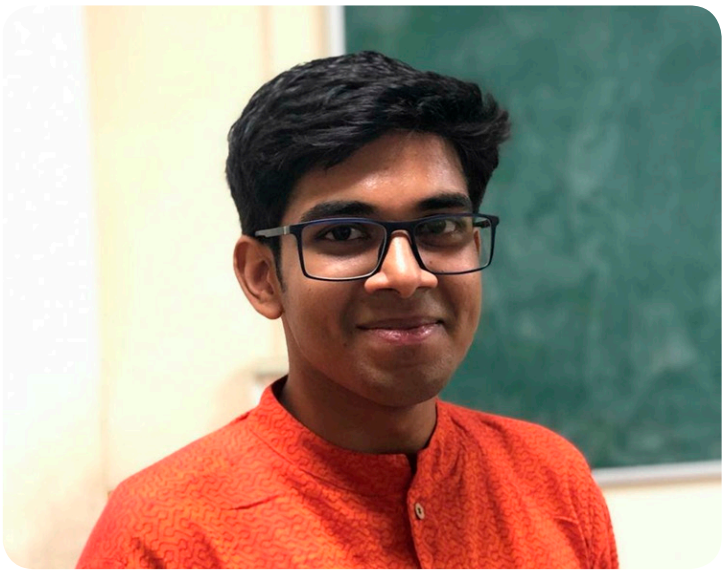
Prashant Govindarajan

Siva: I feel that in IITs and other top universities in India, the UG research is at par with the top universities globally. In universities around the world, they don't expect undergraduates to work on a lot of innovation or a lot of research, because UG is a place where people learn all the stuff and then, if they are actually interested in research, they go do something higher after that. This is the perception all over the world. I had recently gone on an exchange to NTU Singapore and there, like in most other places, the focus on UG research is very minimal. The only kind of research that happens there at the UG level is basically the B.Tech projects and nothing other than that. The kind of innovation that we have at IIT Madras, for instance, where we have the Centre for Innovation, wherein people can just go ahead and discuss with peer groups about whatever they want to ideate on. We have factories and workshops over there, where we can actually make stuff and then play around with it. Not a lot of research actually comes out of it, but it's a place where people go around and play with research papers that have already been published. You don't expect a lot of research innovation from UG people because they don't have the requisite knowledge to actually come up with something new that nobody else in the scientific community has already thought about. The top IITs are at par with institutes all over the world when it comes to UG research, but lag a little bit when it comes to PG research in comparison to top universities like MIT or Stanford. This is because of the lesser amount of funding that we have from the government; it's not very easy to go ahead and do a project just for trial's sake. You need a lot of reasons to actually take up a project itself, whereas in MIT or Stanford, you have a lot of funding, where even if you have a little idea that you want to try out, you can afford to try it.

BVS: And, especially in IISERs and IITs, we have this culture of applying for internships in our UG level as well, and that does encourage some amount of UG research.

Pranav: Yes, exactly. Most of the brightest minds in India end up going abroad for research, which I'm neutral about, but it is definitely a factor. When you see your college as simply like a road to a better university abroad, that may not drive you as much to innovate at college since you may feel that your real innovation comes after graduating.

Siva: The Indian education system is itself very competitive. You can look at school education and how competitive it is, where everyone is just aiming at whichever field is dominating at the moment like computer science. JEE coaching institutes are popping up everywhere, adding to the competition. Once students enter IITs or NITs, the first feeling that people get is to relax. Outside India, like in Singapore or America, joining university is something that is optional; not a lot of people go, and going to university is expensive. They go to universities to actually learn and get something out of it rather than going and like looking for a settled life out of it.



Burhanudddin Sabuwala

BVS: Okay. What are your future plans for this project, are you looking to secure funding to implement this somewhere and have a trial, possibly?

Pranav: We feel that this idea can only show results when implemented at a massive scale. You'll definitely find some results at the local, district or state level, but that'll only influence the local or state policy decisions. We always focussed on cost-reduction instead of profitability when ideating the implementation of our product. Larger-scale policy decisions, like at a national or international level, can only be affected by installing as many of these sensors in as many places as possible. I think that if we planned to go ahead with this, we'd first prepare a prototype, and then install

tens of these initially in a twenty-kilometre radius and then use this data to calibrate the machine. We'd then refine the whole process of data collection and analysis and subsequently take this to governments. We start small and keep growing the network. So, if any of us continue, and I would definitely like to continue, I think we can expect to innovate rapidly for five to ten years before the entire system is set up nation-wide.

Siva: With some success, we can say that we are looking at a social entrepreneurship start-up sort of an entity, but everything depends on how time takes us. Ultimately, we believe that ignoring the vast treasure trove of information in our sewage is a fatal mistake for public health. With the right investment from the government and non-profit organisations, we are confident that we can scale our innovation up and save lives.

Assam's Floods

The catastrophic Brahmaputra floods have once again hit Assam, making it the eighth time in ten years. The first annual flood hit Assam on May 22nd, and over 55 lakh people have been affected in 30 districts of Assam since then. The scenario is worst in the Goalpara district, with over 4.7 lakh people affected. As of July 27th, over 100 people have been killed in the floods and over 50 were killed due to inundation and landslides. The dreadful floods have not only affected humans, but also a major portion of national parks and wildlife sanctuaries; around 1 lakh hectares of crop fields are now underwater.

Cause of Floods

Every year, at least three waves of flood hit the state. This year, following cyclone Amphan that struck East India from 16th to 21st May, heavy monsoon rain has brought multiple flood waves to the state. Monsoon showers, along with the melting of Himalayan glaciers and multiple earthquakes, have made the Brahmaputra unstable and have caused uncontrollable floods. The situation is worsened every year by the unannounced release of water from the Kurichu dam in Bhutan.

Precautions Taken by the Government

The Brahmaputra Board, a central government office forecasting the flood, was working on many flood prevention measures to prevent this catastrophe. Most of their actions, such as the construction of embankments and the placement of sand-filled geotextile bags and RCC porcupine screens, are aimed at dredging the Brahmaputra and reducing the flow of the flood. These measures worked to an extent but were only temporary solutions. The COVID-19 lockdowns have delayed and prevented completion of pre-monsoon repairs on river embankments, and local NGOs were not able to secure sufficient funding.

COVID-19 and the Assam Floods

This year, along with the annual floods, Assam is also facing a pandemic and an outbreak of Japanese Encephalitis. People who had already faced months of lost income due to the coronavirus have now been hit by floods. The state has logged over 21,000 positive COVID-19 cases, with more than 50 deaths so far. To protect people against the novel coronavirus, the ASDMA (Assam State Disaster Management Authority) has issued a revised set of guidelines for the management of relief camps to prevent crowding and the spread of COVID-19.

As per these guidelines, district officials have been told to identify and earmark additional relief camps according to the population density of villages to prevent crowding. Usually, entire villages would be evacuated en masse and put in schools and relief camps. But now, people are evacuated based on the capacity of each designated camp, with 7 sq. m of space allotted to each person instead of 3.5 sq. m to ensure social distancing. Tents used for shelter are not erected closely, with a minimum distance of 20 metres between tents. The camps are tobacco-free zones, and people are provided with face masks, sanitizers and soaps at the relief camps, along with 20-30 litres of water.

People who show symptoms of the COVID-19 infection, such as fever and cough, are immediately isolated and provided emergency medical care. Apart from an increase in COVID-19 cases, Japanese Encephalitis is also rapidly infecting people, and has claimed more than 25 lives so far.

Government's Response to the Casualties

The central government has allotted 346 crore INR to handle the flood situation in Assam. According to the ASDMA, over 50,000 displaced people from affected areas have taken shelter in more than 500 relief camps in 24 of the 33 districts of the state.

National Disaster Response Force teams are constantly working on evacuating and transporting marooned villagers and livestock to safer places, along with distribution of necessary material to the villagers. Besides this, NDRF teams are also helping in the distribution of masks, screening inundated areas and maintaining proper social distancing.

Impact on Fauna

The Kaziranga National Park and the Manas National Park, both heritage wildlife sanctuaries, are flooded, forcing animals to migrate. Most animals naturally migrate out of the flooded Kaziranga on the NH 37 which is also an animal corridor and cross over to the district of Karbi Anglong. They reside in those jungles until the water levels recede. 80% of the total Kaziranga area is inundated. Of the 223 forest camps inside the park, 62 have been inundated, and two have been vacated.

At the Kaziranga National Park, 132 animals, including 14 rhinos, 4 wild buffaloes, 7 wild boars, 2 swamp deer and 82 hog deer have died due to various reasons, including drowning and being hit by vehicles. Despite these unfortunate losses, more than 160 animals including 2 rhinos, 4 tigers, 24 pythons and 4 king cobras have been rescued by forest personnel.

90% of the Pobitora Wildlife Sanctuary, which has India's highest concentration of rhinoceroses, is also currently underwater, forcing rhinos to seek refuge in nearby houses. The flood has also affected around 14 lakh domesticated animals and over 8 lakh poultry birds.

To deal with this catastrophic perennial havoc caused by floods in the North East, a decision has been taken to form a new organization called the North East Water Management Authority (NEWMA) to check the twin dangers of flood and erosion. The new strategies include focusing on 'soft measures' to minimize the destruction caused by floods, and planting grass on erosion-prone river banks.

—Ananya Arvind, B'19

Content References:
[1], [2], [3], [4], [5], [6]

Ableism in Academia

We live in a time of change. A time where people are not afraid to call out social prejudices and have the will to take action to end them. Yet, there remains a type of prejudgement so deeply imbued within us that it almost feels natural. Ableism is the intentional or unintentional discrimination or oppression of individuals with disabilities. Though it remains widely prevalent, particularly in developing countries like India, the topic is frequently left out of conversations. It does not spare the field of academics either.

Studies from the UK show that about 13% of undergraduates have a known disability. Only 3.9% of academic staff have declared health conditions or disabilities, even though it is understood

that up to 16% of working-class people have declared disabilities. Clearly, there is a stark under-representation of disabilities and invisible illnesses among academics. To delve deeper with the hopes of understanding the present situation, we must first consider the consequences of identifying as a person with disabilities in academia. We must keep in mind that by disability, we consider the combined physical/medical view and the social and work-environment standpoint. Pain, fatigue, depression and physical disabilities—all come under the scope of this discussion.

In society, and particularly in academia, people are focused on norms, standards, achievements and productivity. In these workplaces, we can find that ableism has been normalised and ingrained. Indeed, long hours, overwork and superhuman effort are starting to emerge as the new standard. Scholarly contributions are given such a high priority that holidays and sick leaves are minimised and avoided. It is then no surprise that people are hesitant to be honest about their issues and health concerns. Coming out as disabled is a commitment and requires the acceptance of one's condition. By doing so, the academic has to be comfortable identifying as a person with disabilities. This personal acceptance can be difficult in such work atmospheres and can take years to come to terms with. Other than personal implications, a public disclosure also puts job security at risk. It is true that people with disabilities are provided with assistance such as financial support, access support and workplace adjustments. However, the flip side is that in doing so, one is liable to be stigmatised. This is particularly true for academics, and it is this stigmatisation that is at the heart of several concerns. Invisible, less known, or contested conditions are dismissed as fabrication, malingering, or an act of a fundamentally lazy or overwhelmed worker giving out excuses. The decision to disclose, therefore, becomes an issue of image management and self-preservation. Academics are passionate about their work and are put into a precarious spot. Academics with disabilities are concerned that they won't be taken seriously or seen as academics in their own right, and that their achievements and publications are considered through the lens of their disability. In this sense, academics have themselves become the manifestation of ableism.

It is clear that cases of widespread ableism like that of Hitler's regime (where 200,000 disabled people were killed) no longer exist in modern society. Regardless, forms of micro-ableism thrive in today's world and remain invisible while making the lives of millions much more difficult.

How can we begin to overcome this obstacle that is rooted so deeply into our community? A change in the understanding of people with disabilities is needed. We need to shift our focus to the absurd standards set by society. In this ableist community, we must be aware of how we compare ourselves to such standards. Academics need to be seen, not as the privileged elite, but as individuals who may be marginalised in the workplace, whose voices may go unheard. Awareness and understanding are the first steps towards the betterment of the community and the workplace. We must recognise that academics with disabilities are no less capable and no less brilliant. They need to supported in every way they require so that their exemplary contributions to science and society can benefit the world.

—Adarsh Karekkat, B '17

References: [1], [2]

Disability and Society

Disability is any condition that limits a person's ability to perform certain activities or to interact with the surrounding environment. These conditions could be cognitive, intellectual, developmental, or physical.

"Disability is an umbrella term, covering impairments, activity limitations, and participation restrictions. An impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations. Disability is thus, not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person's body and features of the society in which he or she lives," quotes the World Health Organization.

A few types of disabilities have been highlighted in this article, and it is essential to note that this article does not contain an all-inclusive list of disabilities.

Physical disability is a prevalent form of disability that affects a person's physical functioning, mobility, or stamina. There are many prenatal and postnatal factors like genetic disorders, foetal accidents, illness, obesity, and injuries that lead to any physical disability. It could lead to neurological deterioration, muscular disorder, or chronic pain/fatigue conditions. Public spaces must have mandatory provisions for ramps, wheelchair-friendly footpaths and disabled-friendly washrooms. One should always seek permission before touching a disabled friend's motion aids (if any) and before helping.

Visual impairment refers to conditions that decrease a person's ability to see to the extent that it can't be fixed by usual means. Eye disorders, illness, premature birth, stroke, and uncorrected refractive errors are a few of the leading causes of visual impairment. Putting up braille labels on offices, washrooms, vending machines and introducing accessible software should be made mandatory as these are essential for visually impaired people. One should always identify themselves in the presence of a person with visual impairment. The one guiding should always let them take their hands, and if the person's using a guide dog, it is never advisable to feed or pet the dog when it's working.

Hearing impairment is a partial or complete inability to hear. This could be present from birth or acquired at a later stage due to various causes. People with hearing disabilities may use strategies like lip reading, sign language, hearing aids and writing notes for communication. Providing closed captions in a video, employing sign language interpreters, and normalizing hearing aids are a few ways of making a space more accommodative. One need not change the tone or volume of their voice unless requested to do so.

Intellectual disability is a condition of the brain that hinders a person's ability to comprehend and process information. A person with an intellectual disability could face limitations in their intellectual functioning and adaptive behaviours. People show signs of intellectual disabilities at a very young age. Prenatal and postnatal problems, illnesses, and genetic disorders are the leading causes of intellectual disabilities. Giving them ample time and resources could go a long way in accommodating their needs.

One should always remember to treat people with disabilities with dignity. We should be mindful of our language, facial expressions and method of communication. Public and online spaces should become more accommodative.

—J. Vishwathiga, B '19

Sources: [1], [2]

Dr E. K. Janaki Ammal

Either by chance or by design, you probably didn't know her until now. The beauty behind the magnolias, the sweetness in your sugar, the co-creator of the chromosomal atlas and the brains behind many floral varieties that we all praise—you know her, but you don't.

The year is 1980, the country's freedom won, but freedom of the mind was a battle still afresh and mostly lost. A bright young woman who sought out the truth, Dr E. K. Janaki Ammal became not only the first Indian woman botanist, but also an outstanding pioneer in her field. The story of Janaki Ammal is not just that of a scientist, but also of a 20th-century feminist who fought casteism and struggled towards liberation, empowerment and above all, science.

Janaki Ammal's academic journey began at Tellicherry, which was also her birthplace. She received the Barbour Scholarship to the University of Michigan, where she followed through to pursue her master's degree. Returning to India, she continued to teach, and forged ahead to obtain her PhD from the University of Michigan, followed by a professorship at the Maharaja's College of Science, Trivandrum, where she taught botany.

Her intensive research on the process of cross-breeding hybrids and polyploidy in her laboratory allowed the creation of a new kind of sugarcane which could grow well within our country and put India on the sugarcane map of the world. Her remarkable work led her to be hired as an assistant cytologist at the John Innes Horticultural Institute, where she was the first woman scientist to be given a salaried tenure.

She also co-authored the *Chromosome Atlas of Cultivated Plants* with C. D. Darlington. Her work was not just restricted to sugarcane, she also created a rare variety of magnolias in England, which are now named *Magnolia Kobus Janaki Ammal* after her. To this day, on Battleston Hill in Wisley, the saplings that she planted can be seen in full bloom every March.

She was also asked to run the Botanical Survey of India as its Director-General and to set up the Botanical Garden at Lucknow and further in Jammu. She was finally awarded the Padma Shri in 1977, and the National Award of Taxonomy was instituted in her name in 2000. In 2018, two Indian plant breeders, Girija and Viru Viraraghavan named their new bred rose variety *E. K. Janaki Ammal* in honour of her skill and grandeur in botany.

In a time when women were not even allowed to complete high school, Janaki Ammal brilliantly carved a path for herself with great resilience. Janaki dreamt of creating a pan-Asian sisterhood of scholars, to see her own dreams come true as well as to give flight to several others'.

She wasn't a silent bystander either. She spoke up and actively protested the construction of a hydro-electric project across river Kunthipuzha in Kerala's Silent Valley. Her vigour and sweat, although neglected by her people, found herself a place in Princeton University's international symposium on environmental history, 'Man's Role in Changing the Face of the Earth' where she was the only female invitee.

Janaki's exemplar work was ignored in texts and the public knowledge until recent efforts by the Botanical Survey of India to reinstate the superhero whom we never knew. It might not come as a surprise, but it wasn't just Janaki Ammal who was neglected from the pages of our textbooks; many women scientists from the Victorian era have contributed significantly yet are significantly forgotten.

Anna Mani, the physicist and meteorologist who made India self-reliant in weather prediction and harnessing of solar power; Asima Chatterjee, who developed the anti-epileptic drug *Ayush-56*; Anandibai Gopalrao Joshi, the first Indian female practitioner of western medicine; Irawati Karve, the first Indian female anthropologist, and many, many more women—when will we see the people who enabled us to see?

"Our female role models are not limited to the few Curie and Franklin."

(from *Lilavati's Daughters*—a text explaining what it takes to be a woman scientist in India today)

In a world of pop culture and chaos, it is us who bear the responsibility of uplifting our unsung heroes for they are inspirational and most importantly, are symbols of hope.

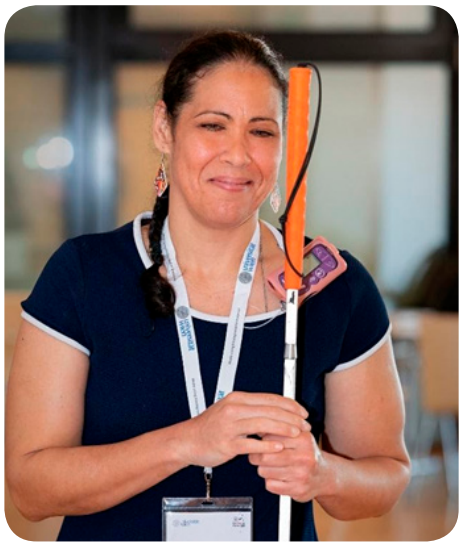
Dr E. K. Janaki Ammal's was a story we never knew we needed.

—Article and artwork by Aiswaraya PS, B '18

References: [1], [2]

Scientists with Disabilities

Innovativeness and ingenuity are characteristics of all scientists, but scientists with disabilities take these traits one step further. Figures like Stephen Hawking are famous not only for their ground-breaking research, but also as visible reminders of the presence of people with disabilities in STEM. Here are the stories of a few more scientists with disabilities.



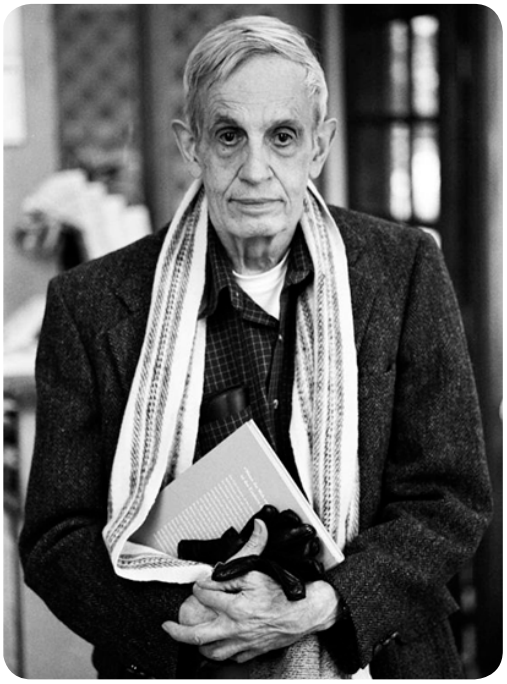
Wanda Diaz-Merced

Wanda Diaz-Merced was like most 10-year olds, with dreams of exploring planets and galaxies. Her love for astronomy eventually drove her to pursue a career in it at the International Astronomical Union's Office of Astronomy for Development in Cape Town, South Africa. However, at the age of 20, she lost her vision due to diabetes. What seemed like a permanent roadblock proved to be an opportunity for invention. Now, instead of using her sight to study data figures collected by telescopes, she uses computer programs to convert the numbers into audible sounds with different frequencies and intensities. Her team created *xSonify*, a Java-based software that changes two-dimensional numeric data into sounds. She believes this enables her to detect subtle differences in data that are key to making new discoveries. "You see better when you use sound," she says.

Caroline M. Solomon

Caroline M. Solomon's resume sounds stellar: a competitive swimmer in high-school, graduate of Harvard University, with a master's degree and a PhD in biological oceanography. She is passionate about conserving natural water bodies, and studies anthropogenic water pollution. Solomon also happens to be deaf. When she had enrolled at Harvard, there were no sign language interpreters on staff, which made it difficult for her to understand her instructors. She now advocates for greater inclusion of deaf people in STEM. Solomon co-created a database of scientific and technological terms in American Sign Language. She is currently a professor at Gallaudet University, a university for deaf and hard-of-hearing students. While normal educators rely on auditory teaching aids such as lectures and videos, Solomon focuses on ensuring her instruction is visual, owing to the special needs of her students. She also hosts workshops and seminars which aim to make STEM more accessible to deaf people.

If you are interested in mathematics, John Forbes Nash Jr is no stranger to you. Nash is the only person in the world to have received a Nobel Prize in Economics (1994) and the Abel Prize (2015). He is best remembered for his contributions to game theory and mathematics. He defined the Nash Equilibrium, the Nash embedding theorem, and did work in the field of non-linear partial differential equations. In 1959, Nash was diagnosed with paranoid schizophrenia and spent the next decade in and out of hospitals for treatment. His condition gradually improved, and he went on to lead a quiet life working in the math department at Princeton. His biography titled *A Beautiful Mind* was also made into an Oscar-winning film. In a lecture he delivered in 2007, he likened his mental illness to his mind 'being on a strike', where it did not function properly. However, this did not rule out the possibility of him going back to being normal someday in the future, and was hopeful about the same.



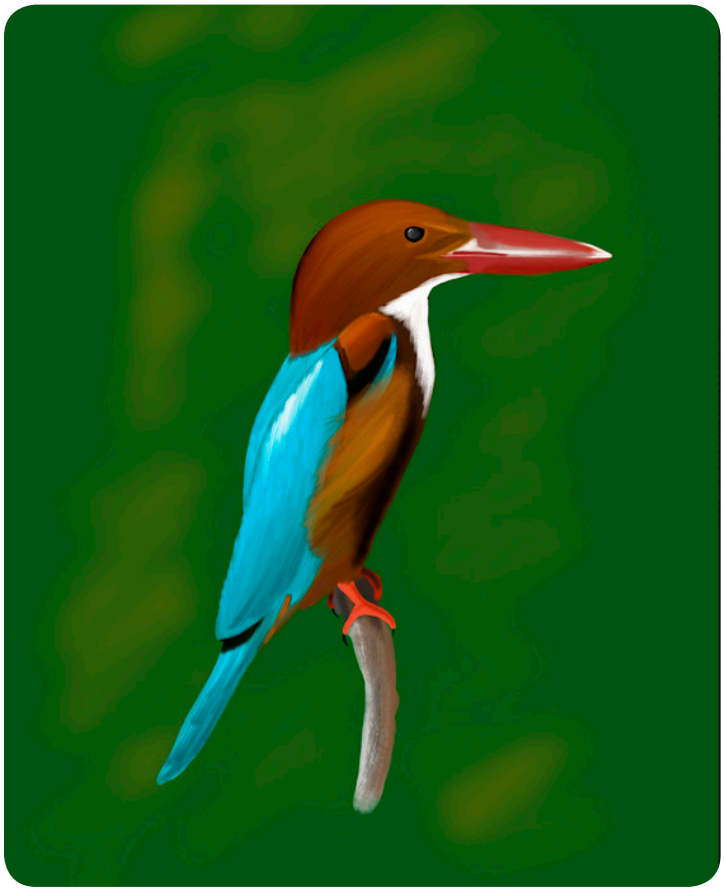
John Forbes Nash Jr

While these stories are enlightening and inspiring, they also highlight the failure of research institutions, and society at large, to accommodate the needs of differently abled people. Regardless of a person's ability, they have the right to dignity, respect, and protection from discrimination.

—Ira Zibbu B '19

ESI Species of the Month: The White-Throated Kingfisher

July-August is when kingfishers are most active, constantly hunting for food, and what better opportunity to introduce the most common of all kingfishers of India? Interestingly, the White-throated Kingfisher (WTKF) belongs to the genus *Halcyon*, which, according to Greek legend, is a mythical bird that ushers in peaceful days! [2]



Description

It is a large kingfisher, with an ordinary dull brown body, but with a refreshing dash of blue across its back and wings [1]. Its heavy orange bill may seem like a setback, but it is excellent to hunt and to excavate nests. Its most characteristic feature is its pure white throat and breast that gives the bird its name [1].

Food

You'd think it feeds exclusively on fish, but don't let the name fool you. This 'kingfisher' feeds on small reptiles, amphibians, crabs, insects and small rodents. Shockingly, there have been reports of WTKFs hunting small birds such as chicks of a red-wattled lapwing, sparrows and munias and the Indian white-eye [5, 6, 7]. Oh, and they also *occasionally* hunt fish.

Habitat

Do you think that the only way you'll see these guys is if you visit a lake? Nope. Again, the name is a misnomer as these birds can often be found well away from water. Doesn't matter if you're near a lake, in a forest, helping out in an agricultural field, in your secluded bungalow, or in your urban apartment balcony, you always have a chance of spotting this bird [1]. Being able to adapt very easily, they are spread throughout India and can be found in almost all habitats.

Behaviour

White-throated Kingfishers are extremely vocal birds. The downside of them being so widespread is that in all parts of the country, you invariably tend to wake up very early in the morning because of their loud, defiant and rattling laugh-like calls [3]. Brilliant flashes of white can be seen on their wings as they flap and rapidly flit across your vision, hunting anything they lay eyes on. If you observe them for long enough, you can spot a most peculiar behaviour: many kingfishers perform. While perched on a comfortable spot, they bob their head up and down in quite a comical way, as if dancing away to some rhythm unheard by the observer.

Breeding

These birds are monogamous, meaning each season, each pair male and female have eyes for nobody else. They raise their young together. The female lays 4-7 eggs in a tunnel-like nest on earthen banks [11]. After 18-22 days of warmth and safety, the eggs hatch. Then it is a hectic 19-20 days for the parents as they desperately try to feed their ever-hungry chicks till they fledge, i.e., develop feathers strong enough to fly [5, 8, 9]. Fun fact: kingfisher nests are extremely smelly as the bird poop, moulted feathers and remains of food are all stashed inside the nest and not thrown out. This helps hide most signs of a nest from predators.

Social Relevance

If you spot a White-throated Kingfisher, they answer to *kilkila* in Hindi. A Punjabi WTKF goes by the name *wadda machhera* while its Bengali cousin calls itself *sandabuk machhranga*. The Assamese kingfisher will acknowledge you only if you call it *māsorokā*. If your mother-tongue is Gujarati, tell your friends you've spotted a *safedchati kalkaliyo*. Your Marathi relatives probably know what a *khandyaa* is while the Tamil WTKF is a *vichuli*. In the richly biodiverse state of Karnataka, this elegant bird has an equally elegant name, *rajamatsi*. Down at the southernmost end of India, the bird-watchers call this bird a *ponman* in Malayalam [4]. The state of West Bengal has the honour of having the WTKF as their state bird [10].

—Anumit Saralkar, B '17

Illustration by Nikitha Srinivas, B '17

The Song of the Last Kauaʻiʻōʻō

He sat on the highest branch,
Waiting for his lifelong match.
He sang the melodious duet alone,
She never came, leaving him on his own.
He sang his parts of the duet,
Leaving pauses where she was supposed to chime in.
He waited for her with hope.
He sang with love, he sang with desire;
But the stage is being closed with a black drape.
He is a part of the opera of Life,
Everyone singing in a symphony,
But among the blaring foreign trumpets,
His dying tune wasn't heeded.
Yet he waited for her with hope.
Little does he realise
That she is never going to come.
And doesn't even know that he's the last
So he kept singing for a better tomorrow.
Above a stream, on a lovely morning
He ceased his melody.
That was the last song of the last Kauaʻiʻōʻō.

The small black and yellow bird Kauaʻiʻōʻō (pronounced as *kaua-ee-oh-oh*) was native to the Kauaʻi island. It used to belong to the extinct genus of the ʻōʻōs. The bird was last sighted in 1985, and its call was recorded by David Boynton in 1987. It would be the last call of a male bird singing for a mate, a mate who would never come because he was the last one there was. Habitat destruction, along with the introduction of foreign species like domestic pigs and Polynesian rats, which ate the eggs of the birds, and mosquitoes, which caused avian malaria, drove this bird to extinction.

—Vidyarashmi Hanehalli, B '19

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We hope you enjoyed this month's edition of Exhibit: A!

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