

Science in India 2047 | Text Transcript | CIRCLE

This is a text transcript for the recorded event “Science in India 2047,” presented by the Canada India Research Centre for Learning and Engagement (CIRCLE) at the University of Guelph. The event was recorded on July 6, 2022 and was moderated by Julie Vale. The guest speakers were Gagandeep Kang, Sonam Wangchuk, and Jahnavi Phalkey.

Transcript:

Julie Vale:

From around the world, I'd like to start by saying (indiscernible) and hello. We, or I, am currently in the city of Guelph in Canada. This is the ancestral lands of the Anishinaabe, Attawandaron, and Haudenosaunee people. It's also the location of the Dish with One Spoon Wampum, which is an agreement between the Haudenosaunee, Anishinaabe and their allies to live peacefully in this region.

This region is covered by Treaty Three, which is between the Lakes Treaty, that was originally signed between the Crown and the Mississaugas of the Credit in 1792. We have people today who are attending from all over the world; some of the people who are attending are Indigenous to the lands on which they reside, and some are not. Some of these lands have treaties that govern them, and some do not. If you're not sure about whether you're indigenous to your land, or whether there's a treaty on your land, I encourage you to go do a little bit of research and learn about that some more. So, Miigwech, (indiscernible) and thank you for listening to my land acknowledgment.

My name is Dr. Julie Vale; my pronouns are she/her. I'm a faculty member in the School of Engineering at the University of Guelph, and I'm the associate director for undergraduate studies. I have a PhD in electrical engineering, with a focus on systems and control theory. My current research, though, is in engineering education, with recent projects involving how to instill deep ethical and justice values and engineering students to help move them towards values-based design thinking.

I'm the moderator for today's event. Today's event is hosted by CIRCLE, which was established in February 2020 at the University of Guelph. This is the Canada India Research Center for Learning and Engagement. It's an interdisciplinary nucleus in Canada for cutting-edge research on India and Indian diaspora to showcase, advocate, catalyze and foster an equitable, respectful, and sustained exchange of knowledge between Canadian and Indian Scholars on complex, emerging, and unexplored topics related to sustainability and socio-economic well-being.

If you'd like to learn more, the website is canadaindiaresearch.ca, no spaces. So, this is the last of the India 2047 series that's presented by CIRCLE. There are additional upcoming events, specifically the one that's coming soonest is the CIRCLE Graduate South Asia virtual conference, which is on the 29th of September to 1st of October. Abstract deadline is 20th of July. You can

check the CIRCLE website for details. Please encourage PhD students from all disciplines to participate in this conference.

“The theme of today's session is science in India. As a planet, we face enormous challenges in the next 25 years. Personally, I believe science, technology and engineering will be crucial in bringing us through these times, but a Western Traditionalist Colonial mindset will not serve the communities who will be most affected. So, we need to build relationships and mindful understanding with these communities to reach a broader understanding of the true problems and to develop culturally relevant solutions.

Our speakers today are at the forefront of this work and I'm so excited to hear their visions for the future. Each speaker will have fifteen minutes to speak, after which we'll have about twenty-five minutes available for questions and we aim to be finished in about ninety minutes. Just a brief comment on etiquette and logistics; most of us have been in a number of online meetings over the past few years so some of this may be old news to you, but please remain on mute and please keep your video turned off to help reduce bandwidth requirements.

At the end, when we're in the Q and A component, I'm going to ask you to type your questions or comments in the chat and then I can read that out to the speakers. If you need to clarify you can always use the raise hand tool and then we can invite you to unmute at that time. The chat is the easier way for us to manage the moderation at this point. I'll also note that the event is being recorded in the hopes that it (indiscernible) later.

Today we have three speakers with us; Dr. Gagandeep Kang is a professor at the Christian Medical College of Vellore. She has a rich background in the development and use of vaccines and regularly advises the WHO. She will be our first speaker. Sonam Wangchuk is a man after my own heart. He's an engineer and an innovator in education. He's the co-founder of the Students Educational and Cultural Movement of Ladakh and the Ladakh-based education reforms initiative. He'll be our second speaker. Our third speaker is Dr. Jahnavi Phalkey. She's a filmmaker and historian of science and technology. She's the founding director of the Science Gallery of Bengaluru, where she seeks to bring science to the people via five accessible laboratories. And at this point I'm going to hand it over to the speakers. Dr. Gagandeep Kang.

Gagandeep Kang:

Thank you very much Julie for the introduction. I think I'm going to be the only speaker using slides today so do let me know if you can see the slides and if they are full stream.

Okay great, thank you. I'm going to be talking about skepticism and adventure, what it takes to build scientific temper in India. I'll draw from what's happening in the world today and some of my own work.

On-screen Content:

Two maps of the world compare official death rates from COVID-19 per country and estimated excess deaths per country.

Gagandeep Kang:

These are data from The Economist; they have published quite extensively, and these data have been discussed quite a lot. According to The Economist, they have estimated that 26 million people have died during the pandemic. If we look at official global COVID deaths, that figure is only 6.3 million. If we look at the two maps that are placed there, the maps compare The Economist's estimates, with the official data from 2020 to about May. What you can see very clearly there, is that there seems to be a problem with the data in many countries.

Canada seems to be about the only one that's overestimating that, according to The Economist. Practically every other country, Canada, Mongolia being exceptions, every other country seems to have underestimated the deaths that they have seen.

On-screen Content:

A table compares the official case numbers of COVID-19, official deaths from COVID-19, population, and June 2021 seropositivity of the most populous states in India.

Gagandeep Kang:

If we move now to India, which clearly had an underestimate and has protested in the global community about the estimates that have been made by The Economist, the estimates that have been made by WHO, and we start to look at data.

What I'd like you to do is do a few comparisons of the figures that are shown in red. Let's just take two states, the one on top, Maharashtra, and the one in the middle Uttar Pradesh. The total population of Uttar Pradesh is about 231 million, Maharashtra is a little more than half that at 125 million. Now Maharashtra has reported about 8 million cases, and almost 150,000 deaths. Uttar Pradesh, double the population, has reported about 2 million cases and about a sixth of the deaths that Maharashtra has had, so a quarter of the cases and one sixth of the deaths.

Now this could be true that Uttar Pradesh has really good healthcare services, really good monitoring. It was able to prevent infections therefore cases were fewer, and deaths were fewer. However, if we look at serology data, seropositivity is shown in the last column there and this is the sero-survey done in June of 2021 by the government, looking at the population-level seropositivity, you see that actually in Uttar Pradesh: 70 percent. This is the time when vaccination was not widespread. You can see that 71 percent of the population has been infected, as opposed to 58 percent in Maharashtra.

To anybody who looks at these data, there are more questions than answers here because this absolutely cannot happen, and yet the government tells us that official estimates are for a total of 450,000 deaths. If we have figures like this, what do we know? How do we decide what to rely on?

One of the things that has been happening quite a lot during the COVID pandemic is this fire hose of information; everybody is throwing stuff at you, and you don't know what to believe.

What's real? What's not real? This is true not just for scientists, it's true for the general population as well. This can be quite complicated when you have authoritarian voices like the government whom you should trust, telling you what the real data are and then it doesn't quite gel with all the figures that you see.

We also have very authoritative voices from the medical community that speak to messaging that complies with, or is aligned with, the government. Yet, as somebody who's dealt with infectious diseases for the past 35 years, that has studied disease in the community, I can't make two and two add up and to me that really is a problem.

On-screen Content:

Education in India, 2019-2020:

- India's literacy rate is 74% (82% for males, 65.5% for females).
- Global literacy rates are 90% for males and 83% for females.
- School dropout rates in India are 1.5% at the primary level and 16% at the secondary level. Most students dropping out of school in India are girls.
- The government runs 68.5% of the country's 1.5 million schools.
- There are 9.68 million teachers in India.

Gagandeep Kang:

Now if we look at education in India, we have advanced quite a lot in the last 75 years, and we will continue to advance. Our literacy rate is 74 percent, and we see a lot of dropouts only at the secondary school level, and that's mainly with girls. One of the things that is important for us to remember is that while most of us who speak in English, live in cities. A lot of the rural population is educated in many of the primary languages that India has. The bulk of the education happens in government schools. The government actually runs more than two-thirds of the educational institutions that we have at school level.

Now during the last few years, there have been a number of efforts by a number of people to change how education is delivered, but they continue to be lacking. We've just had in the last month the National Achievement Survey data released that show in some fields, particularly science and math, a 58 percent drop in attainment in many places. There's also some unbelievable data in there, but I'm skeptical about a lot of data.

On-screen Content:

Core critical thinking skills:

- Interpretation
 - Categorizing
 - Decoding significance
 - Clarifying meaning
- Analysis
 - Examining ideas
 - Detecting arguments

- Analyzing arguments
- Inference
 - Querying evidence
 - Conjecturing alternative
 - Drawing conclusions
- Evaluation
 - Assessing claims
 - Assessing arguments
- Explanation
 - Stating results
 - Justifying procedures
 - Presenting arguments
- Self-regulation
 - Self-examination
 - Self-correction

Gagandeep Kang:

Indian education is a problem, and there is a lot we need to do from the primary school level and I'm looking forward to hearing Sonam talk about his work. We also have not just a problem with the educational system, but with society. We really value hierarchy and deference; to ask questions is not viewed very kindly in every setting that we have. In that situation, how do you really build more critical thinking skills? Which is what you need for the skepticism to which I refer.

That needs to be balanced with the fact that, in India, getting into engineering and medicine is aspirational. Everybody wants to be in an Indian Institute of Technology, or a medical school, so we do the best we can to get in there. Coaching classes start as soon as you finish primary school, but the teaching that we have relies very heavily on rote learning and our assessments rely on regurgitation of facts.

We have very intense competition, and that leaves very little time for reflection and for critical thinking. We recognize that when your results are how many of your students got into IIT or medicine, teachers tend to focus on students that are likely to do well. So how do we build scientific temper? Well, we are very unusual in being a country where our Constitution states that “it shall be the duty of every citizen of India to develop the scientific temper, humanism, and spirit of inquiry and reform.”

On-screen Content:

Government of India in 1958 in its Scientific Policy Resolution (SPR) stated “The dominating feature of the contemporary world is the intense cultivation of science on a large scale, and its application to meet a country’s requirements.”

Gagandeep Kang:

It's actually written in two fundamental duties. We are in that sense an unusual country. We were led by a prime minister who said that we needed adventure and we needed the critical temper of science, the refusal to accept anything without testing and trial. These are principles that we really need to live by as professionals and as members of society.

On-screen Content:

Quote from Jawaharlal Nehru:

"The scientific temper points out the way along which man should travel. It is the temper of a free man. We live in a scientific age, so we are told, but there is little evidence of this temper in the people anywhere or even their leaders. [What is needed] is the scientific approach, the adventurous and yet critical temper of science, the search for truth and new knowledge, the refusal to accept anything without testing and trial, the capacity to change previous conclusions in the face of new evidence, the reliance on observed fact and not on pre-conceived theory, the hard discipline of the mind—all this is necessary, not merely for the application of science but for life itself and the solution of its many problems."

Gagandeep Kang:

Nonetheless, in the last 30 months, we've had a lot of treatments that have been recommended in allopathic medicine, as well as in traditional systems of medicine in India. I think traditional medicine is a completely unexplored area; a lot needs to be done. In what happened in the last 30 months, where was the integrity of the data? Where was the refusal to accept anything without testing or trial? We were told by our Ministries to use these products, and yet the trials that were done were pre-clinical studies, or even in vitro studies, that had been done in laboratories.

Nonetheless, even though we have a lot of authoritarian voices, we also privileged in having people's science movements that have tried to communicate in a variety of different languages since the 1960s. I think, in addition to people thinking about science, journalists communicating science, sharing the adventure and the excitement is, or should be, part of a scientist's responsibility.

On-screen Content:

The Opportunities (and the Challenges) in India Abound:

- identification of needs in public health research
- partners who provided appropriate training
- targeted and monitored mentoring
- commitment to communities and quality
- building multi-disciplinary research groups of young faculty
- working in partnership with the government and like-minded institutions across disciplines
- finding enough credible institutions and trained investigators
- making protected time for research available
- treating research and primarily clinical staff equitably
- finding employment ready technical and support staff

Gagandeep Kang:

Towards that, I think it's important to recognize that we have opportunities and challenges in India, particularly in public health. I'd just like to leave you with some of the work that we've been doing on vaccines.

On-screen Content:

Diagrams show findings from a study on the effectiveness of the rotavirus vaccine in young children.

Gagandeep Kang:

I'm not going to describe the making of the vaccine, though that was an adventure in itself, because it was the first phase of three clinical trials that had been done in India for a product that was made in India by Indians for India and is now available to the world. But we had questions even while we were working on the vaccine. Would it work? How well would it work? What would it mean if children were malnourished? Would they be protected from the vaccine or not? Therefore, we not only developed the vaccine, we are doing the end-to-end studies that show us what the vaccine does in the real world. It shows us what while it does well in children who are well nourished, in children who have chronic malnutrition, we might need to think about other interventions as well.

I've been around for a really long time and the two things that I'd like to leave you with is: you don't do science alone, you do it as a team. Being in the right team, having the right mentors, is critically important. For a country like India, where opportunities abound, we really need to learn how to ask our own questions, to do the kind of high-quality research that needs to be done and we really can change policy in India.

We were able to bring the rotavirus vaccine in and we just have typhoid vaccine being approved for our program. I think there is no limit to the ambitions we can have. Knowing that you can

make a difference is tremendously exciting and getting to the point where you make that difference is the adventure. Thank you very much for your attention.

Sharada Srinivasan:

Julie, you need to unmute.

Julie Vale:

Sorry! You think I'd be better at this by now. I was trying to say thank you very much Dr. Kang, that was a very insightful talk. I certainly learned something in that. Now I'm going to turn it over to Sonam Wangchuk. Hi, welcome Sonam.

Sonam Wangchuk:

Yes, hi. I hope you can hear me and see me. I connect to you from perhaps one of the most remote parts of the planet. I'm in Ladakh on the Tibetan plateau in the northernmost steppe of India, across the Himalayas, where it's a mountain desert at 11,500 feet. Greetings from this part of the world and great to be discussing about science and the future of it in the next 25 years.

As far as the past 75 years are concerned, I'm happy with some progress in various fields of science and economy, but by and large I feel much more could have been done. I look up to the coming 25 years as a more important challenge for us to catch up and make up for the gaps that are still left because, while small pockets and groups have advanced a lot, vast majority of the country still needs a lot of work as far as scientific temper is concerned.

While we speak of COVID deaths, which is something we couldn't avoid and something that came by surprise, we should know that in India, every year as many people (mostly children) die of simple thing as diarrhea. Three to five hundred thousand children mainly die of diarrhea for the simple reason that we cannot keep our water clean, or that our mothers don't know the simplest signs, or knowhow of giving the babies a pinch of salt and sugar when they are dehydrated due to diarrhea, and that takes so many lives. As this widely discussed and widely covered phenomena like COVID.

We have a long way to go in terms of scientific temper among our population. While we are perhaps one of the most religious countries in the world, with all kinds of religions and rituals, we don't seem to be the most logical, nor the most ethical country. That's what I think a country that advances in sciences also advances in ethics, or should, and therefore I think there's a lot of work for the next 25 years when India will turn 100 years, to look up to and to catch up with our neighbors like China, Korea, Taiwan, which all started at a kind of similar status when we started 75 years ago, but a huge gap is emerging which is widening unless we do something extraordinary.

Now, even among the circles where much progress can be said to be happening (say in elite institutions, scientific institutions, technological institutions) I find it very saddening when I visit these IIT's and other institutes when I see our young people (who are supposed to be quite

innovative and enterprising) showing off when I visit. These Robo-fights, you know making robots fight, and racing drones and such, and I find it very sad and peculiar because that's not the biggest problem that India is facing.

You know, to race our robots and make our drones get into dog fights in air. This could be a luxury, or an extravagance that some countries in the West can afford. They shouldn't be, even then, there's so much happening or not happening in the world, we should be more focusing on those. A country like India could at least afford to aid what the decadent West seems to be doing now with their science and technology.

A country like India, or institutes here, should perhaps be taking pride in how they put to use simple principles like evaporative cooling for families in rural India (to keep the baby's milk from being spoiled for a few weeks longer than they can keep now) or simple passive solar heating in the mountains (where elderly people actually count their lives in Winters, "I may last a winter, or two Winters, or three") because they are such a disaster that hits them every year regularly.

If we don't apply our great advancements in science and technology and the education of these to solve real-life problems that our people are actually facing, then we wouldn't be doing much racing drones. Even in the world, I find it sad that we are going scientific in the clever ways, rather than the wiser ways, so I've always made this distinction between cleverness and wisdom.

Cleverness is about making things, new things, impressive things, with our monkey minds and we are seemingly gung-ho about these green horses and blue sheep and what not having trashed the planet Earth we talk of moving on to trash the planet Mars, or Moon. That really doesn't impress me if we imitate them, or even those who are doing it. We, in India (I hope) in the coming decades make signs everybody's business and a part of life of every citizen down to the poorest, in the remotest parts of the country, to be applied in their everyday life, something that can save lives as I said. If every mother knew how to handle her child in times of diarrhea, that would be a much bigger achievement than sending a satellite or a rocket to Mars.

When you're not able to handle your children, you can't be bragging about sending a rocket to Mars. Therefore, I feel that especially about education in science and thereafter entrepreneurship and innovation, it has to be to solve real life problems of the people.

What we have been trying here in the mountains of Ladakh is an interesting experiment in education. We took a bunch of students who were rejected by the system, who had failed and who no schools were ready to take, and we created a school that was meant for them.

It's known as a school where the admission criteria is failure, rather than the marks and grades you achieve. When you do their education, especially in science innovation and entrepreneurship in a way that works with teenagers in a hands-on, applied, creative way, they not only make their world better, but also solve problems of others with simple things.

Like the chapter on heat in say ninth grade, which is all about conduction, convection, radiation. Normally, most students memorize at the time of examination and then forget about it. When you apply these in a place that has minus 30 degrees in Winters and build buildings that, through conduction, captures the sun's rays and, through convection, makes the warm air move from the southern wall where the sun hits throughout the winter, (which is in fact an application of geography) which teaches us that the sun in the northern hemisphere stays in the southern sky in Winters.

Now, if you'd rather than memorizing them, apply them into your life and orient your buildings to the South where the Winter Sun stays, and then build walls that capture the Heat, and we remember from our Primary School signs that black absorbs heat. So if you paint the walls black, the students do at our school have done, paint the South Walls Black and put them behind glass which is selective in how it lets in radiation. It lets the visible rays in, but it is opaque to the long wave rays, so it becomes like a valve where the sun's energy can come but the heat cannot escape. With the wall, through conduction, the heat goes into the room and, with convection, the air moves and at night when you close all these windows and doors the walls that warmed up during the day start radiating the heat indoors and what you get is amazing.

In this minus 30 region, you get plus 18 to 20 rooms that are comfortable for children as well as elderly, who count their lives in Winters without a drop of oil being burnt. I normally call it beyond modern because modern is, like in Canada you would have plus 22 that's modern, but to get that you would burn all the fossil fuels and make the planet a mess. That's not a solution; you're solving one problem and creating another.

When you do the same with just sun's energy, like your own private nuclear fusion reactor up there and you don't need to pollute nor emit and live happily ever after, well that's beyond sustainable, beyond modern because it is more than just sustaining. Sustaining would be to burn the trees that you grew and keep yourself warm; you're sustainable because you grew the trees and you're burning them.

You have the animals and their dung you would burn so our ancestral system was very sustainable but we say that today with science we can make it restorative and regenerative, which is beyond sustainable because when you use the sun to heat the house, the cow dung and the biomass from wood and other things can go back to nature and become a nourishing manure to make flowers bloom and nature's richer. That is restorative. So, likewise, this is just an example that we try to do if we had a system where everything in the books is applied.

Then people's real-world problems are solved. Some of these students, like at our school, are trained to become entrepreneurs with these understandings and know-hows, and they become then entrepreneur builders who take this technology to government, to tourism infrastructure, to local people and to the Indian army, for example.

The Indian army, which has to keep soldiers at minus 30 borders, are now using nothing but sun to keep themselves warm, thereby cutting all the emission and pollution and making nature smile. At the same time, checking the expenses that are normally drained to the Middle East for oil. So with no oil burned, they can keep their soldiers warm.

Similarly, when it is shortage of water, simple application of middle school signs that water maintains its level all that is used is this principle, no generators, no pumps, no moving parts. You just put a pipe upstream in the mountains, which have a gradual slope always, and you bring the pipe downstream. Water wants to maintain its level and there is pressure in the pipe. Using that, you spray the water into the minus 20 winter air and instantly the water freezes and makes a huge cone of ice that can, because of its geometry, a cone has low surface area and high volume, so this cone of ice doesn't melt when all the ice and snow is gone; it lasts till springtime when farmers need the water the most.

With just simple application of this scientific principle, you can make what can be called artificial glaciers (or baby glaciers) to counter the fast-melting glaciers thanks to climate change. We can only try and arrest it or adapt to it with such technologies that is possible thanks to the science in our curriculum. If it is left in the textbooks and just administered in things to memorize, then it doesn't affect anybody except in with some marks in exams.

When applied, it becomes a life-changing experience, and it becomes actually a livelihood for the students. Those who make artificial glaciers, or who build solar heated buildings, can have a lucrative career that they can not only live off, but can proudly say that they have solved people's problems.

Therefore, education and entrepreneurship and innovation in the next 25 years I very much hope will be for what you say, (indiscernible) for the people's problems and for their happiness or the masses rather than just for some examination ritual that you may clear for your career and your certificates and so on. This is how I think education needs to be administered, not only in India but around the world so that it's not just heard wisdom.

In Buddhism, in the Indian tradition, you say wisdom is of three times (indiscernible). Heard wisdom which is what happens in most of our schools; just heard lectures that go in and not much further. What is more important is (indiscernible) or reflective wisdom, which is reflective, which is critical thinking, which is analytical thinking, which is what most of the Western world today talks about.

What we in India knew for thousands of years is the third level, which is (indiscernible) or experienced wisdom. Now that's when you completely absorb the understanding and the wisdom, so experiential learning and application is not something new that comes from London or New York, but rather something we have known for thousands of years. This, when applied, could be transformative not only for India but for the world. This could be something that India can contribute by the time it turns a hundred. Thank you very much.

Julie Vale:

Thank you so much Sonam. I was itching to take some notes while you were talking because many of the things that you were describing are things that I would very much like to implement in my own classes. We're now turning to our final speaker Dr. Jahnavi Phalkey. Oh, I hope I said that right, oh good all right. I'll turn it over to you, thank you.

Jahnavi Phalkey:

Thank you very much. It's a tough act to follow when you're speaking after the person who made India's first rotavirus vaccine and then Sonam, who's incredibly well known through the world for his fabulous experiments in education, but I'll do my best.

When Sharada first asked me to join this panel, you know the title suggested was 2047. I went and I looked and the first thing I found was this; it's a book of science fiction by Ian McDonald called River of Gods, which speaks about what happens in India in 2047 written as science fiction.

Where the key characters are AI's (spelled as A-E-A-I-S) and a range of things happen. I'll not give any spoilers, but that was the first thing I did and then I was reminded of another book written in fact in 1923 by a young Rahul Sankrityayan, who is India's most renowned travel writer, and, in fact, I think Sonam would have probably also seen some of his work, you know, that he carried out also in the Tibetan lands and the Tibetan Delta.

His book was called Baaisveen Sadi, written in Hindi in 1923, when he was in the Hazaribagh prison, put in for sedition. What he did while he was in prison was he translated seven science fiction books and then wrote one of his own, which was a sort of a technology inspired utopia where in India, in the 22nd century, is living a blissful life where you know there are no gender inequalities, no caste inequalities, no class inequalities and technology has made life beautiful.

Those were sort of my starting points and then, you know, you realize as you go forward that you know not everyone wants to participate in the same utopia as ideal and as wonderful as it might be. One such utopia about—around science was articulated in the United Nations, the Universal Declaration of Human Rights, Article 27-1, which says that everyone has the right to freely participate in the cultural life of the community, to enjoy the arts, and to share in scientific advancement and its benefits.

Now, as noble as that starting point is, we can now argue with sufficient confidence that that is not enough. Why is that not enough? Can science actually deliver the advancements and the benefits that it promises? I think it would be a good idea to explore, but let me start with India today in order to talk about what might actually valuably, or meaningfully, explode in the next 25 years to reach some of the utopias that some of us might want to participate in.

I'd like to say, when I started work on the establishment of the Science Gallery of Bengaluru, I was an academic. Prior to that, I was a historian of science participating in academia. I was teaching, doing research, supervision, the usual stuff. Then when I took on this role of creating

a public institution for research-based engagement, bridging essentially the divide between the public and research, there were many questions that I had to answer for myself to begin. Why is there a gap? Why is it good to bridge that gap? What might actually come out of it?

I think the first year and a half was spent thinking around drawing on my own understanding of 20th century history of science in India, but also my experiences of having conducted that kind of field work in Premier science institutions like the ones that Gagandeep spoke about early on, the most aspired to institutions.

What I think I can say with reasonable confidence now is that I think that that we have a strong professional conversation around science in India, we do not have a cultural conversation around science in India. What do I mean by that? Most of our discussions with each other about science and engineering concern ranking, admissions, examinations, competition as Gagandeep indicated, and Sonam also indicated. These are the realms in which we discuss science and engineering; how to get into which school, how to aspire to a career, how to gain that kind of upward social mobility and mind you this is not a critique of that desire of that aspiration or that need for upward social Mobility, but an observation about what that does to the understanding and the place and space of science in Indian Society.

Rarely will you find, apart from of course some families, (this not to say that one speaks at the level of generalizations), but rarely will one find a social conversation or a dining table conversation where you're actually talking about 'so what's your project? why are you doing it? what drives you?' That's the kind of conversation that's not happening between a physicist and a historian, between an engineer and a sociologist, between a biotechnologist and an artist, and those conversations are required.

Why are they required? They're required because today's major challenges that we confront collectively, not only in India, but globally are climate change, new biotechnologies (including gene technologies), pandemics, but equally challenges such as the one that we faced when we came to understand the role that social media and companies like Cambridge Analytica played in shaping electoral behavior. So how can we today, as scholars of...well not just scholars but students of the humanities, of the social sciences, and the sciences not talk to each other in order to understand the society we occupy, the lives we lead and the direction in which we are traveling.

If you can no longer take our understanding of electoral behavior for granted, if you can no longer communicate with each other with the medium that is available to you without actually understanding the full implications of what it means to voice opinions publicly and the implications it might have later, without understanding the links between our behavior of consumption and what relationship it has historically and in the future two ideas like climate change (not ideas sorry the reality of climate change) the arrival of Crispr and what that might mean for you know the future of humanity, etc.

I think in many ways we can no longer afford the luxury of not having a cultural conversation around science and how it affects our everyday life. We need to understand this in conversation with each other and I think the lack of that conversation is not only making us poorer citizens, but also, in many ways, we are compromising the possibilities and opportunities of our own lives.

Now, if we think of what is it that the state, in many ways what is the relationship of science and technology to the state and in many ways what states do is promote, regulate and, in a way, shape scientific research, the conduct of engineering, the production of technology. So, it regulates that space, it occupies that space, it patronizes that space. State policies are often embedded with an understanding of a linearity which follow, which comes as follows: you invest in science, it leads to good tech, which leads to Innovation, which leads to economic growth.

That is the model on which an understanding of where money should be invested or where funding should be granted is often located, however, as historians of science and technology have shown us time and again, this actually does not work that way. So that is the first reason why we need to understand this aspect of the state's relationship to science and technology, in order to shape it in such that our own lives in the future will be affected (or not affected) in a manner in which we choose.

The second, of course, in the face of climate change and the kind of challenges that we face today, how much economic growth do we even want? How much of technology-led economic growth is even required? That is a question that we need to be asking collectively. State policy towards science engineering and the production of technology as enterprises will have to reflect the changing nature of our reality and the age of the Anthropocene in which we find ourselves now.

In many ways, what I'm trying to say is that what the two major things, the two major processes that need to come into conversation with each other is the development of a cultural conversation around science, definitely in India, also elsewhere, but most certainly in India given the hierarchies of education. Where science and engineering education is valued over education and humanities and social sciences, which are simply not valued, that conversation needs to happen in order to inform the state to make better policies in the future or for the future.

We need to arrive at concerns where various kinds of consensus on what are the questions worth asking? Sonam has already hinted at us at one way of asking those questions and Gagandeep indicated that in our last slide, where she said what are our own questions? Ask your own questions, so what are those questions that are worth asking? What are problems worth solving? What products worth making? What are the kind of lives worth living?

This kind of a social and political agreement needs to be arrived at and that is why science policy and culture, and cultural understanding of science, cannot, in a way, be conducted any

longer separately or in separate boxes. We couldn't have afforded it earlier, but now we can't even afford it you know even more.

The state, in many ways, is a guarantor of rights and I spoke about the universal right to science. As at the beginning of this brief talk, the state is a guarantor of rights but it's also a logger at the same time of obligations. Within its fear of action, then, what we need to see in India and you know in order for 2047 to be meaningful, and remember I'm a historian of science by training, so you know the 'ought to' comes more easy to me than that this will be the case, so prediction is not my best quality, but I can certainly share with you informed ideas of what I think, given the circumstances, a better future might look like and what exactly the constituents of that better future are is something we need to collectively decide.

Avenues and funding for interactions across the human, natural, and social sciences, reformed science curricula as Gagandeep also again spoke about already, global rankings and other recognitions will follow but curricula needs to be reformed. Better regulation and public understanding of emerging science and technologies, platforms for public discussions and engagement with science which will lead to an informed public debate on science which will be at the root of any such information.

This is not simply a question of drop down or bottom up because things simply don't function that way. This is a dialogue, and this dialogue will have to happen in a way with equal authority. That authority, ideally in democratic societies, can be cultivated over time with unevenness and imbalances as we've seen in history and we'll see them in the future.

My work at the Science Gallery of Bengaluru is one such effort to create a public institution where people from across the human, social and natural sciences (and art) can come together, discuss with each other and share with the public why their research might actually matter. For the public to make up their mind about why is this worth knowing and, therefore, what kind of extrapolating of course in a caricature way right now, but what kind of lives therefore in the future might be worth leading. Thank you very much for the opportunity to share a few thoughts with you this evening and over to you Julie.

Julie Vale:

Wow, thank you so much all of our speakers for such engaging ideas and inspirational visions. I'm feeling a little overwhelmed right now honestly with all of these ideas that you've all presented to us. I will just briefly say that I think we've lost Sonam; I think maybe his internet dropped, I'm not quite sure. Gagandeep I'm going to invite you to turn your video back on and I'll do my best to direct questions to the two of you until we can get Sonam back.

As I said at the beginning of the session, we're now going to have about 25 to 30 minutes of questions. If you have a question, the easiest way is to just type it into the chat and then I'll read it off and direct it appropriately to the relevant speaker. If you have a question for all speakers, that's totally okay as well. We can do a bit of a round table if that comes up. So, there

are a couple of questions in the chat already so I'm going to just start from the top and away we go. The first question is for you Dr. Kang. Where do you see India in 2047?

Gagandeep Kang:

I really was hoping nobody was going to ask me that even though that is the title of this discussion. The reason for that is that we are a society that is changing a lot and in the ways that it is changing it's very difficult to predict where our current trajectory will land 25 years from now. When it comes to science itself, it worries me that we have a lot of focus on what isn't really evidence-based, being just because it is viewed as a cultural construct that we must have pride in our heritage and therefore we must have achieved glory at some point in the past.

No matter whether that is actually backed by fact or not and that actually leads to a discounting of the value of the slow process of discovery. The rapid insights, the Eureka moments, actually come after a lot of effort, and when you're looking for instant solutions, you don't do the science and that to me is a problem. If we continue as we are doing, 2047 doesn't look very good.

However, the other good thing about India is the heterogeneity and the fact that there are enough people that are willing to do the arguing, do the fighting, do the persisting until we hopefully make a difference wherever we are. So, we'll keep trying, but no guarantees for 2047.

Julie Vale:

Thank you very much. All right the next question in the chat, this is a very interesting one, a very challenging question, I think. How can we compare the ethical value of a country to that of others? There's a follow-up asking if there is some kind of a ranking to see where India versus other countries stand, with respect to each other. I think what I'm going to ask is that each of you speak to the first part of the question—first how can we compare the ethical value of one country to others? I'm going to ask Dr. Jahnvi Phalkey to speak first as Gagandeep as already spoken.

Jahnvi Phalkey:

It's a difficult question because historically, I mean, what do we even mean by ethics right? Like how are you going to create any kind of commensurate ways of comparing the ethics in a country to another, right? I think in the first instance we would need some kind of an agreement and I don't see the, I mean it would be scary to say yes, we should have a universal idea of what ethics are, but at the same time you know it is equally scary to say you know maybe they should vary from place to place.

For good reasons, I'm not sure that there is a single answer to that. I mean I'm glad that we universally now kind of agree that, you know, murder is bad, and you know violence is generally bad and you know hurting people is not a good thing etc. (Indiscernible) comparing ethical to what purpose, right? Why would you want to do that?

Would you want to establish a righteous, one righteous republic over another? For example, why would you want to do this? Because I think in many ways what you would extricate as comparable points would derive from why you want to compare countries on this platform at all so I mean I'm not entirely sure of the value of it.

Gagandeep Kang:

Can I challenge you on that one, please? Let me argue that the human development index, and the global corruption index are actually measures of ethics of societies in very different countries. Okay so if you were to say you have X amount of resources and this is the best you can do with them, can there actually be a scoring system that says where did you land in the use of the resources that you had available to you?

You know, you look at the Gini index for example right, so were you able to reduce the disparity between the richest and the poorest in your country? Do your businesses function without paying rights? Are you actually on the way to developing your population? Are you offering primary education? Are you offering free health care? To me, that is in some senses an ethical society. You wind up ranking the Scandinavians as the best in the world.

Jahnavi Phalkey:

Yeah, I completely agree with you, and I take it back.

Julie Vale:

I'm fascinated by this conversation because one of the things that I look at in my research is ethics and social justice in the context of engineering, and so there's definitely a push and pull on exactly the things that both of you have spoken about and this is absolutely fascinating. Thank you very much for the insight. Okay, so the next question is for Dr Kang. What is the role of Public Health experts to improve scientific use of policy matters?

Gagandeep Kang:

Well I can tell you what the role is; it's the role that they have everywhere in the world but sometimes you wind up in a situation where proponents of Public Health, proponents of evidence-based Public Health policy and decision making have to actually wind up beating their head against brick walls for a really long time to make anything change.

You can look at it from a bureaucrat's point of view; the safer option is to do nothing because if you do nothing, what was there yesterday is there today, not much has changed and you can't be blamed for that. If disasters happen, then you wait for instructions and you follow the rules.

Now, if you really want to make a change in a big way and you want to make a change that needs to be done urgently then that requires that you behave in a very different fashion, and as people who work in public health it is our responsibility to keep advising governments both Central and local but also providing them with the tools they need to strengthen their hands to act when they have to act because they need something to go by to make that change. In the

absence of our generating data, or their generating data, change is just not going to happen. Thank you.

Julie Vale:

Okay, wow. So many things that we're talking about, and the chat is going wild with different comments back and forth, so I'm trying to read through it and make decisions on where to go next. There's been some interesting additional commentary around the ethical framework, content but I think I'll leave that discussion more to what's going on in the chat right now. There's a general question for the whole panel.

I think we still don't have Sonam back yet, so I think we're still with the two of you. Would efforts mean towards open science, open management, and such allow for growing an environment of conversation between actors from within and across fields? In my mind, it does, however, I'm a research aspirant. I would love to know how scholars with experience look at it and its potential. So Dr. Jahnvi Phalkey go ahead.

Jahnvi Phalkey:

Efforts made to its open signs, open management allow for an environment of conversation between actors from within and across fields. How do we look at its potential? I think, like you know, like I was saying earlier, I think that we have to talk about interdisciplinarity. We talk about people coming together, identifying problems but there are two things that I would like to flag here.

When we say so yes, I mean the fundamental answers yes, the two things that I would flag here is one, we are seeing increasingly a move towards problem solving as an almost substitute for knowledge making and I think that is something we need to be alert to. That doesn't mean problems don't need to be solved and when you're identifying a question or a problem, one needs to be aware of that when one chooses to walk down a path, and one need not valorize one over the other but recognize the value of both but not look at them as one and the same thing necessarily.

Now of course, while solving problems, one might actually contribute to fundamental knowledge and likewise the other way around. Someone is alert to that, and one understands that it is a practical boundary one is drawing, but at the same time one needs to be aware of these distinctions. The second thing that I would like to say is also interdisciplinarity needn't stop between the natural sciences and engineering. It needs to extend to the human and social sciences, and I think those conversations need to happen not as sort of you know they understand society and we understand solutions, but actually we need to talk in order to ask the right question. What is that question worth asking is something that needs to be arrived at in conversation and I think that that would be those would be the two things I would say too.

Julie Vale:

Wonderful. My own interpretation of that is that we need to understand how to figure out what the problem is that needs to be solved and then also to be able to reflect back and look to

see whether or not the solution that we've proposed is actually good. Not just from a technical perspective but also from anyone. Awesome, thank you very much.

Gagandeep Kang:

Science can give you understanding. Understanding technology can give you tools but until you use them you haven't solved the problem and the use of the science or the technologies is not generally done by scientists and technologists. The implementation of these requires stakeholders that come with outside our narrow disciplines. What seems to happen quite often is that you know there is a lot of focus on innovation and developing new things; the problem is do you need them? and do you need them here or somewhere else?

As Sonam was pointing out in his conversation, it was really about identifying the problem and then figure out not just a problem that needed to be solved but a problem that needed to be solved considering the entire environment in which he was operating, the people for whom this was being addressed. That's not going to happen without the conversations, without the sharing from an early stage.

I think we are doing better with that now than we did before in some areas and in some places, but at least there are projects that we have done where we have... okay so let me dial that back a bit. When I started out as a scientist, or medical scientist, I knew the solutions that needed to be done for the people that I worked with.

30 years down the line, I am insisting that we start no project without a community advisory board and conversations that start well before the project because what I have learned over time is that if you want to be truly successful, it has to be everybody together all the time.

It's not like on a day-to-day basis the community that I work with needs to know what is going on, but there needs to be touch points, there needs to be discussions because if we want to make a change happen it really requires all of us to interact together. Through the process of developing what we want that change to be, it allows for better implementation, it is more respectful, and I think ultimately, it's more successful and more sustainable. Thank you very much.

Julie Vale:

Oh, my goodness! So many insightful responses and comments. There's a couple in the chat that are more focused to Sonam's conversation on education, so I'm going to skip those until hopefully we can get him back maybe for the last few minutes of the Q and A.

There is a question here I have heard from different professors, and I still hear, that there is a lot of political influence to the scientific research that is happening, even to the research programs or social activism. Do you think if this is going to prevail into 2047 or is there a scope of political freedom and more grants allowance in the future?

Gagandeep Kang:

This is no different from any other part of the world. Politics always influences what is being done, in terms of directions and science, because you will have the policy makers, the politicians with opinions on what they think is critically important. Now the worry that I have with politicians in general is that there are very few politicians that think for the long term. Generally, they tend to think in election cycles; what's the science that gets me a quick result before the next election?

Biologists, you're in bad shape because biology always takes that much longer. Engineers probably have a little more, leaving to align themselves with elections, but I think one of the things that we don't do enough as scientific communities is put on pressure. We don't value ourselves enough, we don't project ourselves enough, we don't make enough of a noise about what we think is important.

Just like there is a fire hose of information coming to us from people that want us to be convinced of something that may or may not be accurate, we also need to be getting information up there about what we think is important, why we think it's important, and create enough of a pressure that we get funded for what we want to be doing.

Ultimately, it's never about the money. It's about, am I taking a problem that is important enough and am I going about it the right way? With persistence, funding always comes.

Julie Vale:

Thank you. Jahn timer, did you have anything you wanted to add to that?

Jahn timer Phalkey:

No, I think I would go with for the simple reason that I've actually never had to raise a grant or hold an academic position in India. I mean, when I moved to Bengaluru to do the Science Gallery, it's a different kind of project. I have experience in the US and UK academia, to some extent the German academia, but not in India. I think we can, yeah.

Julie Vale:

I can certainly echo what is going to be said in the Canadian system, it's no different in terms of the political influence that's definitely there.

Jahn timer Phalkey:

Even historically, just to add sort of a brief perspective from history of science. This isn't a new thing; we've had this before. We've also had this in the latter half of the 20th century where both Nazi Germany and then in the Soviet Union, but also in other regimes with strong political ideologies, they were able to draw and sustain a very strong distinction between scientific freedom and political freedom. You may not be free politically as a citizen, but you have the freedom to do whatever science you want.

It's a highly questionable and tenuous claim, but when one sees what was given to or even in the U.S with entire labs being taken away after the end of the second world war from Germany, and transplanted, and then you're free to do what you want in the lab. What does that mean? In that sense, at least in the 20th century, and since then, the relationship between politics and science has been so strong, the state is so strongly present in the enterprise as a whole.

Be it education, be it research funding, be it funding other kinds of projects, that is very hard to separate. I mean what would one call the Manhattan Project? What would one call the contract projects from the various Department of Energy? Department of Defense? The Office of Naval Research, etc. What would one call that if say a few chunks of money are being given to departments to work on some problems? What are you doing?

So, there's influence in different ways, but the fact remains that there are different interfaces at which politics, the state, and science do intersect. It's important to understand it, it's important to recognize it, but as Gagandeep said, it's not unique to India.

Julie Vale:

So, my next question is really, really simple. Jahnvi, what was the book that you shared at the beginning of the talk?

Jahnvi Phalkey:

Oh, it's River of Gods by Ian McDonald.

Gagandeep Kang:

Can you put it in the chat, Jahnvi please?

Jahnvi Phalkey:

I'll do that, I'll do that.

Julie Vale:

Perfect, thank you very much. All right. We have one question at the bottom of the chat and then I'm going to ask the two of you to give us a hopeful message before we leave [laughs] about how we can make positive change in the next 25 years. Last question first: how do we address the problem of scientific disinformation in the era of social media? Professor Kang's replies highlight the importance of scientific dissemination and cultivating a scientific spirit. It's clear the spread of disinformation is thriving because of the cultural context in India, caste hierarchy etc. but the internet is making it worse. Anybody want to take that one on? [laughs]

Gagandeep Kang:

Okay so I think everywhere in the world there's been a lot of misinformation out there. The problem is all of, you know, who's the audience is the real question. Who are they targeting? How likely are they to be able to convince their target of that message? Can you interrupt the misinformation or counter it in some way? I think having credible scientific voices speaking up and speaking up repeatedly is really, really important because you need a counter narrative.

You need the fact checkers, you need the people who get in there and say if this is what is being said, then here is an accurate assessment of the information by people that you trust.

Now the problem, of course, is that social media creates echo chambers, so the credible voices might not be able to get inside those echo chambers. Particularly WhatsApp groups, or people that you follow on Twitter make it very difficult for you to be able to break in there. Which is why I think speaking up, speaking often, speaking clearly is really important. The more we do, the more chances we have to counter this information.

Julie Vale:

Thank you. Jahnavi, keep it short [laughs].

Jahnavi Phalkey:

I second every single thing that Gagandeep just said. That's what people who practice science can do but, the rest of us, what we can do? The institution that I'm, for example, establishing is...we establish sort of...how should I put it...cultural habits of asking question, of skepticism, as she began speaking of. What is the source? Can I trust it? Is there an alternative source? How do I judge a source? The internet is full of sources, how do I discern? I think that's where education, both public education and school education and University education has a huge role to play.

Julie Vale:

Thank you very much. There are a couple more questions in the chat, but as we're coming very close to the end of our time together, what I was hoping for is each of you to share maybe some thoughts about some ways that we can positively impact moving forward over the next 25 years so that maybe we get to a more hopeful 2047. Also, if Sonam is anywhere in the meeting, it would be great if he could say hi. So, Jahnavi, if you'd like to go first, the hopeful part of the message please.

Jahnavi Phalkey:

Okay, so you know India is a young country. The median age is a ridiculously low 19 I think or maybe it's little higher than that. So, 2047 these are the people who are going to be, in a way, in positions to make decisions, to make...well...they'll be running the country. I read recently a book by Snigdha Poonam called The Dreamers, where she calls this generation unscrupulous, unstoppable, and unsatisfied. The last one is grammatically incorrect, but I think she's making a point. It is extremely scary, and I don't, I mean, given the median age, I don't think India has the number of educational and other kinds of institutions required to nurture them into better, well, into good citizens.

To develop them, to provide for them the opportunities for growth, for growing their minds; extrapolate from that all of those things required for a generation to realize itself to its best potential. I am actually hugely worried that's not what you asked me. Where does the hope come from? The only reason for hope is that time and again, just numbers, in a way, save India. There are several things that have been said about India; for everything that's true, this you

know there's something else that actually counters it or that India is a functioning anarchy etc. It is, in many ways, also at times an unpredictable population simply given the large numbers and so I'm hoping that Snigdha Poonam's sample is just simply and completely wrong and that maybe there's reason to believe that there will be good people after all.

Julie Vale:

Okay, thank you. Gagandeep.

Gagandeep Kang:

So, I think I find that when I talk to young people one-on-one, or in small groups, it gives me hope because they are open, they are receptive, for the most part. In any society, there's always polarization and it's the polarized people that are the noisiest, but the rest of us are the quiet middle or the fully quiet middle. I think this is where hope comes from; conversations, engagement, a population that is actually acquiring in a very competitive environment some level of education and exposure to global communities. So as much as I said social media creates bubbles, I hope those bubbles link up with other good bubbles somewhere and that we can make a change.

Julie Vale:

Awesome. All right. Well, I think we've come to the end of our time together. I would like to thank our speakers so much for their insightful commentary and I'd like to thank our audience for their comments and their engagement and their questions. I will close by saying that this concludes CIRCLE's India 2047 series. All seven such events were held between November 2021 and July, on the economy, democracy, education, India and the world, health, environment, and today's session on science. Recordings of these events are available on the CIRCLE website, which again is canadaindiaresearch.ca and thank you so much everybody. Once more, this concludes our event.

[End of transcript]