Proceedings of the

2021 Geneva Science and Diplomacy Anticipation Summit

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2021 Geneva Science and Diplomacy Anticipation Summit

7–9 October 2021

Campus Biotech Geneva

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Acknowledgments

Proceedings of the 2021 Geneva Science and Diplomacy Anticipation Summit

The 2021 Geneva Science and Diplomacy Anticipation Summit was organized by the GESDA Foundation, under the leadership of Peter Brabeck-Letmathe, Chairman of the Board of Directors, and Stéphane Decoutère, Secretary General, with guidance from all the members of the GESDA Board of Directors and of the GESDA Committee, with collaboration from the GESDA Executive Team and with services provided by The Content Engine.

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Layout

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Geneva, December 2021

Online interactive version

These Proceedings of the 2021 Geneva Science and Diplomacy Anticipation Summit are based on numerous sources, which are easily accessible via the digital PDF version of this document (as indicated in the “More information” boxes), as well as through the GESDA website (www.gesda.global), directly accessible with the QR code below. These sources include the full video recordings of the speeches and the sessions of the 2021 GESDA Summit, hyperlinks to external information indicated in the texts with underlined words, interviews of the GESDA Summit speakers and participants at the dedicated television booth, twitter threads produced during the sessions, as well as material related to the announcement made by GESDA during the Summit (press releases, images, etc.). To easily navigate that content and replay the recordings of the 2021 Geneva Science and Diplomacy Anticipation Summit, please simply scan the following QR with your smartphone.

Executive summary

In the midst of the COVID-19 pandemic, at a time when infection rates were rather low and international travel possible, the inaugural Geneva Science and Diplomacy Anticipation Summit (or GESDA Summit) took place 7–9 October 2021 in Geneva, at Campus Biotech, where GESDA is headquartered. Widely considered as a success from the charts and numbers, this hybrid event attracted overall more than 900 participants, 38% of whom being politicians and diplomats, both onsite and online, including 108 speakers from 33 nations. Scientists and academics, diplomats, executives, investors, philanthropists and citizens gathered to participate in lively sessions and engaged discussions based on GESDA’s vision: “Use the future to build the present”.

GESDA in a nutshell

The Swiss and Geneva governments founded the GESDA Foundation in 2019 as a new tool to help the world cope with all of the breakthrough science and technological advances occurring at an unprecedented speed. These advances, sometimes difficult to understand, will reshape how we view ourselves as humans, relate to each other in society, and care for our environment. GESDA was developed to anticipate those future breakthroughs and their impacts, to accelerate the ways to drive collective benefits from them among others by leveraging the Geneva International ecosystem and the diplomacy community at large, and finally to translate those proposals into concrete solutions and initiatives on the ground, creating new ways for different stakeholders to contribute to a better future. All these aspects were clearly put into light during this first Geneva Science and Diplomacy Anticipation Summit organized by the GESDA Foundation, showing very promising prospects for the relevance of anticipatory science diplomacy to help renew multilateralism. This vision was enhanced by Federal Councillor Ignazio Cassis, 2022 President of the Swiss Confederation, which co-founded GESDA, and head of the Federal Department of Foreign Affairs, in his welcome address: “There is a growing feeling that a new ‘Cold War’ is about to be fought over science and technology and the power they confer to the states, who master them. We must, therefore, reflect on how we can adapt, evolve, and respond to the challenges and opportunities of our time. We need to build the global governance of the 21st century which can only succeed if it is far-sighted, evidence-based and equitable. In this spirit, GESDA is designed as a new tool at the service of effective multilateralism, as a resource we wish to offer to the legitimate actors of international governance.”

The Science Breakthrough Radar®

The inaugural Geneva Science and Diplomacy Anticipation Summit set the stage for the unveiling of GESDA’s first flagship product: the GESDA Science Breakthrough Radar®. This document is a new global indicator of the most significant laboratory advances expected within the next five, ten and 25 years, in the first four scientific frontier issues selected by GESDA: quantum revolution and advanced artificial intelligence, human augmentation, eco-regeneration and geoengineering, and science and diplomacy. As a Swiss foundation and private-public partnership, GESDA strives to be an honest broker of science-backed information, remaining neutral and objective as it gathers ideas from consultations. Developed in partnership with the Fondation pour Genève, the Radar benefited from the collaboration of more than 540 scientists throughout the world. It will serve as a groundbreaking document for further public discussions on the implications of emerging science breakthroughs for international affairs and multilateralism as well as science and technology governance. It first served as the “red thread” for the whole 2021 GESDA Summit.

The Radar was presented during the High-level Opening Plenary session in which renowned decision makers and politicians took part, including Maria-Francesca Spatolisano (Officer-in-Charge, Office of the Secretary-General’s Envoy on Technology and Assistant Secretary-General of the United Nations (UN), speaking on behalf of United Nations the Secretary-General), Tatiana Valovaya (Director-General of the United Nations Office at Geneva), Naledi Pandor (Minister of International Relations and Cooperation for the South African Government), Martina Hirayama (Swiss State Secretary for Education, Research and Innovation), Alondra Nelson (Deputy Director, Science and Society, White House Office of Science and Technology Policy), Sir Peter Gluckman (President of the International Science Council Chair and Chair of the International Network for Government Science Advice INGSA), Achim Steiner (Administrator of the United Nations Development Programme - UNDP), and Nathalie Fontanet (State Councillor of the Republic and Canton of Geneva). The report was largely praised by both the scientific and diplomacy communities. Martina Hirayama said: “From my point of view, what is very important here and for Geneva, and for the multilateral objectives GESDA has, is that the GESDA Science Breakthrough Radar® shows important developments for the future with high impact on our future life. It also shows where we should discuss the needs on the political side to develop [those advances] in a good way.”

Anticipation to renew multilateralism

During the Opening Plenary Session, a high-level panel addressed the questions of whether anticipation in science and diplomacy can help renew multilateralism. “President Joe Biden has described our time as one of great perils and great promises,” Alondra Nelson said. “For those of us in government, to truly be of service, we really have a responsibility to be forthright about both those realities at once. And to be honest both about the risks of innovation and partnership, but also bold in addressing them head-on. And I think that GESDA is a fantastic possibility for working this through. Anticipation is filled, of course, with both enthusiasm and yet unease.” Achim Steiner added: “One interesting question to explore is: ‘Can we make the transition from where science enabled us to understand the challenge, to how diplomacy can accelerate that capacity to act, notwithstanding different interests and geopolitics?’ I think multilateralism is absolutely fundamental to that.” For Naledi Pandor, international collaboration must be aided and supported while dealing with current national challenges on the ground: “I tend to encourage the use of international partnerships for much more adventurous blue skies relationships and exploration, than perhaps the national institutions might be focused upon.” And to Peter Gluckman, meeting that target will be possible only under one essential condition: “One of the things that this debate is highlighting is the need to make sure that all the sciences, in particular social scientists, are part of the discussion right from the start, rather than allowing the technological sciences to run ahead of the social considerations.”

The cost of non-anticipation

During a Public Plenary Session held at the Graduate Institute for International and Development Studies Geneva (Graduate Institute Geneva) in a joint event organized by the GESDA Foundation, the Institute and the Diplomatic Club of Geneva, another distinguished guest, Enrico Letta (Secretary of the Italian Democratic Party; President of the Jacques Delors Institute; former Prime Minister of Italy; former Dean of the Paris School of International Affairs at Science Po - PSIA; and Member of GESDA Diplomacy Forum) reiterated the necessity of anticipation, but made his point with a distinctive argument: not anticipating will induce huge costs, as he showed with the example of the 2008 economic crisis, against which his country fully reacted only four years later: “In this precise example, the cost of non-anticipation has been disastrous in terms of human lives taken, of financial resources collapses.” The same applies for him to non-collaboration, as demonstrated by the current COVID-19 pandemic.

Other highlights

Other highlights of the Plenary Sessions included the final reporting session where three young thinkers under their 30s, coming from the business, scientific and socio-economical communities, told the audience how thrilled they were to see the worlds of science and diplomacy coming together to address the questions about their own future, and the chance they felt to be part of that discussion, wishing for more young people to join them. “I honestly wish that [science and diplomacy anticipation efforts such as those put in place by GESDA] were coupled with the sort of political reform we need – not just domestic context, but also international institutions. And we are able to bring these two things together and make a real difference,” said Keshav Khanna, Master’s student in International Affairs from India, currently at the Graduate Institute Geneva. They were then joined on stage by the Swiss astrophysicist Didier Queloz, 2019 Nobel Prize Laureate in physics, who, while explaining his new project of an institute dedicate to the search for the “origin of life” at Swiss Federal Institute of Technology Zurich (ETHZ) and the University of Cambridge, made a strong plea for un-driven fundamental research, for the breaking of scientific silos, for much broader interactions with social sciences as well as for wider communication actions towards the general public.

A very rich core programme

Sixteen plenary and parallel session formed the core of the 2021 GESDA Summit programme. Most of them where chosen from the 18 emerging topics and 216 possible breakthroughs identified in the GESDA Science Breakthrough Radar®. They were organized based on the four Scientific Frontiers Issues at the core of GESDA’s work as well as along three tracks related to the three actions keywords describing GESDA’s methodology: Anticipate, Accelerate, Translate. Poling tools were used during the session to take the pulse of the audience and engage the discussions. Through a so-called “Anticipatory Situation Room” exercise (the Anticipatory Situation Room process being the implementation tool and methodology developed by GESDA to bring together its academic and diplomacy communities), all sessions gave rise to interesting interactive debates among the panellists and with the attendees, some pointing to ideas where GESDA could play a possible role in the future. For example by helping address the need to establish an international body wider than the UN circles, which would include the new space race private actors, to deal with the necessity to draw new governance treaties in space; by participating in establishing soft laws to go along with artificial intelligence (AI) rapid developments, as hard laws will likely be impossible; by fostering an initiative that would make sure that quantum technologies remain accessible globally, also to countries which do not have the means to develop them by themselves; by accompanying wisely, on the international legal level, the bursting developments around brain-computer interfaces, the acquisition and use of brain data; or by reviving the human right to science, just to name a few. Through this very rich inaugural GESDA Summit programme, scientists and diplomats, business leaders, philanthropist and citizens got together in a nice and inspiring atmosphere to take part in and contribute to reflective, responsible, inclusive and sustainable collaboration, bringing anticipation-based science and diplomacy to the fore. A lot of goodwill for further collaborative actions with GESDA was shown by the participants, of which many have now become close interlocutors to GEDSA, and allowed the GESDA Foundation to widely enlarge its network.

Two major announcements

Apart from the core programme, two major announcements were made during the 2021 GESDA Summit. First, GESDA announced it will work with the XPRIZE Foundation on a global competition on quantum computing as part of a new partnership that includes XPRIZE setting up its European headquarters in Geneva, alongside GESDA at Campus Biotech. The joint GESDA-XPRIZE Quantum competition is one of the elements planned in this new partnership. Second, GESDA announced that 16 Geneva, Swiss and global institutions are joining forces to train future and current leaders who can bridge the worlds of science and diplomacy.

Geneva
- GESDA Foundation
- University of Geneva
- The Graduate Institute Geneva
- CERN
- Geneva Science-Policy Interface (GSPI)
- Geneva Centre for Security Policy (GCSP)
- Inter-Parliamentary Union (IPU)
- United Nations Institute for Training and Research (UNITAR)
- SDG Lab Geneva
- DiploFoundation

Switzerland
- Swiss Federal Institute of Technology Zurich (ETHZ)
- University of Zurich
- University of St Gallen
- Asuera Stiftung

World
- International Network for Government Science Advice (INGSA)
- Foreign Ministries Science and Technology Advice Network (FMSTAN)

A public event on AI&arts

Although the 2021 GESDA Summit was not a fully public event (for capacity reasons at the venue), tens of representatives from the citizens community did attend the event. Additionally to the public plenary session with Enrico Letta, and to extend the reach to the general public on the issues of science and diplomacy, GESDA collaborated with the initiative Tomorrow.Life to organize, in the framework of the local theatre festival at Théâtre Saint-Gervais in Geneva running the same weekend, a stage reading of the American play *The Frozen Sea*, which explores the convergence of art and AI in the near future. This side event attracted undisputable attention.

In the media sphere

In terms of communication and visibility, the inaugural GESDA Summit raised considerable interest in the media. More than 500 articles, video broadcasts and radio interview or podcasts appeared in the two weeks leading up to and including the Summit, appearing in more than 33 countries, reaching an estimated 800 million people, and thereby giving a worldwide attention to Geneva as being a hotspot for science and diplomacy. The coverage was largely positive, Geneva-based daily quality newspaper *Le Temps* claiming in an editorial that “GESDA [is] the quantum leap need for International Geneva”, also calling the Foundation “undoubtedly the best thing that has happened to international Geneva in years”. In the same media, Enrico Letta stated that “GESDA is an intelligent initiative that brings together science and diplomacy. For Geneva, this is a huge opportunity.” *The Associated Press (AP)* news agency, with global distribution, also noted GESDA’s relevance: “While conceived in 2019, GESDA has started to look prescient during the COVID-19 pandemic that caught many governments off guard, drew an uncertain or unclear response by health policy makers like the Geneva-based World Health Organization, and has exposed gaping inequality between the rich countries that have wide access to vaccines–and poor countries that don’t.” Finally, GESDA has made a significant impact on social media in the run-up and during this inaugural Summit as the hashtag #GESDAsummit was tweeted 1,184 times between October 5–13 only, by 392 users (among which key influencers of the field) with a potential reach of more than 9.1 million users. The contents of the social networks included short video interviews shot with the GESDA Summit participants and speakers at a dedicated television booth that was set next to the main auditorium of the venue.

Trust at the core

A first of its kind, the 2021 Geneva Science and Diplomacy Anticipation Summit reached its general objective, to create an event as a unique opportunity to bring the most essential scientific issues out of the laboratories and to the attention of world leaders, politicians and diplomats, creating a positive global effect to foster a renewed multilateralism largely based on science advances, in an effort to safeguard our collective welfare and make the most, for all on the planet, of where knowledge takes us. “We had invaluable inputs. We had creative and motivating comments and messages. They were full of knowledge and of wisdom. And all with intention to help GESDA to find its way into the future,” thanked Peter Brabeck-Letmathe, GESDA Chairman of the Board of Directors, in his Closing Address. “GESDA can be and should be relevant for all stakeholders. But I also know very well that the relevancy will only last as long as you all have trust in our work. Trust in GESDA as an honest broker which works in a fact-based, transparent and inclusive way. Those are the fundamental conditions at which GESDA can perform its duty as a builder of bridges, between the scientists and the politicians, but also with the involvement of the civil communities from all over the world and in the respect of cultural diversity.”

Numbers and figures

Programme

Total number of sessions: 19 (over four half days, spread over three days)

Plenary Sessions: 6

Parallel Sessions: 12

Public Plenary Session: 1

Public Event: 1

Networking cocktails and reception: 2

Invited speakers

Number: 108 (Male: 67 / Female: 41)

Onsite: 91

Online: 17

Speakers and moderators came from 33 countries from the five continents

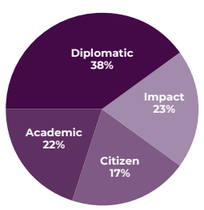
Participation

Registered participants (including speakers and media, staff excluded): 939 (from 35 countries)

- Onsite registrations: 570 (no show rate 24%)
- Online registrations: 357
- Media registrations: 50
- Invitee conversion rate: 48.7%

Distribution of participants among GESDA’s four Communities (Academic, Diplomatic, Impact, Citizen)

- Academic: 22%
- Diplomatic: 38%
- Impact: 23%
- Citizen: 17%

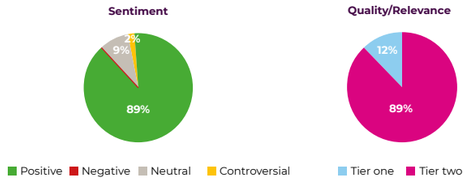


Press, media and social media

Press work

Three press releases during the Summit (1. GESDA Science Breakthrough Radar® & GESDA Summit; 2) GESDA-XPRIZE Quantum Competition; 3) Geneva Science and Diplomacy Capacity Building Initiative).

More than 500 articles, which appeared in 33 countries (mainly the USA and Switzerland, then Britain, Canada, India, Germany, Singapore, Austria, Italy, Hong Kong, Swaziland, and France), reaching an estimated 800 million people across the world.



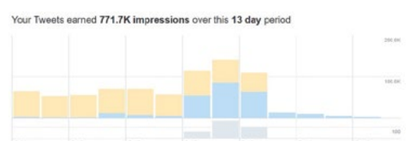
Social media

GESDA has made a significant impact on social media in the run-up and during the Summit from 7–9 October 2021. As of 1 November 2021, GESDA had

- **3,586** followers on **Twitter**
- **1,579** followers on **LinkedIn**

Tweets mentioning the #GESDAsummit from 5–13 October 2021.

The tweets sent in the first half of October have generated 770,000 impressions.



Speakers, Panellists and Moderators

PATRICK AEBISCHER

Vice-Chairman, GESDA

PHILIPPE AGHION

Professor, College de France, INSEAD and London School of Economics

ANOUSHEH ANSARI

CEO, XPRIZE Foundation

MICHELLE BACHELET

High Commissioner for Human Rights, United Nations

RICHARD BALDWIN

Professor, Graduate Institute

GERARD BARRON

CEO & Chairman, The Metals Company

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ROBERT BLASIAK

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ANTJE BOETIUS

Director, Alfred Wegener Institut

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Chairman, GESDA

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Director, UNESCO's Regional Bureau for Sciences, Latin America and the Caribbean

MICHELINE CALMY-REY

Former President, Swiss Confederation

IGNAZIO CASSIS

Vice-President, Swiss Federal Council; Head, Federal Department of Foreign Affairs

MARIA CATTAUI

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Professor of Genetics, Harvard Medical School

CLAUDIA CHWALISZ

Policy Analyst and Author

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Journalist, Author and Think Tanker

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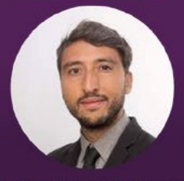

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NINIANE PAEFFGEN

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NALEDI PANDOR

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JANOS PASZTOR

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CHORH CHUAN TAN

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TATIANA VALOVAYA

Director-General, United Nations

EFFY VAYENA

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WENDELL WALLACH

Senior Advisor, The Hastings Center

AMBROISE WONKAM

Professor and Senior Medical Genetics Consultant, University of Cape Town

Thursday 7 October, 9:30–10:30pm CET

Press conference and press review

Press conference

Presentation of the 2021 GESDA Summit and the Science Breakthrough Radar®

Moderated by:

Marieke Hood, Executive Director Corporate Affairs, GESDA, France

With:

Patrick Aebischer, President Emeritus, Swiss Federal Institute of Technology Lausanne (EPFL); Vice-Chairman GESDA, Switzerland

Peter Brabeck-Letmathe, Chairman, GESDA Board of Directors, Austria

Chorh Chuan Tan, Chief Health Scientist at the Ministry of Health of Singapore; Board Member, GESDA, Singapore

Nanjira Sambuli, Policy Analyst, Advocacy Strategist; Board Member, Digital Impact Alliance, Development Gateway and The New Humanitarian, Kenya; Member GESDA Diplomacy Forum

It was a moment two years in the making. GESDA Chairman Peter Brabeck-Letmathe took the microphone to welcome the dozens of journalists who were participating in a news conference that was conducted both in person and online. The news conference marked the start of the inaugural Geneva Science and Diplomacy Anticipation Summit. "It is a first outing of our newly created foundation," he said. Brabeck-Letmathe and Vice-Chairman Patrick Aebischer, flanked by other GESDA board members, staff, and participants, called the news conference to introduce GESDA's Science Breakthrough Radar® for identifying scientific advances that will impact humanity within five, ten and 25 years, as well as the Summit, which provided a platform for discussing the Radar's findings and collectively figuring out how best to respond and act. "The Radar is an open and free accessible digital platform, to facilitate conversations and interactions with all interested parties," underlined Nanjira Sambuli, a policy analyst from Kenya who is also Diplomacy Moderator at GESDA.

GESDA board member Chorh Chuan Tan, who is the Chief scientist at the Ministry of health in Singapore, said he found "the GESDA approach exciting, because it is systematic – and this is needed, because we are dealing with highly complicated problems – yet it is also inclusive and global. Finally, this initiative is open, acknowledging different perspectives, but also structured. What we do hope is to accelerate the science advancement over the many valleys that may hinder its development, and particularly towards a better access to the benefits it can bring to communities all around the world".

Taken together, these two offerings – the Radar and the Summit – drew a lot of interest from the Swiss and international press.

During the question-and-answer part of the hourlong news conference, Jamey Keaten of The Associated Press in Geneva asked whether GESDA had the logistical capacity to carry out its mission since it had only a small staff to deliver on some "very, very big ideas, very big projects" and "big futuristic ambitions". He also asked what lessons GESDA might have learned from the failure of the World Health Organization and others to prevent the glaring vaccine inequities among nations that have become a major theme of the COVID-19 pandemic. GESDA has been managing for the past two years with a nine-member board of directors, three leaders for its academic and diplomatic forums, an executive team of eight employees and several other contractual hires. Aebischer, former head of EPFL, replied that the Radar will always be at the heart of GESDA's functions "because that is the raw material to discuss", and this will always be carried out by a broad community of scientists rather than by reliance on a small, core staff. "You know, I am amazed to see that to build this, that we had 500 top leading scientists engaging their time to do this.

This is quite remarkable. The work of science does not work necessarily like some other part of society which is primarily motivated by financial return. It is really by sharing data, by peer recognition, by wanting to contribute," Aebischer told reporters. "The idea is to get the data we need from the scientists."

Addressing a question on the pandemic, Jeremy Farrar, who directs the Wellcome Trust, and who is another GESDA board member who was in the room, expertly summarized GESDA's reason for being. He said "scientists did not think through the consequences of the problems that would come down the track in terms of inequality" from a pandemic despite making enormous progress on the scientific front by developing coronavirus vaccines in record time. "If you do not put that in the context of society, if you do not put that in the context of politics – and you cannot avoid politics and diplomacy – then scientific advances will increasingly be available to a small elite in the world and not to everybody. And to me that is the greatest challenge of the 21st century: How do we avoid that degree of inequity in the world, whether we're talking about climate inequity, whether we're talking about inequity in terms of energy access, water access, access to science and technology?" Farrar asked.

"And if we are not careful, there will be a small group of countries or individuals in the world with access to the best science, and it will not be accessible to everyone else," he continued. "And unless that is addressed politically and diplomatically, we will not make the advances that humanity needs and obviously we have only got a small planet. And the second is there is, I think, an increasing distance maybe driving the advances in populism globally, which is putting a distance between society, politics, and scientific advances. And if we don't bridge that, then I think we will end up in a very inequitable world. And inequitable worlds are very tense worlds, and ultimately in history have mostly led to conflict."

Laurent Sierro of the Swiss News Agency *Keystone-SDA/ATS* in Geneva asked what GESDA hopes to achieve in the same timeframes the Radar uses – five, ten and 25 years – and whether anyone at GESDA could envision having a "fully AI" board member, as in a robot driven entirely by artificial intelligence, a quarter century from now? GESDA board members smiled at the question and did not answer. Sierro also wondered how had the "P5" countries – Britain, China, France, Russia and the United States, all permanent, veto-wielding members of the 15-nation United Nations Security Council, the world body's most powerful arm – reacted to GESDA? Rather than discuss the complexity of the frequently deadlocked Security Council's reactions and global politics, Brabeck-Letmathe used to occasion to recalibrate expectations of what GESDA could become if Swiss authorities agree to extend its mandate, and to emphasize that its role is to serve as an honest broker of science-backed information, remaining neutral and objective as it gathers ideas through broad consultations.

"There was this question about how can you pretend with 20 people or 30 people to achieve what you want to achieve, which is a global challenge, which has not been tackled up to now?" he began. "The 20 or 30 people are not the ones who are doing the work. The work is being done on a voluntary basis by thousands. Thousands of scientists and thousands of diplomats in the world all over," Brabeck-Letmathe began. "We still need to get the agreement from our founders for the next five and ten years," he continued. "For the next five and ten years, voluntarily and on purpose, I think GESDA should not become much more than what it is. Because we will not be able to incentivize all these thousands of people, all over the world, which we need, if they feel that what we are doing is not exclusively for them, and for their cause, but it's for an institution, or for a company or for a government. I think the biggest challenge that GESDA has is to keep the enthusiasm of all participants all over the world to participate in this challenge, which it has as an objective, like it was said by Jeremy Farrar. The objective is that we make these scientific breakthroughs available to everyone in this world."

Press Review

Swiss and international press coverage of the 2021 GESDA Summit and the Science Breakthrough Radar®

The strong interest and curiosity about GESDA that journalists showed at the press conference and throughout the rest of the Summit translated into very positive and global news coverage: more than 500 articles, video broadcasts and podcasts on GESDA appeared in the two weeks leading up to and including the Summit, reaching an estimated 800 million people – one-in-ten worldwide – according to Adwired of Zurich, the agency mandated to accomplish that press screening. Most stories were published in English or in three of Switzerland's national languages: French, German and Italian. Stories were also published in Arabic, Armenian, Chinese, Japanese, Portuguese, Russian, Spanish, and Vietnamese. They appeared in 33 countries but were concentrated in two nations: 54 per cent in the U.S., 21 per cent in Switzerland. The rest were mainly in Britain, Canada, India, Germany, Singapore, Austria, Italy, Hong Kong, Swaziland, and France, but the remaining countries also spanned Africa, Asia, Europe, and the Americas.

Reporters closely followed three days of intense discussions among leading experts in the fields targeted by GESDA. The news coverage brought the concept of science diplomacy, and GESDA's brand of

anticipatory science diplomacy, to the forefront, with most news articles corroborating the need for more anticipation of the many complex breakthroughs occurring at a dizzying pace. The reports also reflected a fascination with the prospect of GESDA, as a new foundation strengthening Geneva as a preeminent hub of multilateralism. Some raised the questions of whether its mandate would be renewed and be provided with enough public and private funding to scale up sufficiently to accomplish its lofty goals.

"GESDA, the quantum leap needed for International Geneva", proclaimed an editorial in *Le Temps* of Geneva, which called the new foundation "undoubtedly the best thing that has happened to international Geneva in years" and urged the Swiss and Geneva governments to renew GESDA's mandate beyond its three-year startup phase, which comes to an end in 2022. "Ultimately its purpose is not simply for Geneva but for all of humanity," wrote Stéphane Bussard, who also authored other articles strongly supportive of GESDA's ambition of accelerating concrete action. "It has been a long time since international Geneva has seen such an ambitious initiative," he observed in one article. "The most crucial and difficult phase will be to translate innovations identified by the Radar into concrete and useful solutions to face the big challenges ahead." Bussard also prominently covered former Italian Prime Minister Enrico Letta's high-profile address during the Summit, where he described anticipatory science diplomacy as a paradigm-shifting tool. "GESDA is, in this sense, an intelligent initiative that brings together science and diplomacy. For Geneva, this is a huge opportunity," he said. "The cost of not anticipating is enormous. This is why we need to create anticipation mechanisms that allow politicians and scientists to talk to each other. GESDA is an example of this."

Swiss Foreign Minister Ignazio Cassis, along with Brabeck-Letmathe, established the themes many Swiss and international reporters emphasized. Cassis and Brabeck-Letmathe warned that dangerous geopolitical fault lines could emerge if powerful new uses for science and technology are concentrated in the hands of a few wealthy countries or multinational businesses. In a pre-recorded video message played at the news conference and later for participants at the start of the Summit, Cassis spoke of "a growing feeling that a new Cold War is about to be fought over science and technology, and the power they confer to the states that master them". Brabeck-Letmathe cautioned against "neocolonialism", saying GESDA's mission is to help spread the benefits of science and technology equitably around the globe. The "highlights" of the international coverage were articles by outlets such as *The Associated Press*, *Newsweek* and *Bloomberg* that collectively reach billions of readers, Adwired reported. The *AP* article was headlined: "Swiss-Backed Project Aims to Avert New 'Cold War' in Science". Newsweek carried a similar headline: "Biden Administration Shows Interest in Swiss Project Aimed at Preventing 'New Cold War'". Stories by *Keystone-SDA/ATS* were widely carried by news outlets with headlines such as: "GESDA: Switzerland wants to avoid a cold war over science".

Other prominent, globally distributed articles about GESDA's partnership with XPRIZE and planned quantum competition were published by *Axios* and *CQ Roll Call*, which is published on *Westlaw Today* and *Reuters*. At almost 800 words, the *CQ Roll Call* piece was relatively long in length; it had lengthy quotes from Brabeck-Letmathe and Amir Banifatemi, executive director of XPRIZE Europe, and took care to explain GESDA's mission. "While it may be decades before quantum technologies become real world applications, GESDA officials said there is a need to prepare for future disruption it might cause," the article said. "This is part of the Swiss foundation's mission to anticipate scientific breakthroughs and combine science with diplomacy to get better results."

Among 509 news articles about the Summit – most of them published by U.S.- and Swiss-based wire services – 455 had a positive tone, 46 were neutral and eight were controversial in nature by raising questions such as GESDA's long-term sustainability and relevance. Sixty per cent were about GESDA averting a new Cold War over science; 22 per cent focused on the Summit itself; and 8 per cent dealt mainly with the Radar. The other 10 per cent were written about Nobel Prize-winning Swiss astrophysicist Didier Queloz's observations, Brabeck-Letmathe's interviews, advances in neurotechnology, science diplomacy, and the GESDA-XPRIZE collaboration.

The *Keystone-SDA/ATS* interview with Queloz, in French, emphasized his call for scientists, diplomats, citizens, and businesspeople to work more closely together because "science has lost contact with society", and cited as an example the two-fifths of the Swiss population that preferred not to get vaccinated against COVID-19. Brabeck-Letmathe's question-and-answer piece in *Blick*, Switzerland's dominant German-language tabloid, offered concrete, easy-to-understand examples of why GESDA's anticipatory science diplomacy could be a powerful long-range tool. "The Internet was invented in Geneva and is now the basis of business for the three largest corporations in the world," he told the tabloid. "Only today do politicians realize that they should have regulated the whole thing so that nobody becomes so dominant. With GESDA you could have seen it coming."

An article by *Swissinfo*'s Dorian Burkhalter concluded that "civil society and private actors remained underrepresented at the Summit. This was recognized by Aebischer during a session in which he said GESDA hoped to involve more private companies next year. This is particularly relevant for discussions about AI research in which private firms, not countries, have the lead. In the meantime, the Radar offers everyone the possibility of submitting a contribution that could inform GESDA's work in the future". One week before the Summit, an "analysis" published by the English-language *Geneva Observer* website raised some critical points. It quoted unidentified sources attacking Brabeck-Letmathe and Aebischer as "outsiders" with "no knowledge of International Geneva", a perception that for months "slowed down the onboarding of some local stakeholders" but was overcome through no small amount of "fence-mending" and "traditional diplomacy". Brabeck-Letmathe, however, was quoted as saying he was not surprised at a certain lack of understanding because the Summit marked the first time GESDA "really goes public".

By contrast, most stories offered compelling evidence that GESDA is welcome news for multilateralism, and that it could make a positive difference on the world stage if its mandate is extended beyond next year.

A quote in the *Geneva Observer* article underlines this: Professor Paul Arthur Berkman, Associated Fellow of the United Nations Institute for Training and Research (UNITAR) and 2021 Fulbright Arctic Chair awarded by the United States Department of State with the Norwegian Ministry of Foreign Affairs, said he believes Switzerland should be lauded for such efforts. "Science diplomacy is a language of hope," he says. "There is far too much doom and gloom in the world, that is polarized and paralyzed largely because of short-term thinking. The challenge we have right now is to recognize that short-term thinking is related to self-interests. The primary responsibility of science diplomats is to build common interests, which means operating short-to-long term across a continuum of urgencies."

The AP's Jamey Keaten also noted GESDA's relevance. "While conceived in 2019, GESDA has started to look prescient during the COVID-19 pandemic that caught many governments off guard, drew an uncertain or unclear response by health policy makers like the Geneva-based World Health Organization, and has exposed gaping inequality between the rich countries that have wide access to vaccines–and poor countries that don't," wrote Keaten, who quoted one of the Opening Plenary's prominent panellists, Alondra Nelson, Deputy Director for science and Society of the White House Office of Science and Technology Policy, telling the Summit that GESDA and its anticipatory approach offer "a fantastic possibility" for innovation and partnership.

In another article by *Swissinfo*, the reporters expressed being pleasantly surprised by the Summit. "As I walked through the door of the Biotech Campus in Geneva, I still had in mind Greta Thunberg's recent speech in Milan, in which she criticized the 'blah blah blah' of world leaders who, faced with the climate crisis, discuss, and promise lots and lots, but never act. The suspicion that I was facing three days of 'blah blah blah' was strong," journalist Zeno Zoccatelli wrote. "And I was not the only one, it seems. Invited to speak at the summit's opening conference, South Africa's Minister of International Relations and Cooperation Naledi Pandor concluded a long series of speeches by saying: 'But now these words must become deeds.' Will it happen? It is still too early to say, but I certainly came out of the summit less pessimistic than I was going in. One of the reasons is the GESDA Science Breakthrough Radar®, created by the Foundation with the collaboration of hundreds of scientists around the world."

Dorian Burkhalter wrote that the idea behind GESDA's mission of using the future to build the present may not be entirely new, since science fiction has long encouraged people to consider a variety of futures. Yet GESDA brings something valuable, according to him, when raising the question of whether international organizations and global governance systems can address the world's most pressing challenges a quarter century from now: "The creation of a platform specifically designed to address this question is a welcome addition to Geneva's rich ecosystem."

More information

Press conference recording on YouTube

Twitter Moments related to the summit

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

Peter Brabeck-Letmathe

Chairman,
GESDA Board of Directors,
Austria

Opening Plenary Part-1

Welcome Address

Dear representatives of GESDA's Founders,

- Ambassador Alexandre Fasel, Swiss Special Representative for Science Diplomacy representing today Federal Councillor Ignazio Cassis, Swiss Minister for Foreign Affairs
- Swiss State Secretary for Education, Research and Innovation Martina Hirayama
- State Councillor of the Republic and Canton of Geneva Nathalie Fontanet
- Executive Councillor of the City of Geneva Sami Kanaan

Dear representatives of the United Nations Organization,

- Ms Maria-Francesca Spatolisano representing the UN Secretary-General Antonio Guterres
- Ms Tatiana Valovaya, Director-General of the United Nations office at Geneva,

Dear President of the Fondation pour Genève, Mr Marc Pictet,

Dear representatives of the Academic and the Diplomacy world,

Dear all GESDA guests, here in Geneva and online throughout the world,

On behalf of the Geneva Science and Diplomacy Anticipator, I am pleased to welcome you to the opening of the first Geneva Science and Diplomacy Anticipation Summit, and to welcome you, at Campus Biotech and online.

Twenty-four months ago, the Founders at the origin of our organization, the Swiss and the Geneva governments along with the authorities of the City of Geneva entrusted us with a mission:

"To develop an instrument of anticipation and action in the service of humanity in order to widen the circle of beneficiaries of advances in science and technology and on the other hand to strengthen Geneva as a preeminent hub for multilateralism."

Accelerating the use of opportunities that advanced scientific explorations bring to the world seems straightforward. Although I must say, the two years since we have been working on the subject have proven us different. It was quite difficult. Firstly, and thanks to our Scientific Forum, co-headed by Joël Mesot from ETHZ and Martin Vetterli from EPFL Lausanne, we had to access, scout and discover what is already cooking in the laboratories all over the world. And secondly, we confronted this knowledge with our Diplomacy Forum, headed by Michael Møller, former Director General at the UN Office in Geneva, to better understand the political and social implications those scientific breakthroughs will have to confront once they are ready to be applied in our daily life.

In accordance with our mission, we have in fact developed two complementary instruments:

- First, an anticipatory instrument, the GESDA Science Breakthrough Radar®, which offers an open source overview of the scientific disruptions in the making that will unfold their effects in five, ten, and 25 years. It is signed by 543 scientists from around the world. It presents 216 disruptions that will very quickly impact all of our lives, wherever we live, whatever our age or gender, in the digital domain, in the field of health, the environment and science diplomacy.
- Secondly, an instrument for action, the Geneva Science and Diplomacy Anticipation Summit, which is bringing together 900 participants including 108 speakers from 33 different countries.

Thank you to all for your huge interest in participating to this inaugural 2021 edition and being with us today. And welcome, ladies and gentlemen, into GESDA's Anticipatory Situation Room, displaying for you on each wall of this room the content to be found in the GESDA Science Breakthrough Radar® 2021 about the three fundamental questions and the four scientific fields we have been working on for 24 months.

The three fundamental questions are:

- **WHO ARE WE, AS HUMANS?** What does it mean to be human in the era of robots, gene editing and augmented reality?
- **HOW ARE WE GOING TO LIVE TOGETHER?** What technology can be deployed to help reduce inequality, improve well-being and foster inclusive development?
- **HOW CAN WE ASSURE THE WELL-BEING OF HUMANKIND AND THE SUSTAINAIBLE FUTURE OF OUR PLANET EARTH?** How can we supply the world population with the necessary food and energy while regenerating our planet?

The four Scientific Frontiers issues are:

- Quantum Revolution and Advanced Artificial Intelligence
- Human Augmentation
- Eco-Regeneration and Geoengineering
- Science and Diplomacy – perhaps something relatively new.

The walls around you reflect:

- the Pulse of society on these topics and the related debates that has taken place
- the Pulse of science – what is already cooking in the laboratories
- a first Pulse of diplomacy on what could or should be done with these upcoming scientific disruptions.

The goal of this Summit is, based on the results presented in the GESDA Science Breakthrough Radar®, to open a first global consultation on these upcoming disruptions and their potential impact, with you, ladies and gentlemen, representatives of the political authorities, the diplomats, the philanthropists, the entrepreneurs, the NGOs, and the citizens, and all the interested people throughout the world.

We will focus during these three days on 16 of the scientific disruptions presented in our 2021 GESDA Science Breakthrough Radar®, so that you can work on solutions, initiatives and projects that benefit everyone in the world and contribute to the achievement of the 17 UN Sustainable Development Goals.

The first concrete solutions coming out of your thinking and your input will then be presented in the second edition of the Radar and the Summit, both scheduled to take place in Geneva from 29 to 31 August 2022. Both our Radar and our Summit are being developed in close relationship and partnership with the Fondation pour Genève, represented here by its President Marc Pictet and Vice President Guillaume Pictet, and in close collaboration with a large number of partners, including of course our Founders. I cannot mention here all our partners, but they are all listed in the Radar and on our website. Let me just thank the Open Science Publisher *Frontiers* in Lausanne and the XPRIZE Foundation established in California whose CEO Anousheh Ansari is a member of the GESDA Diplomacy Forum. XPRIZE is going to set up its offices in Geneva, here at Campus Biotech. We are working together to launch a joint public competition to develop quantum applications in collaboration with the World Food Programme, the UN Habitat and the World Health Organization. Thank you to our Founders and all our Partners for your support and your trust.

Let me conclude, ladies and gentlemen, by underlining a matter of fact. The speed of scientific and technological development is accelerating even further, and it plays an even greater role in our daily life. In order to fully take advantage of those advancements, we need to coordinate the complex relationships and interactions between scientists, politicians, citizen and entrepreneurs whose agendas, mindsets, experiences, and responsibilities are all very, very different. Geneva, with its UN headquarters, international organizations, universities, and NGOs, is the ideal place to develop science diplomacy based on anticipation and participation by all.

So, ladies and gentlemen, welcome to Geneva. Welcome to our first Geneva Science and Diplomacy Anticipation Summit. And as GESDA motto is saying, let's all together use the future to build a better present. Thank you very much.

More information

Session recording on YouTube

Tweets related to the session

Thursday 7 October, 3:00–4:30pm CET

Video Statement

Opening Plenary Part-1

Federal Councillor Ignazio Cassis

**Vice-President, Swiss Federal Council;
Head, Federal Department of Foreign Affairs,
Switzerland**

Welcome Address

GESDA – Turn new technological challenges into opportunities for each and every one

Dear Mister Peter Brabeck-Letmathe, Chairman of the GESDA Foundation,

Dear Miss Nathalie Fontanet, Honorable State Councillor of the Republic and Canton of Geneva,

Dear Members of the GESDA Board,

Dear guests,

Ladies and gentleman,

On behalf of the Swiss Government, I want to extend to all of you – near or far, in person or online – a warm welcome to Switzerland.

My government and the local authorities of Geneva created the GESDA Foundation two years ago. We felt – as the host state of one of the foremost centres of global governance and as a major global player in science and innovation – that there is an urgent need to fully capture what science and technology have to offer in terms of foresight, understanding, and solutions. The phenomenon of the convergence of sciences is expanding the field of scientific discovery and accelerating technological progress. This will change the face of humanity and, hence, change the way humanity is governed globally. Through the best possible interaction between science and diplomacy, we must acquire the ability to anticipate new technological challenges, in order to design appropriate solutions and to turn new technologies into opportunities for each and every one of us.

Moreover, geopolitical considerations come into play around science and technology. There is a growing feeling that a new "Cold War" is about to be fought over science and technology and the power they confer to the states, who master them. We must, therefore, reflect on how we can adapt, evolve, and respond to the challenges and opportunities of our time. We need to build the global governance of the 21st century which can only succeed if it is far-sighted, evidence-based and equitable.

In this spirit, GESDA is designed as a new tool at the service of effective multilateralism, as a resource we wish to offer to the legitimate actors of international governance. The method is based on anticipation: the international community should be offered a good understanding of the challenges and opportunities ahead. The Science Breakthrough Radar® you are about to discover certainly does that. The method is also based on participation and geared towards impact: GESDA facilitates as an honest broker the conversation between multiple stakeholders, in order to build convergence around concrete solutions to practical problems.

What we are trying to achieve with GESDA is new and hence, difficult. To link anticipation – that looks far ahead – with action – that is immediate – is a major challenge in itself. And the method by which we are attempting to do it, is new and challenging for the participating scientists, diplomats, policymakers, citizens, representatives of the private sector and of philanthropy. But personally, I haven't seen any better proposal yet on how to use science diplomacy to make governance of world affairs fit for the reality we are going to face. With GESDA we are creating an instrument that is based in, and operates out of, Geneva.

But the aspiration is universal. We are working for the global commons, here in Geneva and – through the content and methodology we are proposing – whenever and wherever the conversation is taking place.

Thank you so much for your presence, interest, and participation! Let's set out together on the journey of anticipatory science diplomacy! Thank you.

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

Nathalie Fontanet

State Councillor of the Republic and Canton of Geneva, Switzerland

Welcome Address

Excellencies, ladies and gentlemen, all protocol observed.

On behalf of Geneva authorities, I am very happy to welcome you all. I feel honoured and humbled to be part of such an important event and among so many brilliant people.

We live, I believe, a quite important moment in International Geneva's history, trying to create new bridges between science and diplomacy, between present and future, and between persons of such different backgrounds and origins as you are. The conversation about international public affairs is of concern to all. It has therefore to be as inclusive as possible. I thank GESDA for having made this inclusivity possible today.

Geneva is the place to be when it comes to international cooperation. This is the place where some 600 international organizations, diplomatic missions and NGOs, address today's most pressing global challenges, be it climate changes, pandemics, technological disruption or humanitarian crisis.

Geneva has always taken care to cultivate complementarity between the academic community, the scientific community, the private sector and the organizations of International Geneva.

The dialogue between science and diplomacy is not new, but it has become of major importance, as the world faces new and rapid changes. This is the reason why the Canton of Geneva decided to contribute to the creation of GESDA.

Geneva has strong ties with science and diplomacy, notably hosting the CERN and multiple international organizations. Therefore, it appears only natural to support GESDA as a connector between science and diplomacy, and as a way to propel the International Geneva to the future and to give it appropriate tools to be more efficient and elaborate solutions to global issues.

It might be useful to remember that International Geneva started more than 160 years ago with the Red Cross founded by five people coming from different walks of life as well: a businessman (Henry Dunant), a lawyer (Gustave Moynier), a soldier (Guillaume Henri Dufour) and two medical doctors (Louis Appia and Théodore Maunoir).

Thanks to these doctors, science was associated with International Geneva as from its very beginning. And science's position only grew in the course of the 20th century. I am thinking here about the World Health Organization and all the other public health organizations that we host, but also about the World Meteorological Organization, the Intergovernmental Panel on Climate Change, the International Telecommunication Union, and – last but not least – CERN of course.

GESDA definitely enters a fertile ground. A ground where it can count on the support of the host authorities, as well as on the resources of an outstanding network of local academic institutions.

Geneva is also an operational hub. It is not only about speeches, reports and resolutions. It is also about solutions, actions and results. At a time when traditional multilateralism is put into question, this might be easier said than done.

But I am convinced that this is possible if we support all an inclusive approach and, above all, if we never lose sight of the ultimate goal: a better world; a more peaceful, just and sustainable world, for all human beings, on all continents.

Since the founding of the Red Cross, science, action and humanity go together in International Geneva. There is no better place to pursue these efforts of inclusiveness, and to bring the future that is being made closer to the issues of the present. I can only wish that GESDA be included in this long and ambitious tradition.

Thank you for your attention.

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

Yves Flückiger

**President, Swissuniversities;
Rector, University of Geneva;
President, Campus Biotech Geneva Foundation,
Switzerland**

Welcome Address

Excellencies,

Dear colleagues,

Dear friends of science diplomacy,

On behalf of the Campus Biotech Foundation, which I have the honour of chairing, and on behalf of the two academic institutions that support the scientific project developed on the campus, EPFL, the University of Geneva, as well as with Geneve University Hospitals, I would like to extend a very warm welcome to all of you. It is a real privilege to participate in this opening ceremony of this GESDA Summit.

Located in the centre of international Geneva, close to so many international organizations, GESDA is a perfect symbol of the project that led to the creation of the Foundation in 2015. It is a dialogue between scientists and society, a meeting place between the expectations of international organizations, their challenges and the solutions that the scientific world can provide. A meeting place also for universities to hear the problems that these organizations have to face.

The recent pandemic has highlighted the importance of basic and applied research for our society. It is an opportunity but also a risk in terms of their autonomy. It is an opportunity first of all because science has been able to demonstrate since the early days of this pandemic that it could provide answers to this health challenge and that it could also provide the advice that politicians and international organizations needed to develop effective, evidence-based public policies.

Over the past 18 months, science has made what can only be described as an amazing progress in producing vaccines in a record time never before seen in the history of all viruses. This has been possible because mainly of three factors. Firstly, it was due to unprecedented international collaboration, which reminds us how vital it is for Switzerland to remain associated with the Horizon Europe programme, and I know that our State Secretary, Ms. Hirayama, is working very hard every day to make it possible. Secondly, open-access publications that demonstrate the importance of open science and the possibility of accessing the databases needed for research. Thirdly, it should be remembered that the reason why these new types of mRNA vaccines have been made available so quickly is that basic research on this subject began 20 years ago. This is an opportunity for me to emphasize that behind every innovation there is basic research that cannot be financed by private companies but must be taken on by the public sector.

Science and politics, science and international organizations, science and society must forge close links in order to face the social challenges of the 21st century.

In this interaction, scientists must present facts on which they can give advice, knowing that they do not decide and that it is the politicians who have the difficult task of making these decisions by weighing up the various parameters of this choice. Economic interests on one side versus health imperatives. A balance of costs and benefits that is not always easy to make.

For this relationship to develop, it is necessary to build trust. This requires time, it also implies developing communication skills in the scientific world, remembering that sometimes the truth hurts, but that scientists must never be muzzled. In order to build the trust necessary for dialogue, to ensure that the message of the experts can be heard by civil society, the whole of civil society, and not just the trained individuals, multidisciplinary and multi-institutional platforms must be built, linking science, politics, international organizations, the private sector and civil society. This is precisely the purpose of GESDA. Anticipating tomorrow's technological developments to face current challenges and promote sustainable and inclusive development. GESDA's first goal is to anticipate, accelerate and translate into concrete actions the use of emerging science-driven topics.

In order to reinforce the links between scientific expertise and international organizations and to contribute to the restoration of multilateralism, it is also necessary to ensure that the scientific world understands the challenges facing international organizations.

It is also necessary for the diplomatic world to be aware of all the current developments made in science that can contribute to solving current problems. This is the primary objective of the second platform, very complementary of the GESDA, which is named the Geneva Science Policy Interface (GSPI).

The GSPI specifically seeks to establish platforms between the actors of international Geneva and the academic world in order to promote the adoption of evidence-based policies. These two platforms, GESDA and the GSPI, constitute two perfectly complementary initiatives that both work to reinforce multilateralism and to address the current and future challenges facing our society. And I am very proud that they are both located in Geneva, on this Campus, but open to all academic institutions in Switzerland and worldwide.

I wish you a very fruitful two days of discoveries, exchanges and interaction.

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

Martina Hirayama

State Secretary for Education, Research and Innovation, Switzerland

Welcome Address

Excellencies,

Dear ladies and gentlemen,

Thank you very much for inviting me to join the Opening Plenary Session of the GESDA Summit. The Geneva Science and Diplomacy Accelerator will reflect and anticipate the need of global governance for scientific revolutions to come. Indeed, GESDA is fully in line with Switzerland's federal policy to promote education, research and innovation, or ERI for short. At the core of Switzerland's ERI policy is the following: we continuously strive to offer our stakeholders from the vocational education and training sector, higher education institutions, and research and innovation communities the best possible framework conditions for an autonomous and responsible engagement. Autonomy and individual responsibility are inseparably linked.

The Swiss Confederation keeps a comparatively low profile when it comes to defining the content or priorities in the fields of education, research and innovation. We are convinced that our stakeholders are in a significantly better position to anticipate and accelerate future trends and developments. By contrast, the Confederation sees itself – in close federal cooperation with the Cantons – essentially as an enabler in the ERI sector:

- Firstly, it provides significant financial resources: around 10% of the annual federal budget, which are largely allocated competitively and are awarded based on the criteria of excellence.
- And secondly, ERI policy is orientated towards long-term goals and it acts with great care regarding forward-looking legislation.

There is no question that this approach has been a recipe for success until today. Countless international comparative studies and rankings pay tribute to Switzerland's high competitiveness and excellence in the fields of education, research and innovation.

But these successes and high rankings are due to the commitment of yesterday and the day before yesterday. We are aware that there is an urgency to prepare and enable developments tomorrow and the day after tomorrow. This applies not least to the challenges and opportunities of promoting more internationalization in the field of education, research and innovation. ERI-topics have always had a significant international drive; even Erasmus of Rotterdam was, to a certain extent, globally active in the significantly smaller world of the 15th century.

What is different today, of course, is the speed with which new knowledge and know-how spreads and how this in turn accelerates new knowledge and new know-how again. In other words, international cooperation is nowadays generally at the centre of groundbreaking research results and their translation into marketable innovation. International cooperation, or at least global exchange in education, research and innovation, is particularly indispensable in view of contemporary global challenges. Whether it is climate change and energy supply, sustainable development and migration, digitalization and an economy 4.0 that serves humanity, COVID-19 and other possible epidemics–questions that are arising here can hardly be resolved alone by a small country like Switzerland, regardless how well it performs in ERI rankings. But what is clear is that Swiss ERI actors are capable and willing to tackle these topics and to make a significant contribution towards offering solutions.

From this point of view, GESDA is an exciting and innovative initiative. Its location in Geneva is key, as Geneva is already a successful venue for international diplomacy. At the same time, Geneva and the Léman-Region as a whole are a cutting-edge research and innovation cluster with global appeal. This combination is unique. As a truly multilateral and interdisciplinary platform, GESDA can play an important role in anticipating future trends and developments, while strengthening global governance in questions related to digitalization, climate change, artificial intelligence and much more.

Ladies and gentlemen,

I wish GESDA every success in its ambitious and important endeavour to anticipate the need of global governance on a multilateral level concerning future scientific revolutions!

Thank you very much.

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

Tatiana Valovaya

**Director-General,
United Nations Office at Geneva,
Russia**

Welcome Address

Excellencies,

Ladies and gentlemen,

Dear colleagues and friends,

It is a great pleasure for me to address the Geneva Science and Diplomacy Anticipation Summit.

The world is going through one of the most significant periods of advances in science and technology. We have entered the digital era with an unprecedented speed, a speed further accelerated by the COVID-19 pandemics.

Over the past year and a half, we have in fact transitioned and adapted to an increasingly digital reality. In this context, new technologies provided us with sound tools to face critical challenges: they helped scientists and health practitioners to develop medical solutions to the pandemic; they allowed children and adults to continue learning and working; they also lightened the burden of distance across separated families; and they showed us how more sustainable and inclusive lifestyles can be thanks to technology.

Nevertheless, these benefits have not been equally shared across the globe. Today, around half of the world's population still lacks access to basic technologies which often translates into drastic inequalities in terms of risks, opportunities and vulnerabilities. Just think that half of the humanity still does not have access to the internet.

The impacts of COVID-19 made this gap even wider and more apparent, thus adding to inequalities in livelihoods, income, education level, social mobility and health status. Overall, these inequalities impact one's capacity to recover and develop.

This disparity is often further exacerbated by threats on privacy, security, cyberattacks, as well as matters of human rights protection, both online and offline.

Moreover, some threats to our well-being as a society are yet unknown. It is one of the reasons we must work together to anticipate opportunities and mitigate risks, including through an enhanced dialogue between science and diplomacy. This bridge building is even more fundamental to help accelerate the implementation of the 2030 Agenda for Sustainable Development.

In this context, and in line with the strategic commitments outlined by the Secretary-General of the United Nations in his Strategy on New Technologies, let me underline the three following points:

- Together, we have to advocate for technology not to be understood as an end per se, but rather as a means to achieve the greater good for all, enshrined in the pillars of universality and inclusivity at the heart of the Sustainable Development Goals.
- We have to protect, respect and reinforce the different regulatory frameworks already in place, to maximize the benefits and positive use of technologies for all and to ensure the highest level of ethical standards is applied to scientific and technological progress.
- We also have to commit to multilateralism and multistakeholder dialogue, cooperation and advocacy, to bridge science, policy and society in the best interests of universal inclusivity, equality, human rights, and rule of law.

In this context, I am convinced of the very important role that the rich and diverse ecosystem of Geneva can play. Not only is Geneva a unique place for multi-stakeholder dialogue on how to address these issues in a universal manner, it also offers a vast scientific expertise helping Member States anticipate and tackle the opportunities and potential challenges of new technologies. In addition to science, the United Nations and many other stakeholders of this ecosystem offer unique expertise on human rights, sustainable development, health, social protection, humanitarian aid and so many other themes of high relevance.

The collective thinking and sharing of this GESDA Summit, is an excellent illustration of what can be done in this city.

As a global community, we need to be farsighted and anticipate the scientific and technological trends of tomorrow. Our institutions must be ready to cope with the rapid outburst of new technologies, and to channel their use towards the best possible outcomes. This is precisely where GESDA adds value.

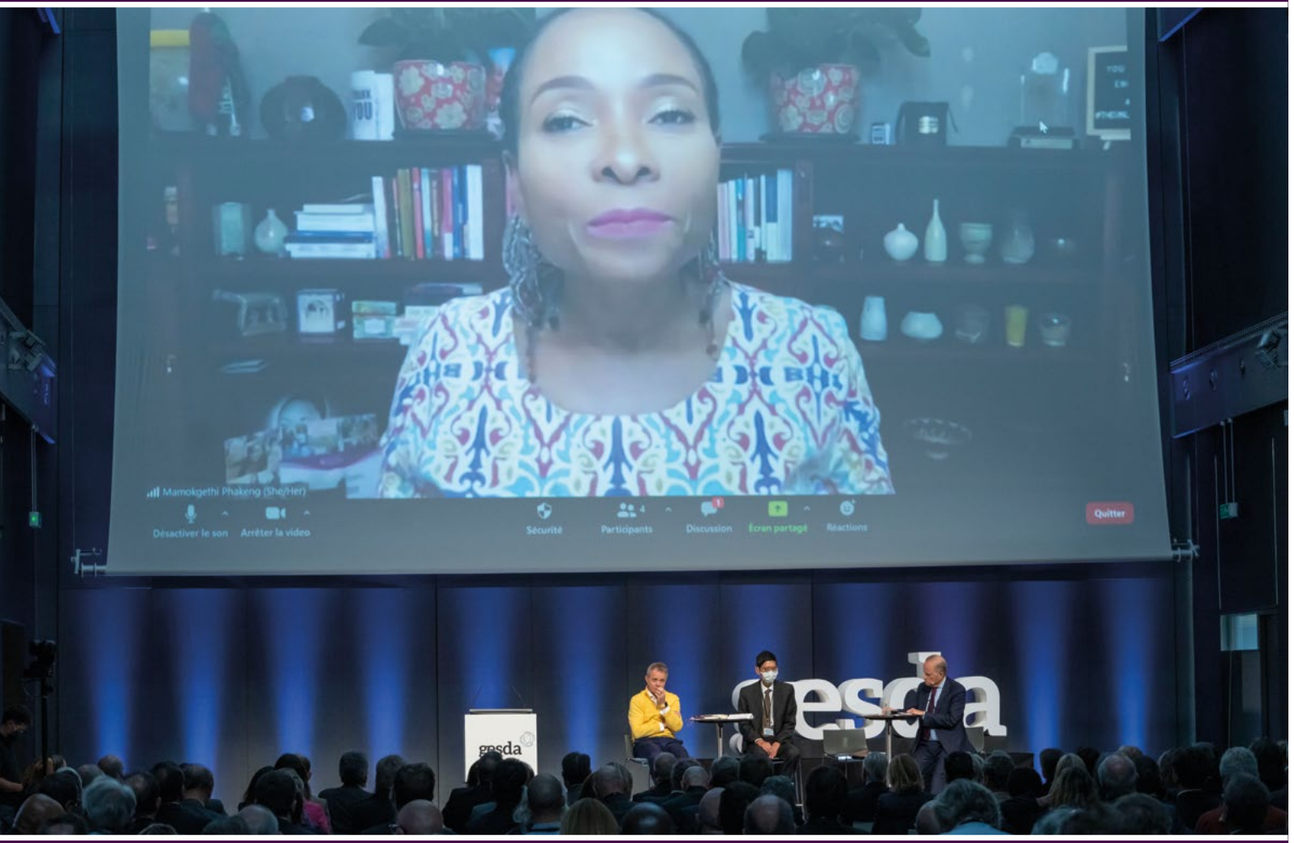
I am confident that this Summit will help us in further tackling complex issues that will become our common tomorrow. I am convinced that discussing these issues before they arise is what will help to prepare for a sustainable, fair and inclusive future.

I wish you all an excellent discussion.

Thank you.

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1



GESDA's 2021 Vision: "Using the Future to Build the Present"

Abstract

GESDA was founded in the belief that anticipatory science diplomacy can help renew multilateralism. It reflects Switzerland's ambition to maintain Geneva as one of the foremost centres of global governance and operational hub of the international community. GESDA serves as an honest broker of science-backed information, remaining neutral and objective as it gathers ideas through broad consultations.

Participants

Moderated by:

Michael Møller, Chairman, GESDA Diplomacy Forum, Denmark

With:

Chorh Chuan Tan, Chief Scientist, Ministry of Health, Singapore; Board Member, GESDA, Singapore

Jeremy Farrar, Director, Wellcome Trust; Board Member, GESDA, UK

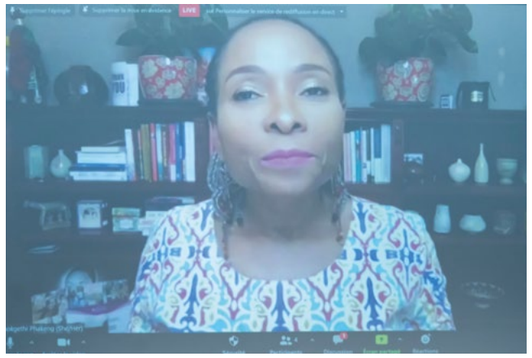
Mamokgethi Phakeng, Vice-Chancellor, University of Cape Town; Board Member, GESDA, South Africa (remotely)

Highlights

Introduction

The creation of GESDA, an independent, private, non-profit Swiss foundation established at Geneva in 2019, was based on the premise that the 21st century's acceleration in pioneering science and technology demands a parallel acceleration in ensuring their uses to humanity are as universally beneficial as possible, a process that will require nations to participate more broadly in multilateral frameworks through scientific anticipatory diplomacy. Operating on the principle of a public-private partnership, GESDA works to accomplish its vision of using the future to build the present by bringing together diverse communities that can jointly anticipate scientific and technological advancements as the basis for developing inclusive and global solutions for a sustainable future. In so doing, GESDA also seeks to renew international Geneva's infrastructures and to strengthen the role of Geneva and Switzerland as a neutral and inclusive location where the topics raised by tomorrow's multilateral world can be discussed.

Mamokgethi Phakeng's input to the vision for GESDA



"This space of dialogue that GESDA has created between science and diplomacy is incredibly important. Science and technology are advancing at a phenomenal pace, and if we do not anticipate how it is going to change us humans, how we relate and how the world functions, then we will exacerbate the global challenges that the world is currently struggling with. Just in case we did not know it already, COVID-19 is teaching us that as people of the world, we are connected. This is irrespective of nationality, race or religion, so it is important that we start considering those different questions – before it is too late. A first key question is how GESDA will enable equity and inclusivity? What are the possible major challenges?

"I think we have got lessons to learn from the challenges that we are facing with achieving the [UN] Sustainable Development Goals in Africa, which include financial resources, maintaining peace, measuring progress, and in accountability. Another important aspect of accountability relates to the ethics of potential new scientific advances, such as genetic editing.

"First, such development needs to include people from different demographic groups in any form. The pharmaceutical industry is already familiar with the tendency for different racial groups to respond differently to various products. So, genetic advances need to address genetic differences in people from the Global South. It is often easy to leave these people out, because sometimes it's difficult to reach them. I see my role and participation in this space to ensure that we are constantly thinking about those communities.

"Second, such important technological advances must not be restricted only to the better-resourced nations. Otherwise, we run the risk of dividing humanity into different species that are separated by genetic enhancements. This is not only unfair for all humanity, but it puts the world at risk of conflict based on genetic inequality. Just as trade is regulated through agencies like the World Trade Organization, and bilateral and multilateral treaties, there is a need for similar kinds of arrangements to regulate the application of any technology that has the potential to advance the human species. Any intervention to ensure that the developing world or Africa benefits from breakthroughs would need to also help build political will. Previous initiatives, such as the USAID Global Development Lab and the UK-based Newton Fund, rely largely on partnerships with the private sector to address most of these challenges. However, as one analyst explains, the private sector and entrepreneurs are not a like-for-like replacement of international development and local initiatives. There are pressing needs to build infrastructure, support health, health and education systems, and support governance and civil society structures. And these are necessary for science to flourish and for technology to transform.

"So, it is important for each African nation to be introduced to how science and technology are advancing fast and how they will affect them or can shape their life for the better. And perhaps for each nation to translate each of the breakthroughs into its own national plan of action, thus contributing to a better future for its own peoples, and by extension to a better future for the world. Objectives need to take into account both the historical marginalization of the developing world and in particular, Africans, and their potential to contribute significantly to the global development."

Chorh Chuan Tan's input to the vision for GESDA

"On one hand, we have very daunting global challenges: climate change, pandemics. On the other hand, we have very exciting research discoveries. And in between we have a long series of very deep valleys, which are very hard to traverse. And many have worked for a long time to accelerate the translation of research into solutions and technologies that can be applied to solve problems. But I think GESDA is unique, has a powerful vision, which is different in several ways.

"The first is it is not just looking at translating research into solutions, but to take it beyond: to also enable those solutions to be accessible to a much wider range of communities around the world. To benefit a much wider range of people from different countries around the world. So, we need to therefore traverse more valleys.

"The second is that it takes a stringent but globally inclusive approach to identifying the most high-potential research discoveries in science and technology so that it creates a strong foundation which is evidence-based, evidence-informed, upon which subsequent decisions can be confidently rested upon.

"And the third is it brings together to the GESDA Anticipation Situation Room many different stakeholders. And have those stakeholders help us understand the nature of those valleys, based on how they perceive them. That enables us, therefore, to figure out ways in which we can build the bridges together that will enable us to cross these valleys in order to reach the ultimate goal, which is to make science and technology solutions accessible and available to the maximum number of people.

"This all is a very complex process. But what has been particularly impressive has been the purposeful, the systematic, and the globally inclusive way in which the methodology is being developed to do this so that it will allow us to replicate, to build upon and to systematically develop better ways to learn how to cross all these areas. This is a very bold undertaking. My sense is that the first few bridges built might not be the best bridges. But it's a learning process, because we are not just at the end trying to build solutions. We are trying to also learn how to build those bridges in a much more systematic and a much more coherent manner that builds on the best of science and is responsive to the needs of most people in the world. So, it is a very powerful mission and vision. And I feel very privileged to be able to play a small part in this."

Jeremy Farrar's input to the vision for GESDA

"I am a medical doctor. My background is in emerging infections. The progress in the last 18 months, as we heard, has been nothing short of staggering. Vaccines developed, drugs developed, new diagnostic tools developed. And science has given us the potential to transform the first pandemic of the 21st century. And yet we have really failed! Multilateralism, which sits here in Geneva, was invented here. We are in a stage now when, despite having those tools, they are only available to a certain sector of society, a certain number of countries. And so, if we are going to change that – because all of the great challenges of the 21st century have common features – science and culture will help provide solutions to them. But if we end up with those being inequitably available globally, we will not have solved those challenges. We will have just added to them. And I am convinced science can play a role.

"But science needs to change. Science needs to accept that it cannot exist in its ivory towers. Science can no longer be in its silos of short-term thinking, chasing short-term grants. As scientists, we have got to think beyond our own spheres and take into account what is happening in society and what is happening in other sectors of science. But the diplomatic and political community – and this is not a criticism – is inevitably behind the curve in that scientific endeavour. It cannot be ahead of the curve, because of all of the constraints of politics and diplomacy, and also, frankly, because not enough scientists go into politics and diplomacy. If GESDA achieves anything, I think it will be to open the minds of scientists that they have a broader role in society, that they need to engage with and take societies with them, not assume that what scientists do will be accepted by everybody.

"I think the political and diplomatic class need to embrace those scientists, not for tomorrow in the short-termism of today's politics, but to think what challenges are coming five, ten, 25 years down the road, and what science is being done now that we need to think about in order to maximize the potential for the maximum number of people globally. We need to move away from being reactive to that change to being proactive and ahead of it. Because if we are reactive, we will put in place bad regulation and we will not take societies with us. So, it is at the heart of GESDA to get ahead of ourselves to break down those silos and think how can we make the maximum benefit of science for the maximum number of people in order to avoid the growing inequalities globally. That is why I wanted to and was honoured to join the board of GESDA."

Takeaway Messages

Science must become more accessible and inclusive, and its benefits more equitable. GESDA can work to accomplish that by considering how different communities are affected by advances.

Building trust – before it is needed in a crisis – is essential to getting diverse communities involved in science and persuading them of its benefits.

Scientists can play a broader role in society through forward-looking thinking beyond research projects that revolve around short-term grants.

Anticipatory science diplomacy will depend on 'bridge-building' among communities through a learning process that is responsive to the needs of people globally.

More information

Session recording on YouTube

Related interviews: Jeremy Farrar

Tweets related to the session

Michael Møller

Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

GESDA's 2021 Flagship product: The Science Breakthrough Radar®

Abstract

The GESDA Science Breakthrough Radar® is a new tool for multilateralism, informed discussions, and concerted action. It gives a neutral overview of the forthcoming possible breakthroughs in science and technology at five, ten and 25 years. Its purpose is to share this knowledge among diplomats, philanthropists, entrepreneurs and the general public for the benefit of all.

Participants

Moderated by:

Nanjira Sambuli, Policy Analyst, Advocacy Strategist; Board Member, Digital Impact Alliance, Development Gateway and The New Humanitarian, Kenya; Member GESDA Diplomacy Forum, Kenya

With:

Patrick Aebischer, President Emeritus, EPFL; Vice-Chairman GESDA, Switzerland

Michael Hengartner, President, ETH Board, Switzerland

Marie-Laure Salles, Director, Graduate Institute Geneva, France

Discussion

Introduction

Nanjira Sambuli started by presenting the topic of the discussion:

"According to GESDA's vision ("Use the future to build the present") and GESDA's mission, which is to anticipate, accelerate and translate the benefits of science and technology, the GESDA Science Breakthrough Radar® is designed to inform discussions and to prompt concerted action ahead of forthcoming science advances. This is to be achieved through a process that involves scientists, diplomats, philanthropists, entrepreneurs, civil society leaders and the general public right from the start.

This inaugural edition of the Radar extends science anticipation to the hot topic issues that societies are debating. It is complemented by assessments from eight leading scholars in philosophy, humanities and the arts. Their job is to assess how science breakthroughs reshape the ways we see ourselves, relate to each other and care for our environment. They also examine the significance of GESDA's chosen topics, synthesizing humanity's challenges.

It contains what GESDA calls the pulse of society, scanning social networks for comments on GESDA's themes.

It also addresses opportunities by answering the question: "What can we do with science anticipation?" That offers insight into global challenges such as the Sustainable Development Goals and some of the trends affecting multilateralism, including the spread of science anticipation among selected international organizations.

The Radar was developed through a strategic partnership with the Fondation pour Genève. Accompanying its development was a high-level scientific advisory board composed of:

- Prof. Michael Hengartner, President of the ETH Board, Zurich
- Sir Peter Gluckman, President of the International Science Council (ISC), outgoing Chair of the Advisory Group to International Network for Government Science Advice (INGSA)
- Prof. Marie-Laure Salles, Director of the Graduate Institute Geneva
- Prof. Michel Mayor, Professor Emeritus at the University of Geneva, 2019 Nobel Prize Laureate in Physics, and the Fondation pour Genève's representative to GESDA.

I am now happy to welcome on stage Michael Hengartner, Marie-Laure Salles and Patrick Aebischer, Vice-Chairman of GESDA."

Interview of the three panellists by Nanjira Sambuli

Nanjira Sambuli: What are the reasons that led GESDA to conceive of a Science Breakthrough Radar®? And what is GESDA trying to achieve with it?

Patrick Aebischer: "First, it came from the observation, as a scientist, that the pace of scientific development is increasing every year. There is a phenomenal acceleration. A second thing is the convergence of technologies: information technology, nanotechnology, biotechnology, cognitive sciences. Science lives no more in silos, but is interacting. It is even harder for scientists to

really grasp the whole breadth of what is going on. The third point is geographical: a hundred years ago, everything [in science] was probably happening in Europe and in the United States. Today, it is much more broadly distributed. We need to bring all those actors together. Look at the scientific development of Asia, for example, of China: you cannot do without it today. This is going to develop even further in the years to come. And the fourth and last element concerns the actors: a lot of the breakthrough disruptive discoveries are still happening in academic settings, with public resources. But some of it, for example in artificial intelligence (AI), is now also happening in big private institutions, in the GAFAs, that have recruited some of the top AI people. They need to be brought into the discussion. This is what we have done through the Radar.

"While we, scientists, are very comfortable in saying what we do and what we might do next year or the following year, it is far less usual and comfortable for us to say where we see our disciplines going in five, ten, or 25 years. But we have to give those trends. And probably some of those top scholars [who appear in the Radar] are the best people to tell us where trends are going, so that society can prepare to integrate them, to frame them, in order for them to be useful to the largest number. There are also things that we should probably prevent to do, prevent to use, prevent to apply. But I think scientists are not the right people to decide: we, scientists, are critical in saying what is happening today and what the trends are. But we have to share this knowledge with the society in general, the policymakers, the philanthropists, the entrepreneurs. That was really the rationale behind the Science Breakthrough Radar®. What we want to do is to provide what I call the 'raw material for the policy people and society' to be aware of and come sufficiently early with policies that can ensure the good utilization of science discoveries. What we want to be is an honest broker between the science and societies in general, and with the policymakers. And there is probably no better place to do it in the world than Geneva with the United Nations, the international organizations, the NGOs and world class research institutions.

"Also, science does not stop, but continuously evolves. That is why we have the concept of a rolling system. Once a year, we will re-adapt the Radar. Some fields may go faster, some slower. Some things, maybe unexpected, will happen, because this is also part of science. This first Radar is a beta version. More than 500 top scholars have contributed. It is never perfect, and will never be perfect, but that is the status of today. We have to increase the number of scientists that will participate, and we will have to adapt it continuously. But it is already a very critical tool for the world to be prepared about the discoveries that are happening, about what is cooking in the laboratories of science today so that we can use it for the best of our species."

Nanjira Sambuli: Michael, 216 breakthroughs predicted within five, ten and 25 years are listed. The science evolves really rapidly. How do we ensure this Radar stays up to date?

Michael Hengartner: "Patrick already mentioned we plan to have an annual update. We will see what happens. There might be new things that will pop up on the horizon. Some things might take more time. Some things might rush towards us at a much faster pace. And so, we need to keep our eyes open and continuously question ourselves and our hypotheses. It's important to realize we are not making predictions about the future. We are simply looking up potential scenarios. But because these scenarios have such tremendous potential impact on humanity, it is important that we start discussing them now and seeing what the implications could be. So, the GESDA Science Breakthrough Radar® simply sketches out the possible scenarios, the tools that might become available to humanities, for good or bad, in the years to come."

Nanjira Sambuli: Marie-Laure, the Radar describes how scientists in the field anticipate impactful advances at five, ten and 25 years. But science does not happen in a vacuum, and it evolves in broader societal and political contexts. How can the Radar take this into account for GESDA to translate the science anticipation into meaningful initiatives?

Marie-Laure Salles: "Let me actually go back to what technology is, what science is. Technology and science are a construction of humanity. And from the very beginning, science and particularly technology have been gifted with two sides. A side that has been about increasing the well-being of humanity – think about fire which, mastered by humans, becomes a technology, by bringing warmth, by allowing to cook food. On the other hand, fire can burn the village of the guy next door. So, technology has always had this double face. But today, we are reaching a moment when we have to really rethink all this. Why? Because over the last decades – at least in words, maybe not yet in reality – we have heard this notion that scientific breakthroughs would become the means to overcome humanity, to get beyond humanity. Transhumanism is really this idea. We are suddenly actually moving to a very different world where scientific breakthroughs are envisioned as a way to overcome our mind. Going back to the notion that science and technology must be inclusive tools for the well-being of the largest possible group of humans on Earth, I think this is really why it is very important to address these questions very seriously and very collectively.

"Now I want to point to what is dear to my heart, which is the role of social sciences in all this. Between on the one hand those breakthroughs, and on the other hand the well-being of humanity and the Sustainable Development Goals, we have valleys of translation. And this is where social sciences are key. Those valleys have been described: it is about trust, governance, ethics, etc. We are not talking about politics yet, but about social scientific innovations that need to be brought in order to interact with the tool that is the Radar. We need to bring those two fields together in certain ways. We need to find the mechanisms where we have social scientists talking with [natural] scientists. A further step will be when will be able to bring this hybridization in the production of the science from the start – and this will actually accelerate the overcoming of the valleys. This implies obviously a lot in terms of education of the next generation, both of [natural] scientists and social scientists, but also diplomats, etc. And for me, this is where we really have to go – as I like to say – from 'tech for good' to 'good in tech'. This is a major revolution, and it will hopefully be the next step for GESDA."

Takeaway Messages

The idea for the Radar came from the observation that the pace of scientific development is accelerating, and that many fields in science are converging (info-, nano-, bio- and neuro-technologies).

Scientists are accustomed to speaking about the near future. They are unaccustomed to talking about where their disciplines may be headed in five, ten, or 25 years – but this needs to change.

The Radar does not make predictions about the future, it looks at potential scenarios. Because of the high stakes involved, it is crucial to discuss the implications of those scenarios now.

The scientific community must share its knowledge with policymakers, philanthropists, entrepreneurs and society at large.

This first Radar is a beta version, continuously adapted, but it will never be perfect.

Many discoveries occur in academic settings with public resources and, increasingly, in well-funded private institutions that should be part of broader discussions GESDA envisions in its science diplomacy.

Social science and natural sciences must be partners from the start to maximize the benefits of breakthroughs.

The Radar has the potential to shape multilateralism and the future of International Geneva.

More information

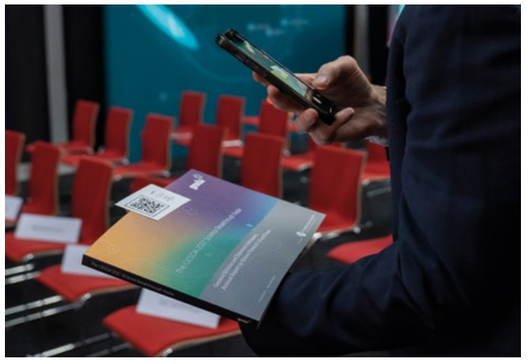
Direct access to the interactive GESDA Science Breakthrough Radar®

Session recording on YouTube

Related interviews: Patrick Aebischer

Tweets related to the session

→ GESDA Science Breakthrough Radar® interactive website



Thursday 7 October, 3:00–4:30pm CET

Opening Plenary Part-1

Marc Pictet

President of Fondation pour Genève, Switzerland

Closing Address

Ladies and gentlemen,

Dear Peter,

Dear friends,

For more than a century, International Geneva has greatly contributed to the search for solutions to the major challenges we are facing.

Today, the GESDA Science Breakthrough Radar® has the potential to help shape the future of modern multilateralism and transform International Geneva.

Science diplomacy is the future! There is no doubt that science and technology will play an increasingly important role in determining the future of humanity.

But as we just heard, science needs to change. It needs to involve the communities. Science needs to be broader and more inclusive. By bringing together different communities and identifying the scientific breakthroughs, we can accelerate the implementation of the 17 UN Sustainable Development Goals and contribute to a fairer, more secure and harmonious world.

I would like to acknowledge the exceptional work of the numerous scientists and diplomats who developed and realized the GESDA Science Breakthrough Radar®. I also would like to highlight the strong commitment of Geneva's private sector, which helped this ambitious project become reality.

The Geneva Science and Diplomacy Anticipator, created by the Swiss Confederation and the Canton of Geneva, and supported by the City of Geneva, is yet another illustration of a successful public-private partnership fostering a dynamic and forward-looking ecosystem in Geneva.

The Fondation pour Genève, celebrating this year its 45th anniversary, is proud to support GESDA, this bold undertaking. Over the next few months, we will be launching a series of publications and roundtables aiming at communicating with the public, the local community, on this new instrument.

These will be directed by Professor Michel Mayor, Nobel Prize in Physics 2019 and scientific advisor of our Foundation to GESDA.

Ladies and gentlemen, International Geneva belongs to all of us: scientists, diplomats, business leaders, civil society, public and private sectors. It is only by uniting our forces and networks that we will make it happen.

Thank you.

Thursday 7 October, 4:45–5:45pm CET

Opening Plenary Part-2

Opening Plenary Part-2

High-Level Panel

Can Anticipation in Science and Diplomacy Help Renew Multilateralism?

Participants

Moderated by:

Alexandre Fasel, Ambassador and Swiss Special Representative for Science Diplomacy in Geneva, Switzerland

With:

Sir Peter Gluckman, outgoing President of the International Science Council (ISC); Chair of the International Network for Government Science Advice (INGSA); Director, Koi Tū: The Centre for Informed Futures; Member, GESDA Diplomacy Forum, New Zealand *(remotely)*

Martina Hirayama, State Secretary for Education, Research and Innovation, Switzerland

Alondra Nelson, Deputy Director for Science and Society, White House Office of Science and Technology Policy, USA *(remotely)*

Naledi Pandor, South African Minister of International Relations and Cooperation, South Africa *(remotely)*

Achim Steiner, Administrator of the United Nations Development Program, Brazil/Germany *(remotely)*

Discussion highlights

The premise of GESDA is based on the observation that the pace of scientific development is increasing every year, accompanied by a convergence of new technologies that affects scientists across the board, rather than in specific fields or locations. And while many of the disruptive breakthroughs occur in academic settings, using public resources, other advances (such as with AI) are happening at large, private institutions. As a result of this fast pace, policymaking is not keeping up. To help politicians and diplomats navigate this rising tide, the GESDA Science Breakthrough Radar® taps into scientists' insights from a spectrum of backgrounds. Scientists are traditionally collaborative, but the increased specialization in their fields plus the furious growth in technologies they tap into are creating silos that exacerbate longstanding gaps between science and policymaking among nations and multilateral institutions. GESDA believes anticipatory science diplomacy can bridge those gaps, reinvigorating Geneva's multilateral institutions by helping ensure these advances benefit as much of humanity as possible.

Alexandre Fasel, a career diplomat who is Switzerland's first science diplomacy envoy, said his short answer to the question posed in the panel's title – "Can anticipation in science and diplomacy help renew multilateralism?" – is "probably yes, if the science is good, and if diplomacy is able and willing to grasp the anticipatory signals, to reflect them". But what GESDA is trying to do is new and, therefore, challenging. "My sense is that we have a double balance to strike," said Fasel. "On one hand, we want to open to opportunities which science and technology bring to us. And then on the other hand, we have to factor in the risk that we have to calculate in and the precautions we need to take. And the other balance we need to strike is between anticipation and challenges: the actors of global governance and multilateralism are already very busy with dealing with today's challenges."

The GESDA Science Breakthrough Radar® as a starting basis: why anticipation is important

The need to encourage politicians to discuss the science of the future, such as the possibility that some new form of global governance might be needed for AI, demonstrates the need for a new forum like GESDA, according to Martina Hirayama, whose expertise spans chemistry, technical sciences, and business. "One thing all scientists have in common is that they work being driven by curiosity. So, if you bring scientists together with diplomats, politics, other people, I think there has to be a curiosity to develop something good for the future," she said. "From my point of view, what is very important here and for Geneva, and for the multilateral objectives GESDA has, is that the GESDA Science Breakthrough Radar® shows important developments for the future with

high impact on our future life. And also, that it shows where we should discuss the needs on the political side to develop [those advances] in a good way." To her, the starting point for discussions should be the important topics facing the world within five, ten and 25 years, because "they are already here. It is actually what we should start to think about", she said. Usually, societies address them too late, she said, rather than "focus on the good news and avoid the things which shouldn't happen". "This is an important point" which, along with "working with curiosity", can "bring the scientists to the table".

Peter Gluckman agreed, saying the history of humankind is technological development, and every technology has an upside and a downside – both for intentional and unintentional uses. What is different now, he said, are the pace, pervasiveness and potential impact of technologies identified by the GESDA Science Breakthrough Radar®. "The challenge is we do not have a structure to deal with these issues at the speed at which they are developing," said Gluckman, a paediatrician and former science adviser to New Zealand's prime minister whose NGO, the International Science Council (ISC), encompasses 40 international scientific groups and more than 140 scientific organizations. "And secondly, I think that we need to ask increasingly whether these technologies are not going to create greater inequality rather than more equality." Within GESDA, he said, there is debate over transhumanist and brain enhancement technologies, whether only an elite part of the world will have access to them, and how the diplomatic community might need to respond. "At the same time, we need to think about how we preemptively think about the implications for society, the ethical implications and the equity considerations that go along with the rapid development of these technologies. And clearly, that's complicated," said Gluckman. "There are the issues at an individual society level. There are enormous issues at the multilateral level. And there are some quite complicated worldview issues. Look at the state of the world because of the Internet: It has got a good side; it has got a downside. Would we have allowed the Internet to develop with all the benefit of hindsight in the way we have allowed it to develop now? I am not sure."

Achim Steiner, a veteran UN administrator and environmental policymaker, said multilateral organizations already have an extensive track record of science enabling diplomacy, such as with climate change or biodiversity. "Take the ozone layer. We saw the emerging science informing, first of all, national thinking about a threat that was really for our planet, and then having to respond to that also as a community of nations," he said. "That then was transacted and facilitated through the UN Environment Programme, and [this helped] our nations to come together to achieve the multilateral structure, most recently the Kigali Amendment.

It shows how science has continuously informed our interests who have to respond." Another important development, he said, is the UN's ability to develop legal instruments such as conventions and agreements like the Intergovernmental Panel on Climate Change (IPCC), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and many others. "So, I think the principle of science and diplomacy being very much twin sisters, so to speak, and enabling a world to move from 'understanding a challenge' to 'acting on it' is established," he said.

Today's challenge, he said, is "we have entered into another era where the problem is not so much the fundamental principle of science informing public policy, it is that we are in a race against time. Our ability to come together as a community of nations of seven and a half billion people to act in unison in the face of global warming, a pandemic, or, indeed, other technological challenges such as cybercrime, clearly is not living up to the needs of our time. And, therefore, I think one interesting question would be to explore: Can we make the transition from where science enabled us to understand the challenge to how diplomacy can accelerate that capacity to act, notwithstanding different interests and geopolitics? And I think multilateralism is absolutely fundamental to that".

Ensuring the access to benefits of science to everyone

Naledi Pandor, a key player in South Africa's foreign policy and member of parliament since 1994, said one of the best approaches GESDA can encourage is to develop as many partnerships as possible between the public and private sectors and citizens. "I think that a milieu, an atmosphere in which free thinking is encouraged and innovation is absolutely vital. And it is not governments that would always have responsibility in encouraging particularly responsiveness to anticipation," she said. "I think it would be primarily the private sector, as well as science institutions that would play a role." To her, addressing challenges that citizens ask policymakers about is key: "Are we responding to the problem of tuberculosis? We need new treatment. It is a real problem here," she said, while noting that "those who are anticipating, who may be looking at innovation in terms of management and processing of digital big data and developing resources in the digital space – they would be more in the anticipatory domain."

Inequities must be addressed because "for science to matter, ordinary communities must see that it makes a difference to their lives", Pandor said. That means policymakers, scientists, diplomats, and investors in science must keep in mind everyone's access to the opportunities offered by science. The message of the pandemic, and the global inequity of vaccine access, is that "the benefits of science are for some

– for those who have money. And those who do not have resources or robust science institutions, they will wait in the line until science reaches them", she said. "We have to change that perception of science by making real these conversations about diplomacy, about international collaboration, and cooperation that we are having. Our people, our communities, must see that through our conversations, that which we promise – vaccines will be a public good – actually becomes a reality."

Alondra Nelson, a distinguished social science professor and researcher, noted that US President Joe Biden has described our time as one of great peril and great promise, and "that's exactly the tension that we sit in at this moment. And I think for those of us in government, to truly be of service, we really have a responsibility to be forthright about both those realities at once. And to be honest both about the risks of innovation and partnership, but also bold in addressing them head-on. And I think that the [Geneva Science and Diplomacy] Anticipator is a fantastic possibility for working this through. Anticipation is filled, of course, with both enthusiasm and yet unease".

International cooperation as a crucial lever

In the policy space, Pandor said, international collaboration must be supported while dealing with current challenges on the ground. "What you need to do is encourage room for innovation and partnerships by all those groupings," she said. "And I tend to encourage the use of international partnerships for much more adventurous blue skies relationships and exploration than perhaps the national institutions might be focused upon."

Everyone's fates are intertwined on the planet when it comes to climate change, economic prosperity, and public health, agreed Nelson, whose work in the Biden-Harris administration focuses on spreading the benefits of science and technology by overcoming economic, gender, racial and geographic disparities. That makes international cooperation a matter of practicality and equity. New tools can be misused or exploited, she said, for example, "extraordinary data can be abused, new technologies can be plagued by bias, research can fall into the wrong hands. So, I think we want to come into anticipation with some humility. We cannot predict the future, but we can certainly, in partnership with other governments, do our due diligence. We can assure that we are attempting to think through the possible implications of a new piece of technology and consider how it might be applied for good or for ill in the future. We cannot predict when the next pandemic will arrive, but we can be better prepared."

The White House unveiled a proposed pandemic preparedness plan to transform US capabilities to respond quickly and effectively to a future pandemic or severe biological threat, Nelson said. One piece involves modernizing digital health data with standardized software so data can be better shared and analysed. "It is the plan that we needed five years ago, and it is the plan that we hope will make us more prepared years from now. And these kinds of anticipatory investments will create products and capabilities that will not just lay dormant until the next pandemic, but will really create active capabilities, tools, resilience across society," she said. "But of course, this approach is going to require international cooperation. So many of the challenges that we face are not challenges of a nation or a country, but of course are whole-of-society challenges. And so, it means that we have got to work with international partners and to really face head-on the complexity of international cooperation, which is not to try to predict the future but to expand global participation and collaboration without sacrificing safety or compromising security."

How to make it concretely happen? Redesigning the future of development by working on concrete cases, and not just meta-conversations.

Steiner said GESDA's anticipatory approach is similar to what he has tried to introduce at UNDP. "Very often, particularly in the international relations and development arena, you transact a lot of what is – essentially – unfulfilled promises. It is very much a legacy agenda. And one of the very deliberate exercises I have tried to bring during my tenure at UNDP is to be very much more anticipatory. What is the future of development?" he said. UNDP and many developing nations have been affected by digitalization and the evolution in fintech, despite some governments not being part of the rulemaking. As a result, UNDP tries to help nations use anticipation as a tool. "There is another element to innovation. That is to understand that science or technology are, in themselves, perhaps factual and conclusive on certain findings. They provide us with choices, but ultimately societies have to make choices," he said. "We established over the last three years 92 so-called Accelerator Labs, essentially inserted into our country teams with a single objective and mandate to go look and understand how innovation is emerging from within a country, whether it is a rural community, whether it is the startup community, and then help a country and its national policymaking to translate those insights."

Towards a global learning platform

These are choices that are not just answered by a technological fact or a scientific finding, but are difficult questions such as "how many poor people is it worth having in order to have a higher rate of GDP growth? What is the price you are willing to pay in terms of exclusion? Or do we prioritize inclusion in a digital ecosystem?" Steiner said. "And these are the kinds of choices where GESDA could really also contribute to through a global learning platform. Science is fundamental. Technology will be a driver.

"At the end of the day, we are still human beings living in communities who have to make very tough choices. And they have to be far more informed, far more empowered, and also – this is part of the United Nations DNA – less discriminatory."

The need to reduce discrimination in society, for example with access to vaccines, is essential to gain citizens' support, Pandor said. "If I am at the back of the queue for a vaccine that will make a difference to my life, science becomes immaterial. And that's a dangerous point for us. Because what happens is then you have a lack of belief in progress and in the modernity offered by science. So, I do think this period of the pandemic has created a basis for us to rethink how we reach those who are most disadvantaged and ensure that they become proponents for science advancement, that they become believers in the enterprise of science, cooperation and innovation. In that way, I believe we will achieve the greatest. It means that one of the things we need to attend to is the development of science in the poorest societies. We have got to ensure that we have science institutions. We must invest in human capacity, develop research capability. Because science becoming a human phenomenon cannot rely on an exclusive view. All of us must have a part to it, must play a role in it."

The need to protect an open space of borderless science cooperation

The Biden-Harris administration stands for "open, equitable and secure science", principles that are not mutually exclusive, said Nelson. "In fact, they have to work together in tandem if we are going to improve lives and livelihoods through the scientific and technological enterprise." Like everything, ensuring those principles work together is a balancing act, she said, and "there are things that we can and should do to ensure the security of our science, of our scientists. Like ensuring that federally-funded researchers disclose potential conflicts. But there are also clear solutions to address the sort of the challenges of our time. And at this moment, we really have to lean into values of openness and transparency, honesty and equity, fair competition, objectivity and democracy. The best antidotes to the risk of open science are the vigorous collaborative pursuit of integrity in our science, across borders and different parts of the scientific universe, and bringing everyone along, understanding that science and technology is truly the inheritance of all of us, not only the work of doing it, but also the implications that it holds for progress and the world. And I think it is really by taking on these practices together that we will be able to, to continue to work together, and to find new ways to reach this kind of geopolitical balancing act".

Accelerating the pace at which foreign ministries take ownership of scientific breakthroughs

Gluckman said history shows science and scientists are always collaborative, but science itself is changing as divisions increase and technologists "run ahead of" social considerations. "And I think one of the things that this discussion is highlighting is the need to make sure, as the ISC is [doing], that all the sciences and, in particular, social scientists are part of the discussion right from the start, rather than allowing the technological sciences to run ahead of the social considerations," he said. "We're seeing the emergence of transdisciplinary science as perhaps the most important way of approaching the many wicked problems we have."

"But I want to make one other comment: science is frustrated by the silos. There are very few countries that actually have effective input of science into their policymaking systems. There are only a few agencies within the multilateral system that, like UNDP and some of the technical agencies, do not view science as a marginal thing on the side," said Gluckman. "Very few countries have science embedded within their foreign ministries in any way, shape or form. And yet, if we are going to advance the global agenda with more equity, science cannot just be seen to be over here and the rest of the activity over there. We need the policy community and the diplomatic community to recognize science also needs to be embedded within their ambit as well. And so, I think there is a lot of thinking about what process might lead to better communication because, as we said earlier, things are moving so fast we do not have the luxury of taking it slowly. We have to think now about the impacts of these rapidly moving technologies."

Conclusions from Ambassador Alexandre Fasel: Bringing the science into the mainstream of multilateralism and global policy

Fasel noted that anticipatory science diplomacy, while ensuring that geopolitics do not interfere with the borderless and global collaborations that science needs to thrive, can lead to practical solutions by encouraging people to work concretely together on problems despite their different languages and agendas. "It is not just about anticipating the science and the technology. It is probably also a matter of anticipating governance," he said. "I think we have heard several elements such as that the time is pressing, that we need to work in a way that guarantees equity and equality, that we need to proceed in the logic of partnerships, that we need to make sure that there are no resource gaps, that we break up the silos and bring everybody on a platform to move those issues forward. And it seems to me those are exactly the orientations that GESDA, by bringing the science into the mainstream of multilateralism and global policy, is adopting with its methodology."

Takeaway Messages

Few nations effectively incorporate science into their policymaking, which would benefit from more international cooperation.

The topics facing the world, which are in the GESDA Science Breakthrough Radar®, should be the starting points of the discussions, to be launched now in order to maximize the beneficial use of those advances while minimizing the associated risks.

The main and most urgent challenge is the current lack of structures to deal with these issues at the speed at which they are developing, in order to avoid creating more inequalities. Diplomacy must accelerate its capacity to act, notwithstanding different interests and geopolitics.

Inequities must be addressed for communities to see that science matters. Everyone must promote universal access to the opportunities offered by science.

Everyone's fates are intertwined when it comes to climate change, economic prosperity, and public health. Countries need to face head on the complexity of international cooperation, without sacrificing safety or compromising security.

Anticipation is not the exclusive responsibility of national governments. More public-private partnerships would help.

People face tough choices that would be better informed and less discriminatory if they were based more on anticipatory science.

Maintaining open science, through collaboration and shared integrity can bring more balance to geopolitics.

More information

Session recording on YouTube

Related interviews: Martina Hirayama

Tweets related to the session

Thursday 7 October, 4:45–5:45pm CET

Opening Plenary Part-2

Maria-Francesca Spatolisano

Officer-in-Charge,
Office of the Secretary-General's Envoy on Technology;
Assistant Secretary-General, Policy Coordination and Inter-Agency Affairs,
Department of Economic and Social Affairs (DESA),
Speaking on behalf of the United Nations Secretary-General,
Italy

Closing Keynote Address

Excellencies,

Ladies and gentlemen,

It is my pleasure to join you here today – thank you for the opportunity to speak at your inaugural summit.

As Assistant Secretary-General for Policy Coordination and Inter-Agency Affairs of the UN Department for Economic and Social Affairs, and Officer-in-Charge of the UN Office of the Secretary-General's Envoy on Technology, but also on behalf of the UN Secretary-General, I welcome this initiative undertaken by GESDA towards advancing multilateral science and diplomacy with the aim of achieving a better future.

I would like to share with you today a few thoughts on diplomacy in the Anthropocene – our times, when human activity is changing the Earth on a planetary scale, perhaps irrevocably.

For many of us here, this is not news.

Indeed, in October 1987 – 34 years ago, almost to the day – the United Nations published 'Our Common Future' which spoke of the Earth, 'as a small and fragile ball', and how 'humanity's inability to fit its activities within it…(was) changing planetary systems, fundamentally.' Prime Minister Brundtland, in introducing the report, spoke of the need to move intentionally from 'One Earth to One World.' Since then, globalization and technology have indeed pushed us towards 'One World'. But this is far from the world we want.

Indeed, it may seem that diplomacy itself may have fallen behind the rapidity with which our world is being transformed. Many of our governance mechanisms and diplomacy are falling increasingly behind the pace of the private sector, particularly in the area of digital technologies. I would suggest that diplomatic institutions, crucial to how we realize 'our common future' in this age, may want to consider three imperatives for their work:

First, for everyone, the global interest is now also their national interest.

Second, science and technology are evolving rapidly, capable of influencing the world at planetary scales.

Third, diplomats need stakeholders from the science and technology communities, just as much as these communities need diplomats.

We don't need to look very far back to find examples of when these three imperatives have effectively guided our work. Just six years ago, in 2015, the world came together to agree to the Addis Ababa Action Agenda, the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change. Each one of these was the result of months of negotiation and consensus building, testament to political will and diplomatic skills, exemplifying the three imperatives I mentioned earlier. In particular, the Addis Ababa Agenda and the 2030 Agenda set up new institutional entry points for science and technology at the apex level of the UN General Assembly, through mandates for the Global Sustainable Development Report, as well as the Technology Facilitation Mechanism. My Department is privileged to operationalize both of them.

Since 2015, the urgency for incorporating these three imperatives as systematically as possible into our work has only grown. Take our experience with the pandemic. Like you, I have despaired at our lack of preparedness, been alarmed at the state of our public institutions, marvelled at the near miraculous advances in science and technology, and felt profoundly grieved at the unnecessary continuation of the pandemic in 'hot spots' around the world. Indeed – to borrow a phrase that many of you here use routinely – we may already be seeing 'alternate futures' evolving – between those with access to vaccines, social protection, technology capacities; and those without. Being able to envision such futures before they happen is critical for being able to make the choices that will ensure that only the best outcomes – for us, as well as for succeeding generations – are realized.

I would like to congratulate this group for supporting these capacities and trust their work will also expand such knowledge and tools to developing countries as well. 'Anticipation', of course, is only the first step – both global efforts such as those from IPCC and IIASA, and national ones such as the Global Trends project in the USA – show that turning foresight into timely action is no easy task. Which is why the recent report of Secretary-General, Antonio Guterres, called 'Our Common Agenda', puts forward a suite of actions to help create a stronger, more networked and inclusive multilateral system, anchored within the UN – making the UN itself also more effective in dealing with the challenges of the present and the future. In addition, the Agenda puts a premium on the need for science as a basis for policy-making, stressing particularly that with regards to information, the "war on science" must end and that we must defend a common, empirically backed consensus around facts, science and knowledge.

One prominent set of actions recommended is around improving digital cooperation. The recommendations in 'Our Common Agenda' build on those of the Secretary-General's High-Level Panel on Digital Cooperation and the Secretary-General's subsequent Roadmap on Digital Cooperation issued last year, and culminate in a Global Digital Compact

to be signed at the Summit of the Future in 2023. Throughout all this, we remain steadfastly committed to realizing a more open, free and secure digital future for all. Of the 90 recommendations contained in this report, there are many that are directly relevant to your work. I note, in particular, the proposal for the creation of the Emergency Platform and the enhanced use of strategic foresight through a Futures Lab to foster better anticipatory approaches and long-termism. Other actions promote a 'quintet of change' for the UN itself, including capacities for innovation, data, strategic foresight, results orientation and behavioural science.

Excellencies, ladies and gentlemen,

I began my remarks by reminding us all that we are indeed in the Anthropocene epoch. As with other geologic epochs, scientific opinion is divided on when it started. But there is consensus that the direction this epoch takes, and how long it lasts, is in our hands.

I trust that our meeting today will strengthen your substantive engagement with the United Nations, bringing us together, in diplomacy and otherwise, to help realize a shared, benevolent future for people and the planet.

I thank you.

More information

Session recording on YouTube

Thursday 7 October, 4:45–5:45pm CET

Opening Plenary Part-2

Naledi Pandor

**Minister of International Relations and Cooperation,
South African Government,
South Africa**

Closing Keynote Address

I would like in closing to really stress our congratulations to the Government of Switzerland and its partners on this I think very strategic initiative, in that bringing the worlds of science and diplomacy together is pioneering work which we believe leverages Geneva's attributes as one of the seats of our multilateral organization the United Nations. There are many urgent issues to which science and international collaborators, diplomats, need to develop responses to, among them the COVID-19 pandemic and future pandemics, as well as developing international cooperation and responses to climate change. The relationship between science and diplomacy needs to be highlighted as an important one, and I think the GESDA initiative is more than timely.

We are very fortunate as South Africa to enjoy a science and innovation partnership with Switzerland. We contribute to various science programmes in major multilateral organizations located in Geneva. For example, we are proud to be the host of the World Health Organization's first technology transfer hub for mRNA vaccine technology and we support the United Nations Conference on Trade and Development, in building capacity for agriculture and energy technology assessment in Africa. We also benefit from the work of the World Intellectual Property Organization in the area of indigenous knowledge science and innovation, and in our work as Co-Chair of the Group on Earth Observations hosted at the World Meteorological Organization.

Through this experience of international partnerships, we are eager and ready to contribute to the work of the Anticipator and I truly appreciate that senior South African scientific and academic leaders such as Prof Mamokgheti Phakeng are already strong participants. I wish to congratulate GESDA on the launch of its Science Breakthrough Radar® as its first flagship product. By anticipating breakthrough technology developments in science and technology, and through delivering authoritative advice for policy- and decision-makers, this will be a valuable tool to enhance the international governance of breakthrough science and thus make this instrument a global good.

I fully endorse the GESDA 2021 vision of "Using the future to build the present", I wish however to conclude by stressing that it is vital that we also not forget the past. As South Africa we are progressing from a young to a maturing democracy. We constantly have to remind ourselves, that in order to deliver a better future for all, we have to be mindful of the past painful legacy and the lessons we derived from it. Similarly, as we celebrate and anticipate the continued rapid progress of science and technology, we should never forget that, shamefully, many of the citizens of our world still live in extreme poverty and that ours remains a world of huge and unacceptable inequalities that we must find international solutions to.

We have thus chosen "Science for Social Justice" as the theme for the UNESCO World Science Forum that South Africa will host in 2022, an event to which I hope many of you will attend and participate in.

So, dear colleagues, let us use the future to build the present, and learning from the past, let us ensure that it is a future, which as stated in the transformative vision of the Sustainable Development Goals, is one that leaves no one behind. I wish the Geneva Science and Diplomacy Anticipator all success in its important mission. You will all be required to respond with agility, it will be imperative that you act with purpose and always use your collaboration to reinforce international solidarity. In this work and in this endeavour, I wish to assure you that you can count on South Africa's diplomatic participation in all your efforts.

I thank you very much for listening to me and for having invited me to be part of this most exciting endeavour.

More information

Session recording on YouTube

Thursday 7 October, 6–7pm CET

Welcome networking reception

Friday 8 October, 7.15–8.15pm CET

In partnership with the Graduate Institute Geneva, Fondation pour Genève and the Club Diplomatique de Genève

Keynote Address by:

Enrico Letta

Secretary of the Italian Democratic Party;
President, Jacques Delors Institute;
Former Prime Minister of Italy;
Former Dean of the Paris School of International Affairs at Science Po-PSIA,
Member of GESDA Diplomacy Forum,
Italy

Public Plenary

Original version in french

Comment anticiper, accompagner et partager les évolutions scientifiques à venir ?

« C'est un énorme plaisir d'être ici parmi vous. Pour parler d'anticipation, de science, de diplomatie et de Genève. Merci à GESDA pour cette invitation.

J'ai gardé deux activités dans mon ancienne et heureuse vie à Paris, durant six ans. L'une est la Présidence de l'Institut Jacques Delors – je ne pourrais absolument pas faire autrement, non seulement pour l'amitié que j'ai pour la personne de Jacques Delors, mais aussi pour l'attachement que je porte à ses idées. L'autre, c'est d'être un des acteurs de GESDA, avec vous tous : une idée géniale, née à Genève, dont je suis vraiment ravi d'avoir pu participer aux moments fondateurs. Des moments durant lesquels j'ai vraiment eu un grand bonheur intellectuel à comprendre, à apprendre.

Anticipation, diplomatie scientifique, Genève: voici les trois points que je vais essayer d'élaborer.

Anticipation

Le premier – le plus intéressant de mon point de vue, naturellement – c'est l'anticipation. Qu'est-ce que cela veut dire, aujourd'hui ? Pourquoi dit-on que l'anticipation est essentielle pour construire le futur ? Les dernières années l'ont simplement démontré.

Quand je suis entré en politique, on me disait que, pour en faire et pour construire le futur, il fallait connaître le passé, se baser sur le passé. C'est vrai. Mais quand je vois tout ce qui s'est passé durant les dernières années, j'ai comme l'impression que le fait de savoir tout ce qui s'était passé dans le passé n'était pas suffisant pour comprendre ce qu'ont été le Brexit, Donald Trump aux Etats-Unis, les crises financières, la pandémie, les changements climatiques, [ni] tout ce que nous sommes en train de vivre dans nos vies et dans les relations internationales. L'anticipation est essentielle, car c'est la capacité d'imaginer le monde de demain. Et pour le faire, il faut à la fois la "capacité d'utiliser l'avenir pour construire le présent" – comme le dit GESDA – et celle de faire en sorte que le présent soit un présent dans lequel les idées pour l'avenir soient le centre de nos activités, autrement dit : quelque chose de concret, de sérieux.

Je prends [pour exemple] l'intelligence artificielle, qui est déjà dans nos vies, et qui le sera de plus en plus. Et je sais que toute intelligence artificielle utilise des données du passé. Cela dit, quand je pense à la créativité, je n'imagine pas l'intelligence artificielle, je continue de penser au cerveau des hommes et des femmes. Et quand je pense à la politique, là aussi, même si un regard en arrière par-dessus nos épaules est la chose la plus simple à faire en période de changements, ce n'est pas la plus juste. Regardez ce qu'il s'est passé pendant les dernières années: une globalisation rapide, forte, qui a amené des tremblements de terre, qui a changé nos vies. Et qui a fait en sorte qu'une grande partie des gens ont eu peur de cette mondialisation et ont cherché un refuge. Ce refuge, c'est le vieil État-nation, ainsi que les langues que l'on maîtrise déjà parfaitement.

Mais quand l'on rentre dans ces refuges bien connus, on ne cherche pas à imaginer des avenirs. On ne se prépare pas pour l'avenir. Le populisme, dans nos sociétés d'aujourd'hui, est ainsi surtout une façon simple de [conforter] les gens qui ont peur – parce que l'accélération de la mondialisation amène des peurs justifiées. Il ne faut absolument pas nier tout cela, mais la question essentielle est : comment faire en sorte que ces peurs se transforment en énergie positive ? C'est exactement ce qui a manqué dans cette période récente, tant on a plutôt cherché un refuge dans le passé.

Et franchement, quand on y pense qu'aujourd'hui, il y a trois États-nations qui sont entrés au G20 sans avoir eu besoin de frapper à sa porte ni d'en demander les règles d'accession. Leur nom ? Apple, Amazon et Microsoft, [des entités] qui sont plus grandes qu'au moins une dizaine de pays membres du G20. Évidemment, ce ne sont pas des États-nations. Mais l'on sait tous très bien que leur dimension non-étatique aujourd'hui est beaucoup plus importante, en termes de changement, que ce qu'on imagine. On a vu la difficulté qu'a eue l'Europe concernant la taxation de ces "pays" – même si une nouvelle positive est venue hier d'Irlande [le pays ayant décidé le 7 octobre 2021 de relever à 15% ses taux d'imposition sur les sociétés, afin de rejoindre l'accord mondial de réforme de la fiscalité négocié sous l'égide de l'OCDE]. Or l'on sait tous très bien que continuer à agir à une échelle uniquement nationale signifie ne pas avoir les outils pour régler l'économie globale, qui est aujourd'hui influencée par ces géants d'une façon que l'on connait très bien. L'Union européenne, dans ce sens-là, peut être une des plus grandes innovations, si elle se maintient, parce qu'elle est capable elle-même de gérer ses relations

en fonction des grands changements et selon les nouveautés institutionnelles dont je vous parlais. Jacques Delors a eu cette expression que j'ai toujours aimée : "L'Europe comme une Fédération d'États-nations". Encore aujourd'hui, c'est la manière la plus efficace pour décrire l'Europe. Parce que l'Europe va continuer à avoir pour base les États-nations. C'est impossible d'imaginer que cela puisse disparaître – je pense que ce serait même stupide d'imaginer que cela puisse disparaître. Mais comment faire en sorte que l'État-nation devienne la partie centrale importante de quelque chose qui est et doit être une fédération ?

Un autre exemple de la nécessité d'utiliser des modèles inédits concerne la démographie. C'est un sujet exceptionnellement passionnant. Là aussi, le passé nous donne rarement des données intéressantes et des pistes pour comprendre. Quand je dis donc "anticiper", on est en train de comprendre que tout va changer à cause du changement démographique. On comprend aussi que ce changement démographique peine à devenir le cœur d'une réflexion politique concrète. Quand je pense à mon propre pays [l'Italie] – l'un des pays vivant une chute démographique parmi les plus violentes –, quand je pense à ce qu'il sera en 2050, et quand on parle de ce qu'on devrait faire pour éviter cette situation, on comprend très bien qu'on voit le problème mais qu'on n'a aucune intention de prendre les décisions nécessaires pour éviter un désastre. On sait tous très bien lesquelles elles sont : ce sont des décisions politiques concernant la natalité et la famille, autant que des décisions complexes à prendre et absolument nécessaires sur les aspects de l'intégration, de l'immigration. Et quand on est un pays comme le mien, qui ne veut plus d'enfants et qui ne veut pas d'immigrés, c'est assez compliqué d'imaginer un futur dans lequel cette chute démographique ne va pas devenir un tremblement de terre qui va complètement changer la donne. Dès lors, comment anticiper ? Parce qu'en démographie, si on se rate sur cinq ans, dix ans, 15 ans, la suite de l'exercice d'anticipation devient pratiquement impossible.

Qu'est-ce que cela veut dire, une population âgée ? Des quartiers, des services complètement ancrés sur les personnes âgées ? Une société qui n'est pas capable d'encourager les jeunes ? Je ne cesse de le répéter, en parlant du rôle de la démocratie : il faut anticiper ce problème [de vieillissement de la population] parce qu'il va arriver. On va alors vivre dans des sociétés dans lesquelles la majorité des électeurs auront des cheveux blancs. Et lorsque l'on est un électeur avec des cheveux blancs, on regarde [les choses] et on vote avec un sens du futur qui est différent. Un jeune de 20 ans vote – s'il le fait aujourd'hui – en sachant qu'il va vivre encore 90 ans en moyenne. Ce n'est pas le cas pour un électeur âgé, évidemment. Cela implique que notre cohorte d'électeurs est totalement déséquilibrée, et le sera encore davantage à l'avenir. Par exemple, il faudrait des Parlements dans lesquels il n'y ait pas seulement un « quota rose », mais aussi des « quotas bleus », à savoir des assemblées dont on tient pour acquis qu'un pourcentage de députés ont moins de 30 ans. Mais vous comprenez très bien qu'aujourd'hui, en faisant une proposition comme celle que je viens de faire, ou comme cette autre que j'avais déjà faite et que je vais continuer à pousser – à savoir donner l'électorat aux jeunes de 16 ans – , je suis attaqué dans mon pays. On me dit : « Ce n'est pas la priorité, il y a beaucoup d'autres problèmes ». C'est vrai. Mais le problème de l'anticipation, c'est cela : on se dit toujours que les priorités sont ailleurs. En italien, on appelle cela le benaltrismo. Et on se dit : « Bon, cela, on le laisse pour après ». Mais l'après n'arrive jamais. Ou il arrive trop tôt, et les problèmes sont déjà là.

Les technologies qui n'existent pas aujourd'hui seront habituelles d'ici à dix ans. Et naturellement, la technologie changera notre façon de voter, de travailler. On sait tous très bien ce que cela va donner. Mais en même temps, les gens de l'après-pandémie demandent des choses différentes. [Pour illustrer cela,] je vous livre une expérience personnelle, ceci cinq jours après avoir terminé ma campagne électorale. Celle-ci m'a amené à passer deux mois de ma vie – peut-être les plus beaux – dans la campagne toscane et ailleurs dans mon pays pour parler aux électeurs. J'ai alors compris que l'idée qu'on pouvait avoir des campagnes électorales – à savoir qu'elles sont toutes basées sur la technologie, les médias sociaux, la communication – ne s'est pas confirmée. Je n'ai rencontré que des électeurs qui voulaient me regarder dans les yeux, qui voulaient me parler et avoir mon attention, physiquement, pour les écouter. Les électeurs de ce genre n'auraient pas été convaincus par un tweet ou [une vidéo sur] Tik Tok, ou que sais-je. Ils voulaient seulement me parler, que je les écoute, que je passe du temps avec eux, que je touche leurs mains. Cette expérience m'a beaucoup touché. Ce n'est pas ce à quoi je m'attendais. J'avais décidé de faire une campagne «boots on the ground », et c'est peut-être grâce à cela que nous avons gagné. [En résumé], le point essentiel m'amène à penser, à l'aune de cette pandémie, que l'anticipation n'est peut-être pas toujours [aussi évidente que ce qu'on imagine au premier regard.]

L'autre aspect important lié à l'anticipation est le coût de la non-anticipation. Un exemple, très simple ? La crise [économico-financière] de 2008-2011. Dans le cas précis de cette crise européenne, le coût de la non-anticipation a été incroyable en termes de vies humaines, de ressources financières. Des pays entiers sont tombés. Des gens se sont suicidés. Un désastre économique [à cause] d'une réponse tardive à la crise et de la non-anticipation. Je ne veux pas dire là qu'il fallait anticiper le fait que la crise arrivait – c'était trop compliqué, je le crains. Mais [il se serait] au moins [agi de faire en sorte] que la réponse tombe un an après [la crise], dix-huit mois après, et non pas quatre ans après. Le « whatever it takes » lancé par le premier ministre du gouvernement de mon pays – que je soutiens –, a été prononcé le 26 juillet 2012, Lehman Brothers s'étant effondré le 15 septembre 2008. Aujourd'hui, on regarde ce qu'il s'est passé : quatre ans, c'est quelque chose d'incroyable ! C'est le coût de la non-anticipation et surtout, de ne pas avoir compris la vitesse à laquelle il fallait absolument apporter des réponses. Donc, l'anticipation est essentielle. Une anticipation qui nous donne aussi la possibilité de faire en sorte qu'on comprenne rapidement ce que le monde de demain va être, parce qu'on est décalé en termes de génération. Aujourd'hui, le développement durable, magnifié par le mouvement des Fridays for future [lancé par des jeunes à travers le monde et qui proteste contre l'inaction contre la crise climatique], est le sujet sur lequel ce décalage est le plus important.

Diplomatie scientifique

Mon deuxième point est la diplomatie scientifique, un point essentiel. Naturellement, GESDA joue un rôle essentiel. C'est incroyable le chemin que vous avez, que nous avons fait ensemble, en deux ans – deux années qui ont été un peu particulières. Cela montre que l'idée est bonne, et il faut absolument continuer. Mais qu'est-ce que cela veut dire? Comment mettre ensemble diplomatie, politique internationale, science, notamment sur les sujets qu'on a connus récemment, dont naturellement la pandémie? Car la pandémie a fait comprendre qu'il faut aussi des gens, des dirigeants politiques, qui soient vraiment capables aujourd'hui de prendre en compte autant les sciences sociales que les sciences dures. S'il vous manque les unes ou les autres, il est très compliqué de trouver la façon de comprendre ce qui est en train de se passer, d'anticiper, de prendre les bonnes décisions.

Autre grand sujet sur lequel la politique et les sciences doivent jouer un rôle essentiel : l'espace. On en parle beaucoup chez GESDA. Quand on voit les acteurs privés et les touristes qui vont dans l'espace, on se demande ce que ce monde sera demain. On sait tous très bien le rôle que les « Moon shots » ont eus dans le passé, mais on comprend très bien que c'est un domaine dans lequel l'anticipation et le rôle de la politique sont absolument essentiels. L'Europe joue un rôle fondamental, pas simple.

Je cite aussi les pôles, l'Arctique et l'Antarctique, qui de mon point de vue, sont les autres grands domaines sur lesquels l'anticipation offre la possibilité aux politiques de jouer un rôle rapide. Par ailleurs, les Big Data sont évidemment un grand sujet, à propos duquel la crainte autour des infrastructures de 5G a été importante, même dans des campagnes électorales récentes, voire dans les relations entre les États : comment faire en sorte que la confiance devienne la clé avec laquelle on peut discuter de cela et éviter ce qu'il s'est passé entre la Chine et les Etats-Unis ? Ce qu'il se passe aussi avec le Canada ? Ce sont des exemples qui nous donnent une idée des conséquences possibles.

Naturellement, enfin, le changement climatique. De nombreuses alarmes ont été tirées par le Groupe intergouvernemental d'experts sur l'évolution du climat (GIEC). Mais l'on sait tous très bien que c'est la science qui a joué un rôle essentiel dans ce domaine. Car seule la science est en position, aujourd'hui, de dire des choses que les politiciens ne peuvent pas dire, ou alors que ceux-ci peuvent dire seulement après que la science les ait dites... Je pense que ce sixième rapport du GIEC joue un rôle crucial : le fait de dire clairement que c'est à cause de l'homme que le changement climatique a lieu oblige évidemment à prendre des actions et à faire en sorte qu'on décide d'une façon différente de celle du passé.

Genève

Mon troisième point, c'est la Ville de Genève. Parce qu'on y est. Parce que Genève n'est pas seulement une ville, c'est beaucoup plus que cela. Je me rappelle nos étudiants de la Paris School of International Affairs (PSIA) : Genève, pour eux, était quelque chose de mystérieux, important, fondamental pour leur futur. La chose la plus intéressante pour eux était de venir à Genève, de faire des choses de nos activités à Genève. La diplomatie a besoin de lieux. Je ne pense pas que ces lieux puissent être des réunions par Zoom. On a [certes] découvert les nombreux aspects positifs de Zoom : cela oblige à être beaucoup plus courts dans nos discours, à aller « straight to the point ». Mais je n'ai pas vu, lors de cette récente période, d'accords conclus par Zoom. Les accords, ou les compromis, on les trouve en se regardant dans les yeux, en se parlant côte-à-côte, en se comprenant. C'est pour cela que la diplomatie a besoin de lieux. Genève est ce lieu par excellence. Et je pense que Genève peut l'être encore davantage, avec ce lancement d'une idée que l'anticipation est la clé du futur, d'un monde qui est en train de changer et ne se base plus sur le passé. Un monde dans lequel l'éducation va jouer un rôle premier.

Genève est donc ce lieu idéal. Le renforcement du multilatéralisme, du modèle onusien, des réformes à ce niveau, est crucial. Car il faut commencer aussi à vraiment calculer les coûts de la non-coordination – un point très important pour faire comprendre aux gens que les Nations Unies, le multilatéralisme, jouent un rôle essentiel dans le présent de nos vies. Considérez la pandémie, durant les premiers mois, avant que la coordination arrive. Nous avons passé des semaines [sans coordination], au niveau européen, parce que l'Europe n'avait pas de compétence, et n'a toujours pas de compétence en matière de santé. Ursula von der Leyen a demandé à la conférence sur l'avenir de l'Europe, qui est en train de se développer jusqu'au mois de mai

prochain, de prendre la décision de créer l'Europe de la santé. Une Europe de la santé qui n'existe pas encore parce que des pays, dans le passé, ont bloqué Jacques Delors himself en lui disant : ce domaine, « là, c'est à nous, ce n'est pas aux bureaucrates de Bruxelles ». Or on a compris au mois de mars 2020 ce que ce « c'est à nous » veut dire : c'est le désastre. La pandémie est un sujet dans lequel le coût de la non-coordination a été un coût de pertes de vies humaines immense. Avant de quitter la PSIA, j'avais d'ailleurs fait la proposition à l'OCDE de monter une initiative multilatérale importante qui puisse essayer de calculer le coût de la non-coordination dans la vie européenne; Jacques Delors lui-même avait lancé cet exercice, le « coût de la non-Europe ». Ce sont là des démarches importantes. Mais la nécessité première est d'avoir un lieu, des lieux physiques, dans lesquels on puisse se parler, avec ce mood d'anticipation, de confiance réciproque. Une confiance avec laquelle on puisse travailler ensemble, entre gens qui ont des backgrounds différents, des gens qui viennent de pays différents, mais des gens qui se rencontrent ici et qui trouvent ici la volonté pour un avenir qui nous tient ensemble.

Et la pandémie a joué un rôle essentiel à cet égard, parce que dans la pandémie, on a compris qu'on était tous dans le même bateau. On l'a beaucoup dit pendant cette période, mais en fait, je peux le résumer dans une phrase très simple. Avant la pandémie, on pensait que les relations internationales étaient un océan avec 195 bateaux, les pays de l'ONU, les pays qui font partie du système des organisations internationales. Et chaque bateau – autrement dit chaque État-nation – était là, en parlant la même langue – quelques-uns, trois ou quatre langues… Si un bateau sombrait, faisait naufrage, on l'aidait. Mais en fait, c'était ce bateau-là qui était concerné le naufrage, pas les autres. Après la pandémie, on a compris qu'on est en fait dans un grand bateau avec 195 pièces. Et dans ces 195 pièces, il y a naturellement des cabines de 1ère classe, 2e classe, 3e classe. (On l'a vu récemment avec les pourcentages de vaccination : nous, ici, sommes tous en 1ère classe, mais il y a des parties du monde qui sont en 3e classe). Mais on sait tous très bien que si le bateau sombre, c'est la 3e, la 2e et la 1ère classe qui vont à l'eau. C'est la différence entre les mondes d'avant et d'après la pandémie. Parce qu'on a compris qu'un événement qui se passe dans un marché d'une ville dont on n'avait peut-être même pas connaissance, peut faire tomber nos économies, et faire en sorte qu'un pays comme le mien doit payer 20 points de dette publique en un an. On a appris l'interdépendance totale. Et cette interdépendance totale fait en sorte que l'anticipation, aujourd'hui, est quelque chose qui nous concerne tous. S'il y a quelqu'un dans un autre pays avec peut-être des idées politiques différentes des miennes, mais qui m'aide à anticiper ce qui va se passer dans tous les domaines que j'ai rapidement cités, c'est évidemment mon intérêt de travailler avec lui. C'est pour cela que ce travail de diplomatie scientifique est tellement crucial aujourd'hui après la pandémie.

Conclusion

Ma conclusion est que, pour construire tout cela, il faut s'appuyer sur l'éducation, qui est essentielle, centrale. C'est pour cela que c'est bien qu'on soit ici [au Graduate Institute Geneva] pour discuter de cela. C'est bien qu'il y ait beaucoup d'étudiants ce soir parce que grâce à vous, votre travail nous pousse vers l'avant. La question des langues, et de leur traduction, est aussi cruciale. Si l'on ne fait pas en sorte que toutes ces activités ne se passent pas dans beaucoup de langues différentes, on reste dans une élite. L'anticipation passe enfin par le fait qu'on soit capable de convaincre les gens que les décisions qu'il faut prendre sont essentielles car, sur la base des données scientifiques qu'on connaît, des phénomènes vont se passer.

Mon message à tous les jeunes, c'est un peu le message que j'essaie de faire passer dans mon pays ; j'ai mis les jeunes au centre de la vie politique de mon parti et de mon projet politique, parce qu'on est en train de créer un monde dans lequel, à cause de la démographie notamment, les jeunes sont trop marginalisés. Je leur demande donc d'être courageux, d'oser et d'exploiter leur capacité de créer, non pas sur les bases de ce qui s'est passé dans le passé mais sur des bases complètement nouvelles – parce qu'on a besoin de cela. J'ai appris ces derniers temps que ce qu'il va se passer n'a pas de base dans le passé, mais sera complètement nouveau. Ce qu'il va se passer, dans nombre de sujets, à cause des changements technologiques ou démographiques, nous oblige à une créativité pour laquelle il est nécessaire que l'on développe l'éducation. Car de toutes les activités humaines aujourd'hui, l'éducation est probablement la plus importante. Merci.

More information

Session recording on YouTube

How to anticipate, accompany and share future scientific developments?

English translation

It is a great pleasure to be here with you. To talk about anticipation, science, diplomacy and Geneva. Thank you GESDA for this invitation.

I have kept two activities in my former and happy life in Paris, for six years. One is the Presidency of the Jacques Delors Institute – I could not do otherwise, not only for the friendship I have for Jacques Delors, but also for the attachment I have to his ideas. The other is to be one of the actors of GESDA, with all of you: a brilliant idea, born in Geneva, of which I am truly delighted to have been able to participate in the founding moments. Moments during which I really had great intellectual pleasure in understanding and learning.

Anticipation, science diplomacy, Geneva: these are the three points I will try to elaborate.

Anticipation

The first – the most interesting from my point of view, of course – is anticipation. What does it mean today? Why do we say that anticipation is essential for building the future? The last few years have simply demonstrated this.

When I entered politics, I was told that, in order to do so and to build the future, you had to know the past, to base yourself on the past. This is true. But when I see everything that has happened in the last few years, I have the impression that knowing everything that happened in the past was not enough to understand Brexit, Donald Trump in the United States, the financial crises, the pandemic, climate change, [and] everything that we are experiencing in our lives and in international relations. Anticipation is essential, because it is the ability to imagine the world of tomorrow. And to do this, you need both the ability to "use the future to build the present" - as you say at GESDA – and the ability to make the present a present in which ideas for the future are the focus of our activities, in other words: something concrete, something serious.

I take [as an example] artificial intelligence, which is already in our lives, and will be more and more. And I know that all artificial intelligence uses data from the past. But when I think of creativity, I don't think of artificial intelligence, I still think of the brains of men and women. And when I think of politics, again, while looking back over our shoulders is the easiest thing to do in times of change, it is not the fairest. Look at what has happened in the last few years: rapid, strong globalization, which has brought earthquakes, which has changed our lives. And it has made a lot of people afraid of this globalization and seek a refuge. This refuge is the old nation-state, and the languages that we already master perfectly.

But when you go to these well-known refuges, you don't try to imagine the future. One does not prepare for the future. Populism, in our societies today, is thus above all a simple way of [comforting] people who are afraid – because the acceleration of globalization brings justified fears. There is no denying this, but the essential question is: how can we turn these fears into positive energy? This is exactly what has been missing in recent times, as we have instead sought refuge in the past.

And frankly, when you think about it, today there are three nation-states that have entered the G20 without knocking on its door or asking for membership. Their names? Apple, Amazon and Microsoft, [entities] that are bigger than at least a dozen G20 member countries. Obviously, they are not nation-states. But we all know very well that their non-state dimension today is much more important, in terms of change, than we imagine. We have seen the difficulty that Europe has had with the taxation of these 'countries' – even though positive news came yesterday from Ireland [the country having decided on 7 October 2021 to raise its corporate tax rates to 15%, in order to join the global tax reform agreement negotiated under the aegis of the OECD]. But we all know very well that continuing to act on a purely national scale means not having the tools to regulate the global economy, which is now influenced by these giants in a way that we know very well. The European Union, in this sense, can be one of the greatest innovations, if it is maintained, because it is capable of managing its relations according to the great changes and institutional innovations that I mentioned. Jacques Delors had this expression that I have always liked: "Europe as a federation of nation-states." Even today, this is the most effective way to describe Europe. Because Europe will continue to be based on nation-states. It is impossible to imagine that this could disappear – I think it would be stupid to imagine that it could disappear. But how do you make the nation-state the important central part of something that is and must be a federation?

Another example of the need to use new models is demography. This is an exceptionally exciting subject. Here again, the past rarely gives us interesting data and leads to understanding. So when I say 'anticipate', we are in the process of understanding that everything will change because of demographic change. We also understand that this demographic change is struggling to become the focus of concrete political reflection. When I think of my own country [Italy] – one of the countries experiencing one of the most violent demographic falls – when I think of what it will be like in 2050, and when we talk about what we should do to avoid this situation, we understand very well that we see the problem but that we have no intention of taking the decisions necessary to avoid a disaster. We all know very well what they are: they are political decisions concerning the birth rate and the family, as well as complex decisions to be taken and absolutely necessary on the aspects of integration and immigration. And when you are a country like mine, which no longer wants children and which does not want immigrants, it is quite complicated to imagine a future in which this demographic fall will not become an earthquake that will completely change the situation. So how can we anticipate? Because in demography, if we miss out on five years, ten years, 15 years, the rest of the anticipation exercise becomes practically impossible.

What does it mean to have an elderly population? Neighbourhoods and services that are completely focused on the elderly? A society that is unable to encourage young people? I keep saying it, talking about the role of democracy: we have to anticipate this problem [of an ageing population] because it will happen. We will then live in societies in which the majority of voters will have white hair. And when you are a voter with white hair, you look [at things] and you vote with a different sense of the future. A 20-year-old votes – if he does so today – knowing that he will live another 90 years on average. This is not the case for an elderly voter, obviously. This means that our electorate is totally unbalanced, and will be even more so in the future. For example, there should be parliaments in which there is not only a "pink quota", but also "blue quotas", i.e. assemblies in which it is taken for granted that a percentage of the members of parliament are under 30 years old. But you understand very well that today, by making a proposal like the one I have just made, or like the other one that I have already made and that I will continue to push – that is to say, to give the electorate to 16-year-olds – I am attacked in my country. I am told: "This is not the priority, there are many other problems." That is true. But the problem of anticipation is this: we always tell ourselves that the priorities are elsewhere. In Italian, we call this benaltrismo. And we say to ourselves: "Well, we'll leave that for later". But the aftermath never comes. Or it arrives too soon, and the problems are already there.

Technologies that don't exist today will be commonplace within ten years. And of course technology will change the way we vote, the way we work. We all know very well what this will mean. But at the same time, post-pandemic people are asking for different things. [To illustrate this,] I will give you a personal experience, five days after I finished my election campaign. I spent two months of my life – perhaps the best – in the Tuscan countryside and elsewhere in my country talking to voters. I realized that the idea that one might have had of election campaigns – that they are all about technology, social media, communication – was not borne out. I only met voters who wanted to look me in the eye, who wanted to talk to me and have my attention, physically, to listen to them. Voters like that wouldn't have been convinced by a tweet or [a video on] Tik Tok, or whatever. They just wanted to talk to me, to listen to them, to spend time with them, to touch their hands. That experience really touched me. It's not what I expected. I had decided to do a 'boots on the ground' campaign, and maybe that's why we won. [To sum up,] the main point is that I think, in the light of this pandemic, that anticipation is perhaps not always [as obvious as one might imagine at first glance].

The other important aspect of anticipation is the cost of not anticipating. A very simple example? The [economic-financial] crisis of 2008–2011. In the specific case of this European crisis, the cost of non-anticipation was incredible in terms of human lives, financial resources. Entire countries have fallen. People committed suicide. An economic disaster [because of] a delayed response to the crisis and non-anticipation. I don't mean to say that it was necessary to anticipate the fact that the crisis was coming – that was too complicated, I'm afraid. But [it would have been] at least [to ensure] that the answer came a year after [the crisis], 18 months after, not four years after. The "whatever it takes" statement by the prime minister of my government – which I support – was made on 26 July 2012, as Lehman Brothers collapsed on 15 September 2008. Today, we look at what has happened: four years is something incredible! This is the cost of not anticipating and, above all, of not having understood the speed at which responses were absolutely necessary. So anticipation is essential. Anticipation also gives us the possibility of quickly understanding what tomorrow's world will be like, because we are out of step in terms of generation. Today, sustainable development, which is highlighted by the Fridays for the Future movement [launched by young people around the world to protest against inaction on the climate crisis], is the subject where this gap is the greatest.

Science diplomacy

My second point is science diplomacy, which is essential. Of course, GESDA plays a key role. It is incredible how far you have come, that we have come together, in two years – two years that have been a bit special. This shows that the idea is good, and we must absolutely continue. But what does that mean? How can we bring together diplomacy, international politics and science, especially on

the subjects we have recently been dealing with, including of course the pandemic? Because the pandemic has made us understand that we also need people, political leaders, who are really capable today of taking into account both the social sciences and the hard sciences. If you lack one or the other, it is very complicated to find a way to understand what is happening, to anticipate, to take the right decisions.

Another big issue where policy and science have to play a key role is space. We talk about it a lot at GESDA. When we see the private actors and tourists who go into space, we wonder what this world will be like tomorrow. We all know very well the role that 'moonshots' have played in the past, but we understand very well that this is an area in which anticipation and the role of politics are absolutely essential. Europe plays a fundamental role, which is not easy.

I would also mention the poles, the Arctic and the Antarctic, which in my view are the other major areas in which anticipation offers politicians the possibility of playing a rapid role. Furthermore, big data is obviously a major issue, and there has been a great deal of fear about 5G infrastructures, even in recent election campaigns, and even in relations between states: how can we ensure that trust becomes the key to discussing this and avoiding what happened between China and the United States? What is also happening with Canada? These are examples that give us an idea of the possible consequences.

Finally, of course, climate change. Many alarms have been sounded by the Intergovernmental Panel on Climate Change (IPCC). But we all know very well that it is science that has played a key role in this area. Because only science is in a position today to say things that politicians cannot say, or that they can say only after science has said them. I think that this sixth IPCC report plays a crucial role: the fact that it is clearly stated that it is because of man that climate change is taking place obviously obliges us to take action and to make sure that we decide in a different way than in the past.

Geneva

My third point is the City of Geneva. Because we are there. Because Geneva is not just a city, it is much more than that. I remember our students at the Paris School of International Affairs (PSIA): Geneva, for them, was something mysterious, important, fundamental for their future. The most interesting thing for them was to come to Geneva, to do things in Geneva. Diplomacy needs places. I don't think these places can be Zoom meetings. We [certainly] discovered the many positive aspects of Zoom: it forces us to be much shorter in our speeches, to go straight to the point. But I haven't seen any agreements reached by Zoom during this recent period. Agreements, or compromises, are reached by looking each other in the eye, by talking side by side, by understanding each other. That is why diplomacy needs places. Geneva is that place par excellence. And I think that Geneva can be even more so, with this launch of an idea that anticipation is the key to the future, to a world that is changing and is no longer based on the past. A world in which education will play a primary role.

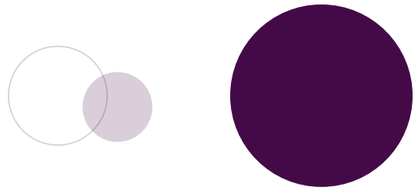
Geneva is therefore the ideal place. The strengthening of multilateralism, of the UN model, of reforms at this level, is crucial. Because we also have to start really calculating the costs of non-coordination – a very important point to make people understand that the United Nations, multilateralism, plays an essential role in the present of our lives. Look at the pandemic, in the first few months, before the coordination came. We spent weeks [without coordination], at the European level, because Europe had no competence, and still has no competence in health. Ursula von der Leyen has asked the Conference on the Future of Europe, which is taking place until next May, to take the decision to create a Europe of health. A Europe of health that does not yet exist because in the past, some countries blocked Jacques Delors himself by telling him that this field was "ours, not the responsibility of the Brussels bureaucrats". But in March 2020 we understood what this "it's up to us" means: it's a disaster. The pandemic is an issue where the cost of not coordinating has been a huge cost in terms of loss of life. Before I left the PSIA, I had proposed to the OECD that it should set up a major multilateral initiative to try to calculate the cost of non-coordination in European life; Jacques Delors himself had launched this exercise, the "cost of non-Europe". These are important steps. But the first necessity is to have a place, physical places, where we can talk to each other, with this mood of anticipation, of mutual trust. A trust with which we can work together, between people with different backgrounds, people who come from different countries, but people who meet here and who find here the will for a future that holds us together.

And the pandemic has played an essential role in this respect, because in the pandemic we understood that we were all in the same boat. A lot has been said during this period, but in fact I can sum it up in a very simple sentence. Before the pandemic, we thought that international relations were an ocean with 195 boats, the UN countries, the countries that are part of the system of international organizations. And every boat – in other words every nation-state – was there, speaking the same language – some, three or four languages... If a boat sank, was shipwrecked, we helped it. But in fact, it was this boat that was concerned with sinking, not the others. After the pandemic, we realized that we are in fact in a big boat with 195 rooms. And in these 195 rooms, there are naturally first class, second class and third class cabins (as we saw recently with the vaccination percentages: we here are all in first class, but there are parts of the world that are in third class). But we all know very well that if the boat sinks, it's the third, second and first class that go in the water. This is the difference between the pre- and post-pandemic worlds. Because we have understood that an event that happens in a market in a city that we may not even have known about can bring down our economies, and cause a country like mine to have to pay 20 points of public debt in one year. We have learned total interdependence. And this total interdependence means that anticipation today is something that concerns us all. If there is someone in another country with perhaps different political ideas from mine, but who helps me to anticipate what is going to happen in all the areas I have just mentioned, it is obviously in my interest to work with him. That is why this work of science diplomacy is so crucial today after the pandemic.

Conclusion

My conclusion is that, in order to build all this, we must rely on education, which is essential, central. That is why it is good that we are here [at the Graduate Institute Geneva] to discuss this. It's good that there are many students here tonight because thanks to you, your work is pushing us forward. The question of languages, and their translation, is also crucial. If we do not ensure that all these activities do not take place in many different languages, we will remain in an elite. Finally, anticipation means being able to convince people that the decisions that need to be taken are essential because, on the basis of the scientific data that we know, phenomena will occur.

My message to all young people is the message I am trying to get across in my country; I have put young people at the centre of the political life of my party and of my political project, because we are creating a world in which, because of demography in particular, young people are too marginalized. I therefore ask them to be courageous, to dare and to exploit their capacity to create, not on the basis of what has happened in the past, but on a completely new basis – because we need that. I have learned recently that what is going to happen has no basis in the past, but will be completely new. What is going to happen in many areas, because of technological or demographic changes, requires us to be creative, for which we need to develop education. Because of all human activities today, education is probably the most important. Thank you.



More information

Session recording on YouTube

Programme sessions

Quantum Revolution and Advanced AI

Human Augmentation

Eco-Regeneration and Geoengineering

Science & Diplomacy

Four Scientific Frontier Issues **16 themes of discussion from three angles**	**Quantum Revolution and Advanced AI**	**Human Augmentation**	**Eco-Regeneration and Geoengineering**	**Science& Diplomacy**
What? Sessions with a focus on anticipating what is 'cooking' in the labs at 5-10-25 years?		Engineering Pathways for Radical Health Extension → **P.92** Negotiating the Boundaries of our Genetic Future → **P.96** Learning from COVID-19 to Prepare the Response to the Next Systemic Crisis → **P.100**	Utilizing Space Resources for Collective Prosperity → **P.108** Advancing Science for Ocean Stewardship → **P.112**	Reviving the Human Right to Science → **P.120** Designing an Economic Compass for Sustainable and Resilient Societies → **P.126**
So What? Sessions with a focus on accelerating the discussion about the potential impact of science breakthroughs for diplomacy	Opening Quantum for the Benefit of Humanity → **P.84** Co-developing Accessible Advanced AI → **P.88**	Establishing Neuro Rights → **P.104**	Accelerating the Active Decarbonization of the Planet → **P.116**	Revitalizing Multilateralism through Anticipatory Science and Diplomacy → **P.130** & Announcement of GESDA's Capacity Building Initiative: → **P.134** Building Digital Models to Navigate the 21st Century's Complex Ecological and Social Systems → **P.136**
Now What? Sessions with a focus on the tools we need to develop in order to translate into solutions this knowledge on those frontier issues				Enriching Science with Citizen Voices and Values → **P.142** Making Sense of Science Anticipation for Concrete Impact → **P.148** & Announcement of GESDA-XPRIZE → **P.152** Catalyzing Inclusive Growth through Anticipatory Science → **P.154**

Friday 8 October, 3:15–4:15pm CET

ACCELERATE

Opening Quantum for the Benefit of Humanity

Abstract

In 2019, Google used a computer with 54 quantum bits, or qubits, to perform a calculation in 200 seconds that would have taken the world's most powerful supercomputer 10,000 years to complete. The answers had little practical use, but it marked a major inflection point in the development of quantum technology. Over the next decade, quantum computers that can turbocharge the search for new materials and drugs will become a reality. So will quantum communication networks with uncrackable encryption and quantum sensors providing ultra-precise measurements in medicine, Earth sciences and positioning systems. The strategic potential of this new quantum infrastructure will require global coordination to both ensure and control access to it, so that its opportunities are open to everyone, and its applications are beneficial to all.

- What intractable problems could quantum computers help to solve?
- What is the best way to help policymakers understand quantum technology, so they are better prepared to take advantage of quantum advances and to make sensible and forward-looking decisions?
- How can we make sure the benefits of quantum technology applications are open to all?

Participants

Moderated by:

Katia Moskvitch, Communications Lead Europe, IBM Research, UK

With:

Anousheh Ansari, CEO, XPRIZE Foundation; Member, GESDA Diplomacy Forum, USA/Iran

Fabiola Gianotti, Director-General, CERN; Board Member, GESDA, Italy

Nicolas Gisin, Honorary Professor, University of Geneva, Switzerland

Elham Kashefi, Professor of Computer Science; Personal Chair, Quantum Computing, School of Informatics, University of Edinburgh; Director, CNRS, Sorbonne University; Co-Founder, VeriQloud, Iran

Matthias Troyer, Distinguished Scientist, Microsoft Quantum; Member, GESDA Academic Forum, Austria

Peter Knight, Emeritus Professor, Faculty, Natural Sciences, Department of Physics, Imperial College London; Former Defence Scientific Advisory Council, UK Ministry of Defence, UK *(remotely)*

Highlights

Along with artificial intelligence, the pursuit of quantum computing – which promises to crack longstanding, complex scientific problems – is growing among the world's top academic and industry research labs. "It's a revolution that's been a long time coming: at least 30 years of research by a large fundamental research community that has actually been at the heart of everything that we see," said Peter Knight, a physicist and emeritus professor known for his pioneering work into theoretical quantum optics. "But what we see now is science developing into technology, exquisite engineering that is generating new prototype systems under control," he said. "Quantum is a total game changer. And it's a game changer that's been recognized right around the world. There's over $22 billion that's been invested worldwide by governments by 2021, and it's become a kind of international race, fuelled sometimes by the fear of missing out. So, we've got to be extraordinarily careful about avoiding hype. But quantum will affect us all."

So, what is it, concretely? Nicolas Gisin, an experimental physicist and professor working on quantum information, communication, and mechanics, explains. "In your smartphones, you have electronic transistors, [materializing] the so-called bits (represented by the series of 1s and 0s). In the quantum world, you have quantum bits, or qubits. They can be, at the same, in state 1 or state 0, in superposition. This – I agree – is complicated to understand. Let's make it even more complex: if now you have two qubits, the theory tells you they can not only be in combination (00, 11, 01 or 01), but can also be in superposition of all those coupled states. And each time you add a qubit, the number of parameters you need to describe that collection doubles – doubling typically means an exponential increase. Now suppose you have 300 of these qubits: the number of parameters needed to describe that is about the same size as the number of atoms in the entire visible universe. Obviously, a classical computer won't be able to handle [or simulate] that. But if you go quantum, with 300 perfect qubits, [which enables such a large number of parameters], because of the superposition principle – which changes everything – you get to computing power that is unthinkable. And that is probably where all the promises are coming from."

Quantum technologies can theoretically be used in many different fields: "It can change all of chemistry and material science. It can help us predict the properties of the materials accurately," said Matthias Troyer, a theoretical physicist. "It could also let us design a catalyst for carbon fixation, which we can use to deal with global warming. It can help us find new materials, superconducting." Since no one knows yet how to build the best quantum computers or what their full capabilities might be, he said, more collaborative projects and the sort of cooperation that GESDA espouses will be essential. "We are also at the start of the race," he said, "because while we have about 50 qubits now, we need a few hundred perfect qubits for real-world applications to concretize."

Quantum is also being applied to cryptography, which is based on difficult math problems like discrete logs and integer factorization. With enough scale, a quantum computer could dramatically accelerate the time it takes today's computers to solve these problems – posing security risks to all kinds of infrastructure, including diplomatic and military communication, protected by cryptographic algorithms. But quantum also offers a "solution for all of these things", said Elham Kashefi, a professor and researcher at the French National Centre for Scientific Research (CNRS), who co-founded VeriQloud, a Paris-based software provider for quantum networks that is developing a hybrid classical-quantum cloud solution for secure data communication, storage, and computation on local networks. She pointed to her ten-year-old son as an example of how giant leaps in science and technology can radically disrupt our ways of thinking. "Whenever I argue with him, 'You should not do this, you should not do that,' he will say that there is a parallel universe in which you accepted that I had this ice cream and we did not have this argument, and we are happy. And I think he's exactly the example of what it is. For him, it's very normal to think in a parallel universe, quantum, superposition – and to bring a complicated problem to me: 'Mommy, can you solve the problem of poverty using quantum?'"

Despite their open minds, not enough young people are being trained to work on quantum, which will be creating hiring challenges for all sorts of conventional and new jobs such as quantum coders, quantum algorithm developers and error correction scientists. This is a challenge that goes to the heart of GESDA's work "because we are not ready; we are not ready

because most people don't even know about it", said Anousheh Ansari, an engineer and the first self-funded female astronaut to go to the International Space Station, whose XPRIZE Foundation is partnering with GESDA to launch a GESDA-XPRIZE Quantum competition over the next several years. "They don't know how to use it. There's a huge skills gap that already exists today and is anticipated to widen in the future. Even the companies who are working on it have issues hiring the right kind of talent and skills they need to actually advance the technologies," she said. "And you know, what worries me is that the small number of people who are working on it will be persuaded by governments to work on military applications and applications that we really don't want to see, because that's where the money is, and it can be done in a closed, dark room and no one can see it."

Quantum computing, though complicated, could be taught earlier than at university; high school students could be introduced to quantum physics, according to Gisin. "Today we have enough understanding that we can teach quantum physics on a relatively easy, mathematically easy level. It's conceptually complicated, but the mathematics are relatively easy, so we could study indeed earlier. I think that's the first thing to do," he said. "About educating not only the advanced countries and the rich countries – on the theory side, the theory is not something very expensive. Making a quantum computer is expensive, but not understanding the principle and developing algorithms. These are things which are not so expensive and that could be done really on the entire planet and should be done on the entire planet."

André Xuereb, a theoretical quantum physicist and associate professor who is Malta's ambassador for digital affairs, said as the father of two young girls that quantum should be taught to kids at an even earlier age; kids, after all, drop things on the floor to learn the laws of mechanics. "And if we somehow bring quantum and other kinds of technologies to even younger kids, then they will learn an innate sense for how the universe works in a different way than we did. And that can make the most of a quantum nature of generation, so to speak. And my gut feeling is that we will not realize the power of these machines. We will not get a proper generation of quantum computer scientists, so to speak, until we do that, until that generation grows up."

One of the ideas that GESDA has identified as a potential solution is a hybrid organization to guarantee safe access to and use of critical quantum infrastructures for communication and computing, such as those related to strategic national and international security agendas. If that were to proceed, said Fabiola Gianotti, the experimental particle physicist who has led CERN since the start of 2016, the development of quantum computers and their deployment also could be shaped according to the core values that CERN embraces and promotes, particularly the importance of fundamental research regardless of any potential applications in the practical or commercial worlds.

"Quantum mechanics was considered a useless knowledge, because we had no applications in a normal life," she recalled. Today its applications are wide-ranging including telecommunication, GPS systems, lasers, transistors, magnetic resonance imaging (MRI), computers and mobile phones. "One never knows what are the impacts that the fundamental research will have one day," said Gianotti. "But we can say there will always be an impact sooner or later." CERN emphasizes collaboration across borders, disciplines and the private-public sectors, and the use of open technologies and open access to information. "If you can share information among scientists, you can share data, we can share knowledge. Of course, developments would be faster," she said. "But also, because knowledge and education are capacity-building and empowering tools, they must be available to everybody if you want to reduce inequities across the world."

Takeaway Messages

Quantum computing is a revolution long in the making: at least 30 years of research by a large fundamental research community. It is a total game-changer with over $22 billion invested worldwide by governments by 2021, prompting international competition fuelled by fear and hype.

Quantum can change chemistry and material science and help us predict the properties of materials accurately. It could let us design a catalyst for negative carbon fixation for global warming.

Not enough young people are being trained to work on quantum, which is creating hiring challenges for all sorts of jobs due to a huge skills gap. Governments with money to hire young talent could put them to work on military and less desirable uses.

More collaborative projects and the sort of cooperation that GESDA espouses will be essential, because building a quantum system is complex and there is a need to steer research towards beneficial applications that are not only focused on economic, geopolitical or military advantages.

Quantum computing, though complicated, can be taught earlier than at university: it could be introduced to high school students or even at an earlier age, so kids get an innate sense of it.

Sharing information and data are important because knowledge and education are capacity-building and empowering tools that can reduce inequities across the world.

A hybrid organization for quantum could guarantee safe access to and use of critical quantum infrastructures for communication and computing.

More information

Session recording on YouTube

Related interviews: Anousheh Ansari

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Quantum Technologies and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Quantum Communication, Quantum Computing, Quantum Sensing and Imaging, Quantum Foundations

Saturday 9 October, 10:15–11:15am CET

ACCELERATE

Co-Developing Accessible Advanced AI

Abstract

There are 56 artificial intelligence (AI) startups worth over $1 billion today. That is a testament to the enormous power of deep learning, which has found transformative applications in everything from finance to healthcare. These approaches require huge amounts of data and computational power, however, which means that advances are increasingly driven by a handful of large companies and governments. We are about to enter a "third wave" of AI that will imbue machines with "common sense" and reasoning capabilities, allowing much broader deployment, and increasing the breadth and depth of human-machine interactions. That makes it crucial that these advances are not shaped by narrow interests and that everyone can take part in the development of advanced AI and benefit from its use.

- What will the next generation of AI look like and how should we best prepare for it?
- What priorities should inform the next stage of AI development?
- How will advanced AI be able to address global challenges differently than today's technology?
- What can we do to avoid "AI nationalism" and ensure broad access to the technology and applications developed on the basis of advanced AI?

Participants

Moderated by:

Amandeep Gill, Director I-DAIR project, India

With:

Pushmeet Kohli, Head, AI for Science, DeepMind, India *(remotely)*

Nanjira Sambuli, Policy Analyst, Advocacy Strategist; Board Member, Digital Impact Alliance, Development Gateway, and The New Humanitarian; Member, GESDA Diplomacy Forum, Kenya

Daren Tang, Director General, World Intellectual Property Organization; Member, GESDA Diplomacy Forum, Singapore

Rüdiger Urbanke, Professor of Communication Theory, EPFL; Member, GESDA Academic Forum, Austria

Wendell Wallach, Senior Advisor, The Hastings Center, United States

Ewan Birney, Deputy Director General, EMBL; Director, EMBL-EBI, UK

Highlights

Artificial intelligence (AI) has many common daily uses including to manage homes and drive cars. Artificial general intelligence (AGI) – the hypothetical ability of a machine to perform tasks equally to humans, with common sense and general reasoning – remains years away. However, advanced AI systems that can process reams of data, learn by themselves and find solutions beyond what most people could discover already signal the potential for huge breakthroughs.

At Google DeepMind, for example, Pushmeet Kohli's team recently developed AlphaFold, an AI software that, basing its calculations work on extremely huge amounts of public data on proteins, predicts their 3D structure from the amino acid sequence. Considered an AI solution to a half-century "grand challenge" in biology, this rapid system to determine the shape of proteins could pave the way for a host of new uses such as treatments for diseases or enzymes that break down industrial waste. And in 2015, DeepMind created AlphaGo, a programme that combines advanced search tree with deep neural networks and which, for the first time, defeated a professional human playing the Go board game. There are few scientific areas that have not been impacted or completely revamped by the "pervasiveness" of advanced AI such as the breakthrough solutions developed by Kohli's research teams, said Rüdiger Urbanke, a computer scientist, professor and pioneer in coding theory and communications theory. "Essentially, they are based on neural networks and our ability to process and collect huge amounts of data," he said. "And so, for the next probably five, ten years, we'll see still a lot of this exploitation of this paradigm and amazing things will happen."

It is not just scientists following this fast-developing field with intense scrutiny. Digital technologies also play a key role in the UN's 2030 Agenda for Sustainable Development, particularly with diversity, equity and inclusion. As advanced AI promises to make the world more accessible, deep scepticism remains with AI algorithms and technology. Experts point out these are culturally constructed, shaped by the experiences of scientists and technologists. New products can radically change how we communicate, interact, and learn, potentially including or excluding more people.

AI algorithms and tools are often developed and used in ways that experts say are discriminatory towards minorities and vulnerable groups. Therefore, more regulation is needed to prevent bias, said Nanjira Sambuli, a policy analyst and researcher who studies how information and communication technology affect culture, entrepreneurship, governance and media. "It comes down to a number of things: whether it's already obvious that society is not monolithic, who is involved in shaping how AI advances, or whose worldviews are incorporated, or even which versions of society incorporated into what is training these machines versus who's been left out. And how do we correct for that?" she asked. To create a fairer world, the worlds of science, diplomacy, business and civic society must question their assumptions towards AI "because without doing so, we'll end up with these divides", according to Sambuli. "That is not something we want: conflicting humans and conflicting AI. That's not a world I personally want to be in." The rise of AI is moving from data input to context and experience, leading to the "politics of who's a creator and who's the subject", she added. "How do we change the paradigm of inclusion from being this afterthought? You've built a table, and you're just bringing an extra seat, versus building a table altogether that remembers that these seats should have been there in the first place. That should be a key concern for everybody involved in this."

Another important aspect to consider is accessibility to raw data. For decades, Ewan Birney recalled, he and his scientific colleagues stored data eventually used for DeepMind's AlphaFold. "That goes to the importance of data and data-sharing in a fair way to create these possibilities," said Birney, a biochemist who oversees European Molecular Biology Laboratory (EMBL), Europe's flagship laboratory for the life sciences. "I was very struck by this business of 'we shouldn't just bring a chair to the table, we should make the table all together,'" he said as a prominent advocate of open source data-sharing in bioinformatics and science. "It's really important that we continue to do data-sharing, but do it in a fair and equitable way, and we do it with co-creation across the world at the start." If the emergence of big data represents a new global "commons" like oceans and space, then GESDA-backed International Digital Health and AI Research Collaborative (I-DAIR) could help protect it. The initiative, overseen by Amandeep Gill at the Graduate Institute Geneva, is building a global platform to foster inclusive, impactful and responsible research uses of that data, and to head off potential future conflicts.

Wendell Wallach, a prominent bioethicist and scholar who focuses on ethical and governance concerns posed by emerging technologies such as AI and neuroscience, agrees. "The technologies often get deployed before we even know what is problematic with them. By the time we do know what is problematic, they are so deeply entrenched, we do very little to reform them," he said. As Urbanke noted, some of the things that can go wrong are massive unemployment for those without access to education for the new sorts of jobs that will be created; terrorism by people who co-opt future technologies; and the spread of lethal autonomous weapons, bearing high-powered munitions.

That has prompted the need for what experts describe as 21st century approaches to governance, relying more on “soft law” that is not always enforceable but can be applied quickly through standards, practices, codes of conduct and insurance. “Hardly a day goes by without somebody putting in front of me a new scenario of what we need to be concerned about,” said Wallach. “I, like most of you, perceive technology as a source of both promise and productivity. But there’s considerable disquiet – disquiet not only over specific technologies, but disquiet over the overall trajectory of this vast scientific development and technological deployments that we are witnessing. And for me, I look very much at the two sides of it. How can we reap the benefits but without naively overlooking the detrimental societal impacts?” Wallach said he was particularly worried that “learning algorithms are not transparent”, meaning even those who develop them or the experts who work with them “cannot explain how we got from the input to the output”.

To those points, Kohli said the DeepMind teams that came up with AlphaFold and AlphaGo used a multidisciplinary approach that is important to solve major problems. Since AI and machine learning are powerful technologies that can have “many different side effects”, he said, there should be no “complacency” towards their uses; people with diverse sets of interests should be represented when developing projects. “In our DNA, we are sort of thinking about ourselves as an organization which is representative of what we want to achieve in the world and have everyone on the table,” said Kohli. “Our hiring practices, how we go about developing our project roadmaps, have a first-glance element: we think about diversity, think about ethics, think about impact, about any particular project, even before we take the first step in executing it.”

Overall, the potential uses of advanced AI are a “deep concern” among many nations and global institutions looking at the social, technological, cultural, and corporate implications, said Daren Tang, who before taking over one of Geneva’s most prominent international organizations held various legal positions dealing with trade and industry in Singapore’s government. In today’s climate of rising nationalist populism, authoritarianism, and disinformation, it’s become “very, very tough” to promote multilateralism, he noted, and “any attempts to push big multilateral norm-setting treaties and international treaties and AI, for example, I don’t think it’s going to work. Not for the foreseeable future anyway”. What might work instead? “First, we can come together to talk about soft laws. Standards can be harmonized on these standards,” said Tang. “More and more of us are beginning to broaden our offerings to do these soft approaches.” That requires an international city like Geneva where “GESDA is a classic example of how Geneva is playing to its strengths, bringing the world of science and diplomacy together,” he added. “More of these things need to happen.”

Asked by the audience if “hard laws” for regulating AI might be needed someday beyond merely relying on soft laws, Tang argued for a phased-in approach due to escalating tensions among the major powers. “Norms are only set when there is consensus amongst key countries,” he said, pointing to past global trade pacts pushed by the European Union, Japan and the United States. “Those days are over.” Now, he said, national interests are paramount such as with corporate global taxes. “The challenge for AI and technology is that it’s become geopolitical. It’s become a key part of competition amongst member states. And you don’t have to look too far,” said Tang. “But we can’t give up just because of that. So what? What do we do next? And if we can get hard law, we get soft law. And I think soft law then becomes a way for us to build up towards hard law, because I don’t think the world is going to be like that forever and ever. And so, let’s prepare for the time.”

Wallach, however, proposed a middle way between hard law, which he said tends to become “crystallized” by installing bureaucracies that stifle innovation, and soft law, which has problems of “enforceability”. He suggested two institutional approaches, both of which he said GESDA could be useful in championing. The first would create a global governance network, as proposed by the UN Secretary-General’s Roadmap on Digital Cooperation last year, setting up a “true multi-stakeholder forum working through these problems together”, Wallach said. The second would be a “rapid response” panel of “good-faith brokers” such as GESDA, the Carnegie Council for Ethics in International Affairs and others with international prominence that could “quickly convene the appropriate experts to work together and see if we can speed up our responsiveness to these various kinds of challenges”, he said. “Responses in this on all three levels of engineering, first of all. What can we and can we not engineer? Secondly, ethics. How do we ensure that the deployment of these systems is appropriate. And third, governance. How can we put in place effective means for that?”

Takeaway Messages

The rise of AI is moving from data input to context and experience.

Few scientific areas have not been impacted or completely revamped by the “pervasiveness” of advanced AI, and many things can go wrong if improperly used.

Deep scepticism remains with AI algorithms, data sets and technology, which experts point out is culturally constructed. More regulation may be needed to prevent bias.

Digital technologies and AI condition access to the world for an ever-larger group of people, making inclusiveness, representativeness and cultural biases ever mor important. Inclusivity means building a table for everyone to gather round in the first place, not just adding seats.

Open source data and data-sharing in a fair and equitable way is essential to create new possibilities and solve scientific and technological problems.

Science and technology organizations should incorporate people and strategies that reflect diverse sets of interests from the start when developing projects, not as an afterthought.

More reliance on 21st century governance – such as “soft law” that is not always enforceable but can be applied quickly through standards, practices, codes of conduct and insurance – might be useful.

More information

Session recording on YouTube

Related interviews: Nanjira Sambuli part 1, Nanjira Sambuli part 2, Daren Tang & Rüdiger Urbanke

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Advanced Artificial Intelligence and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Deeper Machine Learning, Human-centred AI, Next-level AI, Interdisciplinary AI

Brain-inspired Computing and related breakthroughs at five, ten and 25 years: Full breakthrough brief

ANTICIPATE

Engineering Pathways for Radical Health Extension

Abstract

By 2050 one in six people worldwide will be over the age of 65. This grey tsunami threatens to put a huge strain on health and economic systems as the burden of age-related illness booms and the proportion of working-age adults shrinks. But breakthroughs in our ability to slow the physical and cognitive decline associated with advanced years are on the horizon. Drugs that target biological pathways that underpin ageing and interventions that turn back cells' "epigenetic clock" could soon extend our healthy years long into old age. This could completely reshape the dynamics of ageing populations and will require fundamental shifts in public health policy, economic planning, and labour relations.

- Where will breakthroughs in radical health extension come from?
- How will societies change as the number of healthy older people grows?
- How can we ensure boosting health span becomes a global priority?

Participants

Moderated by:

Jane Metcalfe, Founder, NEO.LIFE; Co-Founder, WIRED magazine, USA

With:

Samia Hurst, Professor of Ethics, University of Geneva, Switzerland

Brian Kennedy, Distinguished Professor, Department of Biochemistry and Physiology, Yong Loo Lin School of Medicine, National University of Singapore, USA

Guy Ryder, Director-General, International Labour Organization; Member, GESDA Diplomacy Forum, UK

Atsushi Seike, Executive Advisor for Academic Affairs; Professor Emeritus, Keio University, Japan *(remotely)*

Highlights

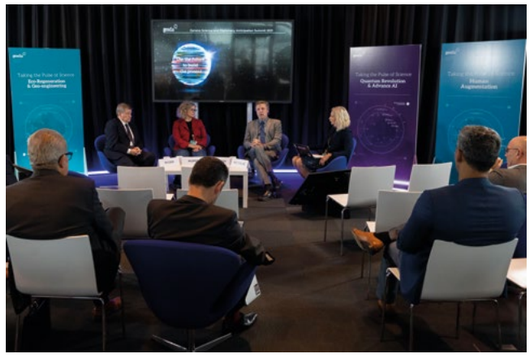
Today it is still rare, but not uncommon, to live for a century, particularly in parts of Italy and Japan, and most people can expect to survive into their 70s. There are an estimated 573,000 centenarians on the planet today, according to the United Nations. As many as two billion people are expected to be over the age of 65 in 2050. "We have gone from an average lifespan of 30 years beginning in the 19th century to 40 years at the beginning of the 20th century to 72.8 in 2021," explained Jane Metcalfe, founder of *Neo.Life*, a publication that focuses on these issues. "Those numbers, of course, hide the gross inequalities and inequities that existed across geography, across gender, across socioeconomic status. The good news is that on average the entire world now enjoys a longer life expectancy than the richest country did just 100 years ago. And those trends are expected to continue as sanitation, medicine and lifestyle change, and wealth reaches more and more people." Recent studies by researchers in Russia, Singapore and the United States showed that the theoretical limit on the human life span may be up to 150 years of age, assuming no new medical treatments for common diseases are found.

As recently as three decades ago, ageing research was a small field in which most of the practitioners believed it was not possible to alter the ageing process, recalled Brian Kennedy, a biologist and professor who conducts research based in Singapore and has become a widely known expert on the biology of ageing. "I think almost everyone in the ageing field believes now that is possible." The research on this field is growing fast. For example, the Longevity Science Foundation, based in Switzerland, announced on 30 September 2021 it will provide $1 billion over ten years for research, institutions and projects that advance healthy human longevity and help extend the healthy human lifespan to more than 120 years.

"There are a number of interventions available that could potentially extend both lifespan and health span," Kennedy said. "Much research has been done on mice, including interventions on cells (stem cells therapy) and the genome (gene therapy). The challenge is that we have now to validate those interventions on humans." Other research shows the positive effects of improved diet, exercise, reduced stress and mental outlooks on ageing and age-related disease, he said, and "there are also a lot of pharmaceutical and natural products and supplements that are candidates to slow ageing, and which are being tested right now."

For Kennedy, the first thing people imagine when they are told they could live up to 120 years is that they would be living in a frail state and be kept alive with oxygen machines. "But our field of research is really more of a prevention-oriented field. It's targeting the biggest risk factor for everything ageing and realizing that it's now possible to alter the rate of ageing, and seeing what the outcome of that is. In pretty much all the studies that have been done so far, the outcome is that individuals don't get sick, they stay more functional," he said. "And it's not just chronic diseases, either. COVID has brought home a major point, which is that ageing itself is the biggest risk factor for mortality in hospitalization due to many infectious diseases."

"What is interesting is that we now also have ways of measuring the rate of ageing – a major breakthrough in the last decade," he added. A distinction must be made, however, between chronological age – the actual amount of time a person has existed, as indicated on everyone's passports – and biological age, which refers to how old a person seems. The latter can be determined by biomarkers; in the blood, for example. "And when you combine the interventions with the markers," Kennedy said, "you really have the possibility to study how ageing has been affecting humans."



If it were to become more common for people to live beyond 100, even to 120, the impacts on society and work remain unclear. As Samia Hurst, a medical doctor, bioethicist and professor who has served as vice-chair of the 25-member Swiss National COVID-19 Science Task Force explained, there are environmental impacts. "If you have people living longer, you also have more people living" on the planet that affects everything from education to retirement, she said. "Is it something we want to have – a longer life?" she asked, while noting along with the other experts that the answers vary according to demographic and geographic variables. "You have to think about what sort of life would that be?" she said. "If we prolong life without modifying how work happens, it means that you wind up spending most of your life doing things that are messaged by your society as less worthy, and that also makes your life not as good. If you are messaged as a sort of second-class citizen for most of your life, that is problematic."

"The concept of learning-working-retiring is dead," said Guy Ryder, director-general of the International Labour Organization (ILO). "I think we're looking – as the age of retirement goes up – at organizing work better for people reaching the end of what is currently defined as their professional working time," he said. "So, adapting workplaces, adapting work arrangements, reduced work hours, that sort of combined less work [and] a little bit of retirement coming in. No, these aren't hard and fast, hermetically sealed frontiers. They're permeable."

For Samia Hurst, an ethics professor, ageing raises mainly fundamental questions about equity "with the minimal goal to be no worse than today". In terms of fairness, she said, "it also raises the question of how much these interventions [to extend lifespan] will cost, which is a point we always forget to resolve, even today." This a big question, Guy Ryder agreed. Will these so-called ageing interventions in the future be made "available generically as a public good", or will they be available only "to those who can afford them, both in terms of intra-societal and inter-societal issues?" he asked. "I think a lot of the societal debate that will follow from these types of interventions depends very much upon them." For him, questions of equity should be debated now, not sometime in the future.

The wider implications for work and society has been on the "radar screen" of the ILO for some time now, though not in precisely the same terms posed today, according to Ryder, who advised distinguishing between lifespan and health span. "If we're looking to increase longevity, at what age do we retire?" he asked, raising the question of "aptitude to work" with regards to age. "So, the real question is: are these longevity interventions such that people will be able to work into their 70s, or their 80s, not based on economical requirements but within the parameters of human welfare which these interventions are supposed to advance? I don't know the answer." Ryder said this raises questions about how to organize care and social protections, noting that the issue of old age pensions is the "most developed of all fields of social protections" and some of the most difficult social debates revolve around retirement ages. "That is when you get people on the street," he said. "They really feel it," he added, because they fear that they are "losing something."

The effects of an ageing population on employment and the labour market point to a paradox, said Atsushi Seike, a labour economist who is president of the Promotion and Mutual Aid Corporation for Private Schools of Japan (PMAC) and former president of Keio University. "We see an ageing population as a result of our success of promoting the health conditions of people, but as a result of our success, we face some problems," he said. "One of the most serious problems we face with the ageing population is the declining workforce. It may slow down the economic growth and it may also reduce the sustainability of our social security system. So, in order to cope with such a problem, it is extremely important for us to promote the employment of older people." For that, he said, it is necessary for those people to remain in good health conditions, as the two aspects are strongly linked: "Having conducted a survey on labour supply of older people, we could show that if their health condition got better, their likelihood of labour force participation would be increased by about 30%." It also is important for people to maintain good cognitive conditions "so that they can manage their accumulated financial assets," he said. And the distinction between biological and chronological ageing is helpful, he said, partly because older people can still contribute "in many ways" as workers, investors, teachers, and social workers. "We need to change the definition of older people," he said. "Older people who have, for example, experiences in the business community can teach young people at the school" or could provide "childcare services" for younger people.

In some countries, people stop working at an age "where many feel they could continue", Hurst summed up, while modern parenting often leads to a "coexistence of the time when most people want to have their children and there are the most demands on their professional life". These reflect a fundamental "disorganization of our biographies", she concluded. "There are many ways in which our biographies are in a mismatch with our social organization, and this would be increased by a prolongation of life expectancy. So maybe we need to have language based on rules and functions other than actual age. Maybe we need to have language based on health status, and maybe biomarkers will one day be the way in which we make these distinctions, but they of course need to be validated first. And there are many ways in which we can think about that. One of the exciting things in this field [of longevity sciences] is that it leads us to ask questions that we should have been asking anyway. But this throws them in a light that makes them more urgent."

Takeaway Messages

Ageing research formerly was a field in which it was not believed that people could alter the ageing process, but now most researchers think it is possible.

New tools (pharmaceutical and natural products, gene therapies, and stem cells treatments) might increase the average lifespan to 120 years; blood biomarkers may determine the biological age of a person.

People living longer lives raises fundamental questions about inequality based on demographics, geography, and socioeconomic status.

Among the chief questions to be addressed are how to organize social protections and care, and to balance retirement ages with the workforce and funding for social safety nets.

Distinguishing between biological and chronological ageing would be helpful, partly because older people can still contribute as workers, investors, teachers, mentor, social and childcare workers. Promoting good health among elderly people is, therefore, crucial.

The wider implications raise fundamental questions about how people structure the "biographies" of their lives; new language might be needed that is based on health status, rules, and functions, other than actual age.

More information

Session recording on YouTube

Related interviews: Guy Ryder

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Radical health extension and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Age-related Diagnostics and Prevention, Fundamental Geroscience, Slowing Biological Ageing, Reversing Ageing

Sustainable Economics and related breakthroughs at five, ten and 25 years: Automation and Work

Friday 8 October, 3:15–4:15pm CET

ANTICIPATE

Negotiating the Boundaries of our Genetic Future

Abstract

The price of sequencing a human genome has fallen from $2.7 billion to $300 in just 20 years. This dramatic improvement in our ability to read DNA is now setting the stage for an even bigger revolution in our ability to write our genetic futures. Over the next decade gene therapies that can tackle the most intractable inherited diseases and cancers will go mainstream. Within 25 years the ability to enhance human capabilities will come within reach, letting us augment sensory capacities and enabling us to thrive in space. That could pose complex biosecurity challenges and raise profound questions about what it means to be human. Given the immense costs of today's experimental gene therapies, work needs to be done to ensure their benefits are shared equitably.

- What are the opportunities and risks posed by our growing mastery over human genetics?
- Where does the line between healing and augmentation lie and who decides what is allowed?
- Genetic capabilities will appear gradually and surreptitiously. How do we ensure their benefits are shared equitably?

Participants

Moderated by:

Jane Metcalfe, Founder, NEO.LIFE; Co-Founder, WIRED magazine, USA

With:

George Church, Professor of Genetics, Harvard Medical School; Professor, Health Sciences and Technology, Harvard and MIT, USA *(remotely)*

Katherine Littler, Co-Lead, Global Health Ethics & Governance Unit, World Health Organization, UK

Effy Vayena, Professor of Bioethics, ETHZ; Founder, Health Ethics and Policy Lab, Department of Health Sciences and Technology; Member, GESDA Academic Forum, Greece/Switzerland *(remotely)*

Ambroise Wonkam, Professor and Senior Medical Genetics Consultant, Division of Human Genetics, Faculty, Health Sciences, University of Cape Town, Cameroon

Highlights

Almost two decades have passed since the completion of the Human Genome Project, an international collaboration that resulted in our ability to read the complete genetic blueprint for building a human being. That 13 year-effort, which revealed there are probably about 20,500 human genes, marked the beginning of the genomics era in which researchers created inexpensive home DNA testing kits. This reference genome changed how scientists conduct research and share genetic data, and it has steadily grown in size as the use of genomics in health care and other pursuits becomes routine.

The vast majority of this reference genome, however, is from European DNA: The genomes of more than one million individuals have been sequenced but less than 2% are from Africa or recent African descent, raising questions of inclusion and equity. Moreover, the lack of African genetic material impedes our understanding of basic functions and diseases, because African genomes are the oldest and most diverse. The new Crispr gene-editing tools, discovered in 2012, opened new and questionable frontier uses, showing how science and technology often outpaces our ability to understand their applications.

"What's really interesting about this discussion is how grey it is, how grey the areas are, whether you're talking about the language, which technology we should focus on, or where we're going," said Katherine Littler, whose unit within the UN health agency has been developing guidance for governments on how to make ethical decisions. "There is a plethora of governance mechanisms out there, depending on whether you're talking about somatic or hereditary or germline. It really depends. And I think we're at very differing stages all over the globe in terms of governance and oversight. And we have very different starting points of what we think is acceptable, or where we are starting from." She urged more preparedness along the lines of anticipatory science. "We talk about epidemic preparedness, but we should be talking about preparedness for genome and emerging technologies," said Littler. "And when I define preparedness, I'm not talking about just the science. I'm really talking about the governance, because I think governance really is not the panacea, but it's what will help us address a lot of the challenges."

Gene-editing pioneer George Church, who gained notoriety proposing to use synthetic biology for "de-extinction" – the resurrection of an extinct species, like the woolly mammoths – recently announced the launch of a startup that uses gene-editing technology to fight climate change by preserving endangered animals. He also keeps a list of genes that could be modified to enhance human abilities. He noted that people question the safety of COVID-19 vaccines, even though 16 childhood vaccines exist today that are among the cheapest, safest technologies ever made. "All vaccines could be classified as enhancements or augmentation, relative to our ancestors, who lived in fear of these 17 diseases and ones like it," he said. "Almost all powerful and popular technologies are enhancements, whether they're cars or books or computers, etc. I think what's more significant here is whether they're reversible or not. If you try to reverse, say, the cell[phone], the telephone revolution, that would be politically very difficult to do. So, in a way that's irreversible, at least so far."

A more urgent message can be found in the history of smallpox eradication, according to Church. "We did not wait for smallpox vaccination for full understanding of all the genes or even understanding of virology or immunology. We started vaccinating before we could see a virus, before we even knew there were viruses, and before we knew anything about immunology," he said. "So, I'm not recommending that we act on ignorance. I am just saying that occasionally we can reach consensus without full understanding. And in terms of reversibility, I think that editing is definitely reversible. I'm not advocating editing our genomes so much as editing, changing our genetics. It could be messenger RNA, which is perceived as being temporary." RNA is a molecule that is essential in various biological roles in regulating the expression of genes, but does not change the DNA itself.

A more cautionary approach would be preferable, said Ambroise Wonkam, a medical genetics professor whose research focuses on sickle cell disease, genetics of hearing loss and ethical and educational issues involving human genetics in Africa. He recently launched the Three Million African Genomes (3MAG) project to build capacity on the African continent in genomics research and its applications and governance. It is based on an estimate that capturing the full scope of Africa's genetic variation would require sequencing three million people across Africa to cover ethnolinguistic, regional, and

other groups. It also would have benefits worldwide, he said, much like research on Ebola outbreaks helped with the COVID-19 pandemic.

Because of the data gaps, Wonkam said, he was "not sure we are genetically literate enough" to undertake gene editing and, similarly, "not sure we have addressed the question of equity in the level of gene editing". Rather than focus first on applying gene editing to HIV, as a Chinese scientist claimed to have done in 2018 by creating the first human genetically edited babies with the Crispr technology, he said, there are 300,000 children a year that are born with sickle cell disease. "And 80% of those kids are born in Africa. That makes it our priority, right?" he said. However, Church said, "the right question is how many people are affected" and factors such as cost since genetic drugs for rare diseases "are very expensive, while vaccines are very cheap", including those based on RNA.

Africa only has 20 medical geneticists to serve 15 million people, Wonkam said, pointing to a need for more education and genetic literacy. "We have about 20,000 genes in our genome now. If we all look in the OMIM database that we use as medical geneticists, only 25% of the genes that we know are associated with disease conditions," he said. "We have no idea how the 75% are different. Are we genetically literate enough? The answer is no."

George Church and Jane Metcalfe

Wonkam urged people to use a concept from the Akan tribe or language group in Ghana called the power of Sankofa, which translates as "it is not taboo to fetch what is at risk of being left behind" and is symbolized by a bird turning to put an egg on its back. "And actually, Sankofa speaks about the past, but the egg is to fertilize the future," he said. "I believe that we have to go into the past of our genome to understand how actually our genome combats infection by selection, instead of trying to create a new way through editing."

Effy Vayena, a professor of bioethics and founder of a lab focused on ethical and policy challenges in personal medicine and digital health, said she agreed immunization can be considered as an enhancement, but that it is irrelevant to distinguish between a disease treatment and an enhancement.

"That might be a controversial statement, but I would invite us to think a little bit about it in the following way: If we are trying to draw the line between the two, we're probably thinking of health as a sense of physical health, perhaps even mental health. But we're not thinking of well-being. And if we think of well-being and what we can do to improve that, I think the boundary between treating a disease and enhancing is – it gets very messy."

A more fundamental question, Vayena said, is "which version of progress" to follow: for science or for society? "We're constantly trying to improve the human condition with all means we have. We want to reduce human suffering, we want to improve well-being, but we revise constantly the ways in which we do that and its meaning. The question again is how do we do that in a manner that allows all voices to be heard?" Vayena asked. "I really welcome the initiative of GESDA. I think it's an opportunity to lead us to this global dialogue we need. But again, it's about deliberating about our disagreements here, and our opinions, not simply stating them."

Jane Metcalfe, a serial entrepreneur, and publisher who focuses on what she calls the "neobiological revolution", said she agreed. "There's an enormous role for GESDA to play here, if for no other reason than to just bring the various parties together in one room, create a common language and a sort of baseline of knowledge, and then frame the questions and the issues. It is astonishing to me that this many years after the development of Crispr, that's still not really happened," said Metcalfe. "We really are missing all of the stakeholders, including private industry, to come together and have these conversations. So definitely a work to do on GESDA's to-do list."

Takeaway Messages

The new Crispr gene-editing tool opened new and questionable frontier uses, showing how science and technology often outpaces our ability to understand their applications.

The genomes of more than one million individuals have been sequenced but less than 2% are from Africa or recent African descent, raising questions of inclusion and equity. Moreover, the lack of African genetic material might impede our full understanding of basic functions

There is a differing opinion about when and if a technology (such as gene-editing tools) is ready to be integrated with the public and how that process should be carried out, also in terms of communication.

We did not wait for full understanding of all the genes or virology or immunology before vaccinating for smallpox. Similarly, some of the technical hurdles in gene-editing technology lie in the fact that it's impossible to wait as long as necessary to really know if something will be safe for a person's lifetime. Occasionally we can reach consensus without full understanding.

It may be irrelevant to distinguish between a disease treatment and an enhancement, because if one thinks in terms of well-being, the boundaries are blurry. The questions of safety and precision of the interventions are key.

There are differing stages all over the globe in terms of governance and oversight, and different starting points of what we think is acceptable. We should be talking about preparedness for genome and emerging technologies in terms of governance.

There are differing stages all over the globe in terms of governance and oversight, and different starting points of what we think is acceptable. We should be talking about preparedness for genome and emerging technologies in terms of governance.

More information

Session recording on YouTube

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Human Applications of Genetic Engineering and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Gene-based Diagnostics and Prevention, Gene Therapies and Enhancement, Novel Bioengineering Approaches, Synthetic organisms

Saturday 9 October, 8:30–9:45am CET

ANTICIPATE

Learning from COVID-19 to Prepare the Response to the Next Systemic Crisis

Abstract

More than 200 million people around the world have been infected by COVID-19, and the number of deaths is approaching five million. Almost six billion vaccine doses have been administered. The pandemic has put the principles and practices of multilateralism to their most severe test in decades. Many environmental, economic, and societal factors have contributed to this global health crisis, including a focus on national rather than international solutions. These trends show no signs of slowing and the next pandemic may be just around the corner. This makes it imperative to integrate the lessons of COVID-19 quickly and to start preparing our response to future systemic crises now. Tomorrow's global challenges will be inherently transdisciplinary and transnational in nature. That means it will be crucial to break down traditional silos if we want to improve our ability to anticipate and prepare for these kinds of emergencies.

- What lessons can be learned from the response to COVID-19?
- Where is the next systemic crisis likely to come from?
- What role should be played by the international community, both in Geneva and around the world, in preparing for the next systemic crisis?

Participants

Moderated by:

Elaine Fletcher, Editor-in-Chief, Health Policy Watch, Switzerland/USA

With:

Patrick Aebischer, President Emeritus, EPFL; Vice-Chairman GESDA, Switzerland

Chorh Chuan Tan, Chief Scientist, Ministry of Health, Singapore; Board Member, GESDA, Singapore

Matthias Egger, Professor of Bioethics, ETHZ; Founder, Health Ethics and Policy Lab, Department of Health Sciences and Technology; Board Member GESDA, Switzerland

Jeremy Farrar, Director, Wellcome Trust; Board Member, GESDA, UK

Soumya Swaminathan, Chief Scientist, World Health Organization (WHO), India

Highlights

The first year and a half of the pandemic brought wildly uneven results. Vaccines were developed in record-breaking time with the help of longstanding research on mRNA technology. But as wealthy nations moved past the initial waves of vaccinations and onto booster shots, the vast majority of low-income countries still had yet to get their first shots. The COVAX Facility, created by an alliance of international organizations to ensure a greater measure of equitable access, had contributed only about 5% of all vaccines administered globally. A part of the problem has to do with the manufacturing process, however, which could be improved through so-called "tabletop" processes that would provide a workaround to existing cumbersome processes for producing the mRNA-based vaccines, according to GESDA's vice-chairman, Patrick Aebischer, a prominent scientist with extensive experience in startups who said that "Big Pharma has failed" to deliver adequate production at scale. Permitting these smaller operations to proceed with fully automated, tabletop vaccine "printers" could enable nations with smaller populations to vaccine their inhabitants then provide more for shipments abroad. "I think this is a game changer. So it has two things: it has speed and scale," said Aebischer. "You could imagine having pilot plants, public-private pilot plants. The footprint of a pilot plant for Switzerland would be extremely small. You cover the needs of a country like Switzerland quickly; you could then also produce vaccines for export," he said. "One of the big breakthroughs in those new crises will be the manufacturing capability associated with mRNA."

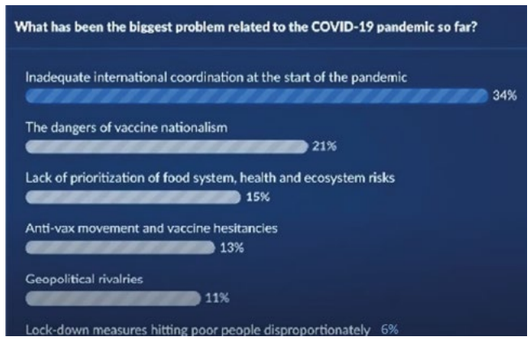
The World Health Organization created a new science division in 2019, just before the pandemic hit. The timing made it "a rollercoaster ride", recalled WHO's chief scientist, Soumya Swaminathan, a paediatrician and clinical scientist, because the new division had only begun to focus on topics such as norms and standards, digital health and innovation. "And eight months later, the pandemic hit. We had to accelerate," she said. "And the needs became very, very obvious." Swaminathan said nobody expected vaccines to be produced in less than a year, and at the start of the pandemic it was clear that despite the convening power of an organization like WHO, overcoming the "uncoordinated and fragmented response" of nations would be a big challenge. To do a better job, she said, the UN health agency should be empowered to receive more data. "We need global governance of existential threats like pandemics and climate change. You cannot do a country at the time," she said. "We need a stronger, better financed and more empowered WHO to actually do the work that we are expected to do."

International cooperation is the key, said GESDA board member Jeremy Farrar, director of the Wellcome trust, and former professor of tropical medicine. "The problem is national governments willing to do what is right for the world and share with COVAX the stuff that they have, essentially vaccines, therapeutics and PPE and oxygen, but essentially vaccines," he said. "Ultimately, all of these multilateral agencies, including WHO, are really dependent on national governments. If national governments want them to work, they can work." Over the past couple of decades, he said, the world has had a series of warnings that include the Nipah, SARS, MERS and Zika viruses. "Every two to three years, we have had a warning of a national or regional issue which disrupted the societies in which it happened. And anticipation is important, because I think what governments really struggle with is that ability to deal with today's issues, which are pressing and which require a great deal of attention," said Farrar, adding that is where GESDA can play a role by focusing on anticipation. "We talk about multilateralism. We have to accept that in this crisis, at the moment, multilateralism is failing," he said. "And I think trying to get that bridge between national tensions, national polls and international action lies at the heart of GESDA."

Another GESDA board member, Chorh Chuan Tan, emphasized the importance of integrating all efforts, a critical lesson for Singapore, where the pandemic response drew on the lessons of previous outbreaks. "It is really critical to learn from this to do much better integration for infectious disease pandemics, like the one we have," said Tan, a former university president. "If we look at the cross-country comparisons about endemic responses to COVID, one of the features was the fact that countries where the response was fragmented tended to do less well," he said. "There is a lot that we can do for data integration, not just within a country but across countries to accelerate our ability to make decisions faster. Then there is also the integration between the response efforts and the rest of the healthcare system. Because eventually there is the impact on the wider health care system." He compared the process of getting prepared for a pandemic with setting up a tent at a windy campsite. "You have to peg all the sides of the tent down, but you know they are all flying all over the place," said Tan. "And so, my point is, we need to find one or two places to peg the tent down so it will not fly away. And some things, some pegs are going to take a longer time to fix."

In Switzerland, the high degree of innovation still did not prepare the nation fully for this pandemic; also, its deep aversion to making mistakes made it too slow to react, according to Matthias Egger, a professor of epidemiology and public health. "When you look at the Swiss system, we are very good at moderation. We are good at long-term compromise. We are good at thinking hard and long about things. We are not very good at acting quickly

because we may actually make a mistake," he said. "So, our political system is not ideal for such a crisis." Egger suggested adopting more evidence-based policymaking to include mechanisms that allow leaders to quickly have evidence synthesized and made understandable. "Politicians do not want to read long academic papers. They want information for action," he said. "And scientists want to write long academic papers and publish them in high impact journals. But high-impact journals do not necessarily have a high impact on policymaking. So, there is a whole range of challenges that we need to address in that context in order to make Switzerland fit for the next crisis." Egger also proposed establishing a Geneva hub modelled after WHO's Hub for Pandemic and Epidemic Intelligence in Berlin. Germany invested $100 million in it as part of WHO's Health Emergencies Programme. With the help of the Swiss, he added, a Geneva hub would represent a "practical application" of GESDA's mission.



Answers from audience to poll about challenges of the COVID-19. Note the importance given to lack of international coordination and to vaccine nationalism.

Takeaway Messages

Develop leadership structures and strategies to respond faster and to distribute vaccines more fairly, establishing a bridge between scientists and policymakers that should be permanent, not restricted to moments of crisis.

Create a worldwide genomic surveillance network to spot new diseases wherever they emerge. Better integration of national data and surveillance are essential tools for fighting a pandemic. The Swiss and GESDA could help set up a Geneva hub of WHO's Health Emergencies Programme like that in Berlin.

Invest in manufacturing and coordination of research and development; mRNA technology allows for quick prototyping and decentralized manufacturing, which could break through some of the impasses in vaccine inequality. Scientific research on vaccines (and also on anti-viral and anti-microbial agents) needs to be accelerated and put in a holistic frame, notably in a One Health (humans, animals) approach. More emphasis should be put on the links between climate change and threat of pandemics.

More information

Session recording on YouTube

Related interviews: Patrick Aebischer, Soumya Swaminathan & Chorh Chuan Tan, Jeremy Farrar

Tweets related to the session

Friday 8 October, 10.00am–11.00am CET

ANTICIPATE

Establishing Neuro Rights

Abstract

Brain implants already enable people with paraplegia to control robotic limbs, restore basic vision and modulate neural activity to treat diseases like Parkinson's. Over the next decade our growing ability to both read and write brain data will transform the treatment of neurodegenerative and psychiatric conditions, but it will also increasingly be used to enhance cognitive function in healthy people. This could greatly expand our ability to learn and improve ourselves. But the creation of two-way conduits into people's minds and huge pools of sensitive brain data also raise profound questions about privacy, personal agency, and the integrity of the individual. This might necessitate the establishment of a new bill of neuro rights to ensure that new technology is used properly, and its benefits are available to all.

- What are the implications for society of the development of technology in brain science?
- How can we ensure wide access to neurotechnology and prevent the formation of "cognitive elites"?
- Do we need new neuro rights or a reinterpretation of existing human rights?

Participants

Moderated by:

Nadia Isler, Director and Founder, SDG Lab, Office of the Director General of the UN Office at Geneva, Switzerland

With:

Olaf Blanke, Professor of Neurosciences; Bertarelli Chair, Cognitive Neuroprosthetics; Director, Laboratory of Cognitive Neuroscience, EPFL/Campus Biotech; Professor, Neurology, Department of Neurology, University Hospital of Geneva; Member, GESDA Academic Forum, Switzerland

Lidia Brito, Director, UNESCO's Regional Bureau for Sciences, Latin America, and the Caribbean; Member, GESDA Diplomacy Forum, Mozambique *(remotely)*

Marcello Ienca, Group Leader, EPFL; Senior Research Fellow, ETHZ, Italy

Judy Illes, Professor of Neurology, University of British Columbia, Canada *(remotely)*

Jürg Lauber, Permanent Representative of Switzerland to the United Nations and other International Organizations in Geneva; Member, GESDA Diplomacy Forum, Switzerland

Highlights

Neuroscience and neurotechnology are progressing quickly, bringing profound questions that society will have to face in the realms of human rights and governance.

The driving factor in all these scientific breakthrough advances over the last two decades has been the engineering sciences, computer science and AI that have enabled new ways to read signals from the brain, said Olaf Blanke, which leads to questions about how to decode, detect, and describe all that activity. Getting access to all that neural biological data is a modern novelty. "We can also write now into the brains," said Blanke, a medical doctor whose research focuses on the neuroscientific study of multisensory body perception and its relevance for self-consciousness. "So, you have this reading out of the brain and this writing into the brain. A very important aspect is that most of the research currently done is trying to build loops, reading out and writing in, in specific synchrony, because the brain does not need the same input all the time. It needs it when I am speaking, when I am moving my arms, it needs to coordinate an orchestrated activity. These closed-loop systems, a typical engineering way of thinking, is really something that has happened over the last 10 years, I would say, in the neurotechnology and neuroscience field."

It is clear to experts in the field that people should have privacy rights towards the data extracted from their brain, regardless of whether the data entails invasive or non-invasive brain-computer interfaces (BCI). However, it is unclear what might be the best way to enforce those rights. There are four levels of governance that could be applied towards neurotechnology: self-regulation; ethical guidelines and so-called 'soft law';binding national regulations; and international human rights law. A poll of the audience at the session found 70% said they had personally anticipated some of the opportunities and risks of neuroscience and/or neurotechnology; 30% said they had not. Whether or not the UN's landmark 1948 Universal Declaration of Human Rights (UDHR) needs to be updated remains an open question worth looking into by scientific experts and diplomats together, said Jürg Lauber. That is why the idea of "neuro rights" emerged from the observation that the intimate link between the human brain function and personal identity is so important that it cannot be addressed at the normative level exclusively on ethical requirements and best practices. It also needs to involve fundamental entitlements and interests that can be construed as moral and legal rights.

"We certainly should not shy away from this [idea to update the UDHR] at this stage of the discussion. We have to look into it," said Lauber, a lawyer who was Swiss ambassador to the UN both in New York and in Geneva, and, before starting his long career as a Swiss diplomat, worked on peacekeeping missions in Namibia and the Korean Peninsula. "Which is why it is so important to have GESDA as a platform to bring those who understand the issue and those who think about the necessary governance action together to have a discussion that is very science-based, fact-based." The key to governance is to consider all sides and perspectives, he said, including asking whether the best way might be a treaty, non-binding rules or just making existing rules more accessible to countries that don't have policy frameworks to handle these emerging advances. "If we do not have common understanding, processes, we are likely to become hostage of hidden agendas, of wrong perceptions," he said. "We need to understand each other's concerns and then remain flexible, adapt the process."

The UN education and culture agency, UNESCO, has been looking at this issue. It established the International Bioethics Committee (IBC), which issued a declaration on bioethics and human rights, and is examining whether the UDHR needs updating. The Organization for Economic Cooperation and Development (OECD), established a neurotechnology working group that released, in 2019, a recommendation on responsible innovation in neurotechnology. That set the first international standard and is designed to foster responsible innovation and to bridge the gap between neurotechnology development, society, and ethical norms. Because of the far-reaching issues involved, Lidia Brito said, it is clear that more than scientists and policymakers must be involved. "We do need society to be involved. Because we are talking about the human being," said Brito, a forest engineer who has worked with UNESCO since 2009 and served as a member of several international boards. "And that is why it is so great that we have a chance in the [GESDA] Summit to have this session," she said. "These kinds of global issues need global responses." And for that to happen, emphasized Brito and other experts, diverse opinions from all walks of like

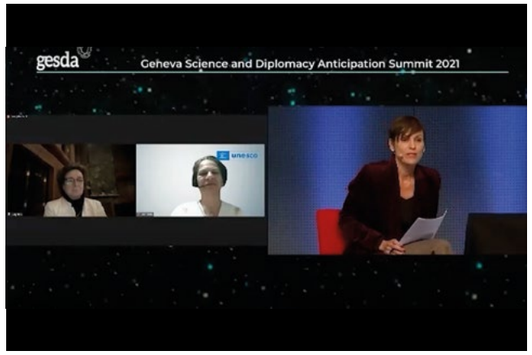
should be heard, particularly those from vulnerable populations that may become still more vulnerable if new technologies are not used ethically and for the benefit of all. “I think that is also why GESDA has chosen this topic,” she said. “Because we know that we have to anticipate.”

Using those advances in neurosciences, researchers are looking into potential powerful therapies for individuals with cognitive deficits in attention and memory. That opens questions about identity and personality, based on memory, that need examining by scientists, policymakers and civil society. Even religion could be a factor. “Will these patients who are lucky to recover a memory have an alteration of the self?” asked Blanke, drawing distinctions between this work and other areas of public health. “If you have a new vaccine or you have a new cancer therapy, you do not have this consequence on humanity or on identity itself, or at least it is an open forum for discussion.”

That has led to short-, medium-, and long-term ethical imperatives, according to Judy Illes, who pointed out that religious and spiritual leaders in Canada, including those from Indigenous communities, are engaged in this examination through the Canadian Brain Research Strategy (CBRS), which is associated with the International Brain Initiative (IBI), a collaboration between Australia, Canada, China, Europe, Japan, Korea and the United States to speed up progress on ‘cracking the brain’s code’. The short-term priority must be to focus innovation on brain diseases such as Alzheimer’s and Parkinson’s, drug-resistant paediatric epilepsy, mental illnesses such as depression and obsessive-compulsive disorder, and degenerative diseases that could be helped by neurotechnology, said Illes, a pioneer in neuroethics who focuses on ethical, legal, social and policy challenges at the intersection of the brain sciences and biomedical ethics.

Over the longer term, she said, there should be increasing focus on “questions also about invasiveness and non-invasiveness: what we put into the brain, what do we not put into the brain, but we can still modulate it. And what these concepts mean to different people; focus our attention on what are the important goals and expectations of patients and medical doctors and targets that define good and bad outcomes”. She recommended more discussion through forums like GESDA rather than pushing for new laws, though the shortcomings of tech giants like Facebook show that more self-governance “may not work”. Blanke agreed, recommending that questions of governance generally “should not split” brain data from all of the information that people reveal about themselves online “since it’s all related to brain activity and brain processes”.

Some neurotechnology companies that deal with “potentially highly sensitive” brain data are committing to responsible innovation and establishing best practices and standards to ensure the safety, efficacy, and scientific validity of the technologies they develop, said Marcello Ienca, whose research focuses on ethical, legal, social and policy implications of emerging technologies. International associations like the Institute of Electrical and Electronics Engineers (IEEE) are establishing standards for brain-computer interfaces. A second level of governance – ethical guidelines – extends to privacy, personal autonomy and respect for personal identity, and are being worked out by some organizations and academics such as the International Neuroethics Society (INS) and a working group on neuroethics within the United States’ NIH BRAIN Initiative. One of the initiators of the NIH effort, Columbia University professor Rafael Yuste’s lab, is another leader in this field. Several countries also are legislating on neurotechnology and neurorights. “The pioneering country is Chile,” said Ienca, “which has recently passed both a neuroprotection bill, which will regulate the collection and processing on brain data, and also a constitutional amendment, which will introduce certain principles such as psychological integrity in their constitution, and they are moving quite fast with this.”



Other nations such as Brazil, France and Spain are passing laws on bioethics and neurotechnology, while Italy has been working on it from a data protection perspective. Internationally, the Council of Europe has launched a five-year strategic plan on human rights in biomedicine. “It’s very unlikely that a one-size-fits-all approach to governance will be effective,” Ienca said. “In fact, what we are seeing emerging internationally is what can be called a multilateral governance framework.” Which is why forums like GESDA and anticipatory ethics are important, Ienca added, because it would be valuable to consider regulating not a specific category of data, like a neurological measurement, but more around function. “If we can make privacy-sensitive inferences about people’s mental states, without their authorization, that’s probably what we need to regulate,” he said.

Takeaway Messages

Over the last two decades, the driving factors in neuroscience and neurotechnology have been the engineering sciences, computer science and AI that enabled new ways to read brain signals.

“Neuro rights” are the moral and legal rights to protect the human brain.

Four levels of governance could be applied towards neurotechnology: self-regulation; ethical guidelines and so-called soft law; binding national regulations; and international human rights law.

Given the novelties of neurotechnologies, emerging governance frameworks are subject to the same novelties, making it a rapidly dynamically evolving scenario.

Because of the complexity of the ethical challenges, a one-size-fits-all approach to governance will likely not be effective; a multilateral governance framework will probably offer the best solution.

It is clear that the involvement of scientists and policymakers is not enough; the voices of citizens also need to be heard because of the profound implications.

More information

Session recording on YouTube

Related interviews: Nadia Isler, Olaf Blanke, Marcello Ienca

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Cognitive Enhancement and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Brain Monitoring, Neuromodulation Delivery Systems, Hybrid Cognition, Memory Modification.

Consciousness Augmentation and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Cognitive Capacity Enhancement, Consciousness Assessment, Brain-Machine Interfaces, Sense-expanding Technologies

Friday 8 October, 10:00–11:00am CET

ANTICIPATE

Utilizing Space Resources for Collective Prosperity

Abstract

The minerals locked up in the most valuable asteroid in our solar system are worth $15 quintillion, according to estimates from startup Planetary Resources. The number should be taken with a grain of salt, but even if it's off by several orders of magnitude, the sum would still be colossal. The ability to mine these minerals is at least 25 years away and the economic benefits still uncertain, but their scale demonstrates the enormous opportunities lying beyond Earth's atmosphere. Taking advantage of this abundance is beyond any one country or industry and will require renewed multilateralism to ensure the global commons of space benefits all of humanity. Setting the stage for a new, collaborative approach to using space resources will also have nearer-term impacts as we expand our use of low-Earth orbit and prepare to go to the Moon.

- What is the potential scale of space resources, and will we be able to exploit them?
- Will/Should space resources boost development on Earth or fuel off-world expansion?
- What rights should countries have to own or exploit resources beyond Earth's orbit?

Participants

Moderated by:

Adriana Marais, Director, Foundation for Space Development Africa; Member, South African Government Ministerial Task Team on the fourth Industrial Revolution; Faculty, Singularity University and Duke Corporate Education, South Africa

With:

Niklas Hedman, Chief of Committee, Policy and Legal Affairs Section, UNOOSA, Sweden *(remotely)*

Mathias Link, Director, European Space Resources Innovation Centre (ESRIC); Director, International Affairs and Space Resources, Luxemburg Space Agency, Luxembourg

Tanja Masson-Zwaan, Assistant Professor and Deputy Director, International Institute of Air and Space Law, Leiden University; President Emerita, International Institute of Space Law, The Netherlands *(remotely)*

Su Meng, Founder, Origin Space Corp., China *(remotely)*

Patrick Michel, Senior Researcher, CNRS (Observatoire de la Côte d'Azur), Team Leader, TOP(Théories et Observations en Planétologie), France

Highlights

The commercial era of space tourism is upon us – though limited mainly to billionaires and other well-heeled adventurers for the time being – and it is by no means the only business pursuit that governments and entrepreneurs such as Jeff Bezos, Richard Branson and Elon Musk are chasing in the vast regions just beyond Earth's atmosphere. Already, nations and companies alike are seeking profits, strategic advantages, and glory in the realms of global communications, planetary observations, space exploration, and prospective mining. A poll at the start of this session showed that, by a four-to-one margin, attendees believed the pursuit of minerals and other space resources is worthwhile, but that it should primarily benefit people on Earth, not any off-world expansion.

As astronauts delve ever deeper into the universe, however, Mathias Link emphasized that the most important and immediate benefits of the gases, water and metals that could be found in space would be the life support they offer, in terms of refuelling satellites and rockets, or providing raw materials for homes and antennae in spatial environments. Moreover, the costs of bringing space minerals to Earth are prohibitive: as much as $115 million per kilogram, by some estimates. "It's more important to use these resources in space," said Link, an expert in space resources, who was astonished at how fast the topic had become relevant. Only months earlier, NASA's extraction of oxygen on Mars marked the first use of space resources on that planet. "Five years ago, this was a very niche topic."

Another concrete example came from Su Meng, founder of Shenzhen-based Origin Space. His company's long-term goal is to discover and use metals and water mined from near asteroids for space industry expansion. Origin Space is China's first space mining startup, and in the past couple of years it has developed and launched into low-Earth orbit several satellites and a prototype robot spacecraft that is being tested for asteroid mining and space debris removal. The two activities are closely linked. The technology to catch debris in space could be put to use scooping up minerals from asteroids, which is "way more difficult", said Patrick Michel, an asteroid expert. That is because asteroids behave in a way that "is totally counterintuitive, making it very difficult to touch them, even more land on them", he explained, citing two recent missions to study asteroids. "The images that they sent back showed us that all our initial assumptions were wrong about their surface composition, their low gravity." There are still more pressing reasons to study space debris removal and asteroids, Adriana Marais, who heads an organization that aims to send Africa's first mission to the Moon, contended: debris collisions can damage communications; asteroid collisions caused mass species extinctions. Since the first Sputnik satellite was launched in 1957, she noted, more than 7,000 satellites have been put into orbit, a space increasingly crowded.

Just how those asteroids studies are carried out, and who has the capacity to undertake them, remains "a big question" because of the high costs and technical risks involved, according to Meng. "I don't think anybody has a real solution," he said. To that end, academic institutions should team up more with businesses like Meng's that are more willing to take the risks that go along with space exploration, said Michel, a longtime contributor and leader for research projects and space missions about asteroid science and defence. "Observations about asteroids from Earth provide very little data about their potential uses for mining. But we have the chance to have publicly founded missions (DART and Lucy, for example) now launching to asteroids to feed us with more data," he said. "And while scientists gain this expertise, it is important that the academy work with the private industry, such as Origin Space, because they have more courage to take the necessary risks."

Beyond the technical and financial risks, commercial challenges to space exploration extend to a complex web of legal and regulatory hurdles, including some yet unforeseen. "Business models still have to be sharply developed on markets that we see coming, but which don't yet exist," said Link. "Step by step, we are showing that this field is growing. Investors no longer views space resources as science fiction. It's going to happen; now it's just a matter of how," said Meng, who was optimistic that much could be accomplished in the next five years.

During the last decade, a growing number of nations and businesses have shown interest in space resources. China, Europe, Japan, Russia and the United States all have concrete plans to establish outposts on the Moon. Since its founding with 14 space agencies in 2006, the International Space Exploration Coordination Group (ISECG) has grown to include 26 members that agree to coordinate their mutual efforts at space exploration for the next decade. But only a few years ago did it

include space resources as part of the architecture of further space missions. That approach was mirrored in this session's initial poll, which found that respondents, by a margin of 87% to 13%, favoured using a multilateral framework rather than a liberal approach to the thorny issues surrounding the governance of space resources. "We are dealing here with novel activities that will be taken on outside of national jurisdiction, and there it becomes a matter of governance," said Niklas Hedman, one of the UN's top experts on space policy. In the game come the geopolitical interests from governments, the growing interests of the commercial sector and, lastly, the interests of the scientific community.

Just two UN-brokered treaties, he said, explicitly deal with the use of space resources: the 1967 Outer Space Treaty, which is legally binding among 111 nations and forbids the use of nuclear arms and any claims of sovereignty in space; and the 1984 Moon Agreement, which is legally binding but only among 18 nations. The Outer Space Treaty's fundamental provision is Article 1, Hedman emphasized, which states that all "exploration and use of outer space, including the Moon, and other celestial bodies, shall be carried out for the benefit and interest of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind". However, policymakers face challenges trying to apply Earth-bound rules to "extraterritorial" space resources, he said, and it was "interesting to note" that the legal subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS) set up a working group this year to tackle this issue. So far, the 95-member committee has adopted its terms of reference and work methods for a five-year plan on how to approach the exploration and utilization of space resources. "That such issues are dealt with at the UN level is a major step to show that they now need to be discussed widely," Link said. "And it shows that in the long term, we will need to have a framework to organize [these discussions] on the international level."

Several principles should guide the use of space resources, said Tanja Masson-Zwaan, a leading space law researcher and arbitrator for space-related disputes, who called this topic "a difficult, new endeavour for humankind" that will require lawyers to frame the issues and potential pitfalls for scientists and engineers. "So far there have not been any major disputes in space exploration, and that is, I think, a tribute to humankind, which realized that cooperation is the way forward," she said. "Definitely, this is an area where there is room for potential disputes, because here we are talking about commercial interests. There is a major difference with the exploration era we knew over the last 50 years." Most important, Masson-Zwaan said it is important to clarify areas that were "not clearly addressed in the current founding treaties" on space, such as any lack of guidelines for dealing with waste on the Moon. Among the most prominent areas in need of clarification, according to Masson-Zwaan, would be the installation of safety zones around resource extraction areas; creation of priority rights so investing companies' interests are protected; assurances that space exploration is done for all humanity, not just wealthier countries; and environmental protection measures.

For Masson-Zwaan, the use of "adaptive governance" would help avoid conflicts by regulating what is feasible now and in the near future, not on a long-term basis. Making that work would require the involvement of private entities and stakeholders not represented by UN bodies. Two groups of nations have been competing to establish lunar outposts, she noted, but over the next decade "we can work towards a strong regulatory framework to set 'common standards' for the benefit of all humankind". It is a very fast-moving area, in terms of governance and regulatory aspects, Hedman said. "It's only in a couple of years, only maybe five years, that we have on the table kind of a really good collection of already-formed building blocks and basis for further discussion," he said. The talks will extend to science and technology, not just legal issues. "This step-by-step approach actually applies to all the challenges in the field," Michel said. "In order to solve these regulatory issues, we also need to see very practically on the ground [of celestial bodies] what it actually means."

Takeaway Messages

Interest is widely growing among nations and private companies towards the identification, extraction and use of space resources.

More knowledge about asteroids is needed that goes beyond Earth observations and can only be gained through space missions. Academic institutions and space agencies are developing such missions.

Companies are willing to take on risks that space agencies prefer to avoid in the space exploration race, but the business model behind that risk-taking has yet to be fully developed.

In addition to UN discussions about the regulation of space resources, another forum at the international level is needed to encompass private sector-related issues such as extraction safety zones, environmental protection measures and mining priority rights.

In this fast-moving field, a step-by-step system of 'adaptive governance' is the best way to approach technological, financial and regulatory issues.

Equitable access to resources and technology, and efforts to broaden the involvement of developing nations, are important questions without clear answers.

Potential conflicts exist between the use of space resources for Earth or for further space exploration.

More information

Session recording on YouTube

Related interviews: Patrick Michel

Tweets feed related to the session

Related content in the 2021 Science Breakthrough Radar®

Space Resources and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Earth Orbit, The Moon, Asteroid Belt, Mars

Saturday 9 October, 10:15–11:15am CET

ANTICIPATE

Advancing Science for Ocean Stewardship

Abstract

The ocean supports all life on Earth, but we've explored only 80% of it and an estimated 91% of ocean species have yet to be classified. It is also changing at unprecedented rates in the face of climate change, pollution and overuse by people. This demands a rapid scale-up in ocean monitoring to understand these changes and to collect valuable data before it disappears. Innovations in sensors and autonomous vehicles are needed to collect that data; new modelling technology will be needed to make sense of it. The benefits will be a wealth of genetic information with applications in pharmaceuticals and biotech as well as a better understanding of ocean ecosystems, their connectivity, and how we can manage these vast resources in a more equitable and sustainable way.

- What do we not know about the ocean that we should know?
- How can we make the best use of the vast amount of genetic data flowing from the oceans?
- How can scientists catch up with the rapidly changing state of the ocean?
- How can we measure the value of the oceans and share those benefits equitably before its resources are irreparably harmed or depleted?

Participants

Moderated by:

Kasmira Jefford, Editor-in-Chief, *Geneva Solutions*, UK

With:

Gerard Barron, CEO & Chairman, The Metals Company, Canada *(remotely)*

Robert Blasiak, Researcher, Stockholm Resilience Centre, USA *(remotely)*

Antje Boetius, Director, Alfred Wegener Institute; Marine Biologist; Leader, Helmholtz Association, German Research Centres, Germany *(remotely)*

Anders Meibom, Professor, EPFL's Laboratory for Biological Geochemistry; Professor ad personam, Institute of Earth Sciences, University of Lausanne, Denmark

Vladimir Ryabinin, Executive Secretary, Intergovernmental Oceanographic Commission (IOC) of UNESCO, Russia

André Hoffmann, Businessman, Environmentalist, Philanthropist; Vice-Chairman, Hoffmann-La Roche, Switzerland

Highlights

"We have on the one hand, a necessity to understand our ecosystems [starting with the oceans,] at a very deep level if we are going to protect them. On the other hand, we have to have international collaboration, especially when it comes to the oceans, because there are no real boundaries for pollution and the extraction of resources have to be controlled by the international community," said Anders Meibom, a physicist and professor who runs a lab for biological geochemistry at EPFL for biological geochemistry, summing up the challenges facing ocean governance, the main one being to find a right balance between protection to allow scientific exploration and utilization of known oceanic resources for the common needs. Solving this issue is far from simple, as the current frameworks are blurred.

After it came into force in 1994, the UN Convention on the Law of the Sea (UNCLOS) – the main law for managing ocean resources – created three new international organizations: the International Tribunal for the Law of the Sea (ITLOS) in Hamburg, Germany; the International Seabed Authority (ISA) in Kingston, Jamaica; and the Commission on the Limits of the Continental Shelf (CLCS) in the UN's headquarters at New York. The Convention has 167 parties, but not the United States – the only major nation that does not belong. (The United States is party to an extension of UNCLOS, the UN's Straddling Fish Stocks Agreement, which covers species that migrate among or are found in more than one exclusive economic zone.) The ocean and coastal areas cover more than two-thirds of Earth's surface and contain 97% of the planet's water. UNCLOS has no jurisdiction, however, over the high seas – international waters beyond the 370-kilometer jurisdiction of coastal nations. That leaves about 45% of the Earth's surface without laws to protect marine species and minerals. "It's basically more or less a lawless zone. It's a bit like outer space. There's no governance of this," said Meibom, who also founded the Transnational Red Sea Center (TRSC), a Swiss-backed initiative for science diplomacy in the Red Sea region. "We are focusing on the coastal zones. And here we are simply dealing with national interests and trying to organize a cross-nation protection of the system. And this is a situation where the diplomacy is absolutely required. There's no escape from it."

Meibom and other marine experts said they see a need for some kind of "global charter" or, at least, more effective regional laws to protect the ocean. They agree more must be done to achieve one of the UN's 17 Sustainable Development Goals for 2030, which calls for conserving and sustainably using oceans, seas, and marine resources to sustain fishing, shipping, mining and other industries. The only question is at what scale.

Coastal and marine resources provide sustenance, livelihoods and tourism, contributing $28 trillion a year to the global economy in ecosystem services, the UN estimates. Negotiations have been underway at the United Nations towards new international agreements on sustainable uses of the high seas among commercial and national interests: everything from deep-sea mining to new patents, commercial applications and discoveries could be affected. However, wealthier nations have an advantage on monitoring, enforcement, regulation, and marine sciences, which are aided by UNESCO's Intergovernmental Oceanographic Commission (IOC).

"The threats of climate change have increased so dramatically for the ocean, that the race is to protect the ocean species, the network of life in the oceans, the ocean functions," said Antje Boetius, a renowned marine biologist whose research focuses on the impacts of climate change on the Earth's ocean and polar regions, among others on the biodiversity of the deep seas. "There are heat waves that reprogram ocean life so that it becomes pathogenic. We are trusting today that there are almost no marine pathogens, no marine viruses that could be a threat to humans. But we cannot be sure, and we have not the knowledge, not the database, to understand the genetic life of the oceans and what secrets it has."

Even the remote deep seas are harmed by plastic litter, warming of the ocean surface, oil spills and other threats. At least eight million tons a year of plastic wind up in oceans; plastic waste accounts for 80% of all marine debris from surface waters to deep sea sediments, according to the International Union for Conservation of Nature (IUCN), which said plastic pollution is found on the shorelines of all continents and is the most widespread problem affecting marine life. "We have to understand that this is one system," Boetius emphasized. "We count on the ocean as a store of species' DNA. And Earth history shows us that when things have been really bad on land, the life that re-emerged after a catastrophe like vulcanism and meteorites came from the ocean. So, the global-scale solution is a political one. It's one of international cooperation. It's one of enabling, sharing knowledge, and having that right amount of ocean literacy."

In 1903, Prince Albert I of Monaco initiated the General Bathymetric Chart of the Oceans (GEBCO) with the goal of mapping the bathymetry of the ocean's seafloor. The difficulty of mapping through water made progress slow-going. Starting in 2017, the UNESCO-backed Nippon Foundation-GEBCO Seabed 2030 Project accelerated the mapped extent to 20.6% now, more than tripling the mere 6% previously mapped to modern standards. "So, we hope that we will be able to cover 100% of the depths by the year 2030. Very ambitious. And everything is

ambitious here. I think we are now rediscovering the ocean, and the fact that we live on the 'planet ocean', not the planet Earth," said Vladimir Ryabinin, an oceanographer, climatologist and marine engineer who oversees the IOC, the UN body responsible for supporting global ocean science and services. He described the world's agreements on the coastal zones as "actually the largest redistribution of national jurisdiction in the history of humankind" and called for new global governance to protect the ocean and its biodiversity. "There is only one single ocean on this planet. It is connected, and it is not our property," Ryabinin said. "We belong to the ocean. The ocean does not belong to us. And we need to have a global charter."

Adding to the pressure on the ocean, paradoxically, is a vast demand for minerals like cobalt, copper, manganese, nickel and rare earths to facilitate the world's battery-powered transition to electric vehicles and sources of clean energy such as windmills and solar panels. The world will need triple the copper, 21 times the cobalt, eight times the manganese and 19 times the nickel that is used now to produce the clean energy needed to meet the Paris Agreement's climate change goals, the International Energy Agency reported. An abundance of such minerals can be found in potato-sized polymetallic nodules scattered across parts of the seabed. The International Seabed Authority has been drafting rules to mine them. Proponents say their use would protect land from mining. "I think that it's starting to dawn on people just how metal-intensive the green transition is going to be," said Gerard Barron, whose company argues tapping seabed will have the "lightest planetary touch" as the world shifts to a "circular" economy. "We do not dig or tunnel our way to find them. They literally sit there like this," he said at the Summit session, displaying one of the blackish nodules. "Getting off those fossil fuels and not collapsing the world in the process requires the electrification of transportation and energy production, and both of those require a lot of batteries, and that's the raw materials needed to make them. Battery metals are a critical step to a post-carbon and closed-loop world. And so now the question is where are they going to come from?"

Scraping the ocean seabed for minerals is an idea that worries some conservationists and marine scientists, because polymetallic nodules are a core part of a biome and disturbing them could damage unknown marine life while dramatically worsening climate change by releasing pent-up carbon from the depths. "We are just scratching the surface of the ocean in terms of our understanding. I mean, we know that life has existed in the ocean about 3.7 billion years, around three times as long as life on land. And that means there's tremendous diversity in the ocean and maybe around two million species, complex species. But we've only described about 10% of those," said Robert Blasiak, whose marine research focuses on a nexus between stewardship, sustainable management, and international cooperation.

Some companies have rushed to register patents for marine genetic resources of organisms that can withstand extreme conditions involving high pressure, hot and cold temperatures, and dim light. For entrepreneurs, these deep-sea genomes could have lucrative and beneficial uses for industry and biomedicine. The Nagoya Protocol, which grew from the UN Convention on Biological Diversity, only requires prospectors to share biological resources with researchers or companies in the national jurisdiction where they are found and does not apply to the high seas.

"Stewardship rests on three pillars," said Blasiak. "It needs to have knowledge. You need to know about the system before you can really take responsibility for it. The second is care. Once you have that knowledge, maybe you start to care; maybe you don't need to know that much to already feel a connection with the system and want to do something about it. The third one is agency, being able to actually do something about it. And for much of our existence, a lot of the ocean has been kind of out of reach. We haven't been able to access the deep ocean, the really remote parts of the ocean."

The world faces marine degradation on an unprecedented scale, said André Hoffmann, great-grandson of Roche Holding's founder and a former WWF International vice president. "For the past 250 years, our absolute, relentless pursuit of short-term profit maximization has destroyed the planet. And in particular, it's destroyed part of the planet that we don't even know. So, we don't even know what we are missing," said Hoffmann, adding that the belief in business as a panacea and wealth generator for protecting common interests and the environment "has not worked. And it is exactly the reason why we need things like GESDA, which will help bring us towards diplomacy at that level." Hoffmann said he was encouraged by a vote a day earlier in the UN Human Rights Council at Geneva recognizing for the first time that having a healthy environment is a human right. "The pandemic," he said, "has allowed us to realize that our system is not resilient." For example, 90% of the world's fish stocks is now fully or overfished, according to the Food and Agriculture Organization (FAO). Global fish production is approaching its sustainable limit, FAO said, with a 17% increase in production forecast by 2025. Overfishing more than tripled since the 1970s, and 40% of the most popular species like tuna is caught unsustainably. "When it comes to ocean protection, the marriage between science and diplomacy is absolutely essential," said Meibom. "It is not just that it is a good idea – it is essential. Now that is why, of course, I am a big fan of GESDA."

Takeaway Messages

The ocean and coastal areas cover more than two-thirds of Earth's surface and contain 97% of the planet's water, but 45% of the Earth's surface has no laws to protect marine species and minerals.

Ocean life goes back about 3.7 billion years, but scientists have described only about 10% of it.

Companies rush to register patents for marine genetic resources of organisms that could have lucrative and beneficial uses for industry and biomedicine.

The threat of climate change has increased dramatically for the oceans, creating a race to protect marine species and functions.

Demand for minerals for the world's battery-powered transition to electric vehicles and sources of clean energy has led to prospective mining on the ocean seabed that could spare land from mining but damage unknown marine life and release pent-up carbon from the depths.

Efforts to map the bathymetry of the ocean seafloor are accelerating with international cooperation.

Stewardship rests on three pillars: knowledge, care, and agency. That is why stewardship could be at the core of science and diplomacy actions for ocean protection.

A "global charter" may be needed to fulfil one of the UN's 17 Sustainable Development Goals for 2030 that calls for conserving and sustainably using oceans, seas, and marine resources.

More information

Session recording on YouTube

Related interviews: Anders Meibom & Vladimir Ryabinin

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Ocean Stewardship and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Harnessing Ocean Biodiversity, Transition Ecosystems, Repairing the Ocean, Improved Ocean Observation

Friday 8 October, 11:30am–12:30pm CET

ACCELERATE

Accelerating the Active Decarbonization of our Planet

Abstract

The amount of carbon dioxide in the atmosphere is at its highest level in four million years. If we want to meet our goal of capping global warming at 2°C, urgent action is required to both slash emissions and remove carbon dioxide from the atmosphere. Emerging negative emissions technologies such as direct air capture and materials able to absorb massive amounts of carbon will play a crucial role, but large-scale demonstrations are still a decade away. That means we probably need to combine accelerated R&D efforts with aggressive carbon pricing, major reforestation, and new agricultural and industrial approaches that help create a circular economy.

- How can we get promising decarbonization technologies out of the lab that are viable in the marketplace?
- How can we reach an agreement on a global minimum carbon price and how should we set carbon prices?
- How can we ensure that the burden of decarbonization is shared equitably?

Participants

Moderated by:

Janos Pasztor, Executive Director, Carnegie Climate Governance Initiative C2G, Hungary/Switzerland

With:

Jim Hagemann Snabe, Chairman, Supervisory Board, Siemens AG; Chairman of the Board of Directors, A.P. Møller–Mærsk A/S; Member, GESDA Diplomacy Forum, Denmark *(remotely)*

Gerald Haug, President, German National Academy of Sciences Leopoldina; Professor for Climate Geology at ETHZ; Director, Climate Geochemistry Department and Scientific Member at the Max Planck Institute; Member, GESDA Academic Forum, Germany

Sergio Mujica, Secretary-General, International Organization for Standardization; Member, GESDA Diplomacy Forum, Chile

Wendy Lee Queen, Tenure Track Assistant Professor, Laboratory of Functional Inorganic Materials, at EPFL, United States

Highlights

Ahead of the UN climate summit in November at Glasgow, Scotland, much of the world was pinning its hopes on governments to urgently commit to effective measures for countering the abundance of heat-trapping greenhouse gases in the atmosphere, which once again reached a new record in 2020, with the annual rate of increase above the 2011 to 2020 average. Concentration of atmospheric carbon dioxide (CO_2) reached 413.2 parts per million in 2020, or 149% above pre-industrial levels; methane (CH_4) was 262% and nitrous oxide (N_2O) was 123% above levels from the mid-18th century threshold when the fossil fuel era began. Though the COVID-19 pandemic temporarily slowed the rise of new emissions, it had virtually no impact on atmospheric concentrations of greenhouse gases, which raise the global mean surface temperature that reflects both land and ocean areas. By now some extreme impacts appear unavoidable due to long-term effects from fossil fuel burning, though humanity still has a brief window to avoid some of the worst scenarios if it undertakes swift emissions cuts, the UN's Intergovernmental Panel on Climate Change warned in August.

"It's very clear that the response of governments and the response of others is simply insufficient," Janos Pasztor, a nuclear engineer and former senior UN diplomat who headed the world body's climate diplomacy, said in framing the issue. "Now, the challenge is huge, and we need to decarbonize the world by the middle of the century, and then we must reach net zero, and then we have to go to net negative, because life doesn't stop at 2050. And we have to do it in a way that the transition is just, so that everybody is able to move forward positively to accelerate the decarbonization process."

The Nobel Prize-winning IPCC offered five likely scenarios for what would happen when the world exceeds the 2015 Paris Agreement's goal of preventing average global temperatures from rising more than 2°C above pre-industrial levels, or 1.5°C if possible. Since the world already warmed by more than 1°C, each scenario in the latest IPCC report – which reviews the latest research including land and ocean temperatures, emissions, extreme weather, drought, wildfires and sea level rise – shows the world crossing the 1.5°C threshold in the 2030s, faster than predicted. The report emphasized that human-caused climate change is causing severe and widespread impacts on Earth, such as heatwaves, drought and flooding, and these will be dramatically worse at 2°C than at 1.5°C. Ocean warming and melting ice sheets will likely cause sea level rise of five to ten metres into the 22nd century, IPCC reported. Extreme heat waves happen five times more often now and will occur 14 times as often if the 2°C threshold is breached; once-a-decade droughts happen 70% more often now.

"I would like to make a bold opening statement. The 2° Paris target is gone in ten to 15 years. The 1.5° target is already gone," said Gerald Haug, an expert in geosciences and oceanography. "If we would act in the next five to ten years, there's the opportunity to keep the 2° target. I think we have five to ten years for action. We do not have a knowledge problem. And I think this is where we go next; and we have a serious implementation problem. So, this where GESDA, Switzerland, Geneva – science-meeting-technology-meeting-diplomacy – could be very useful." Haug said the most potentially effective instrument that the world could use to combat climate change is carbon pricing. Two years ago, the International Monetary Fund (IMF) recommended a steep global tax on carbon emissions within a decade as the most effective way to reduce heat-trapping gases. The IMF report said imposing a global tax that rises to $75 per ton of carbon by 2030 could reduce emissions by 35% over the next decade. That would help meet the 2°C limit set in the Paris treaty. Without such urgent action, the IMF said in its climate mitigation report, global temperatures are projected to rise by double the Paris goal, or 4°C above pre-industrial levels, by 2100.

Such a tax would raise coal prices by 214%, increase electricity prices by 43% and send gas prices for cars up by 14% around the world, according to the IMF. A carbon tax of $50 per ton would send coal prices up by 142%, raise electricity prices by 32%, and send gas prices for cars up by 9%. But it would quickly reorder the global economy, creating demand for more sustainable energy sources and greener fuels. A more recent IMF report found nations spend $11 million per minute on subsidies for fossil fuels. "At the moment we are still at exponential growth. Ever since the Paris agreement, nothing has happened," said Haug. "The sharpest knife we have is a CO_2 price. And if we could manage this, with a good example starting here all over Europe, together with the United States and then probably China, that would be the winner. Without that knife, there's very little opportunity and chance that we meet the Paris agreement."

A poll of the session audience found just 13% believe the world is on track to scale up for global decarbonization and negative emissions; an overwhelming 87% believe it is not. Some 43% of respondents named insufficient political will by political leaders as the biggest impediment to the timely scaling up of techniques and technologies for decarbonization, and eventually net negative emissions. Another 30% said the private sector, motivated only by the profit motive, is the biggest impediment; 23% mainly blamed inadequate government mechanisms; 3% pointed to inadequate standards and regulations. No one chose an overabundance of standards and regulations as the biggest culprit.

"It's clear that business plays the major role in the action necessary. Policymakers can create environments which makes it attractive or unattractive to pollute, or attractive to solve the problem. But we need to do the action," said Jim Hagemann Snabe, who has pushed for a pragmatic stance on climate as chairman of both Moller-Maersk, the Danish conglomerate that dominates container shipping, and Siemens, Europe's leading industrial group. "And that's a little bit how I look at this problem and hence take on a big responsibility as well in business. I have one fundamental assumption. I believe we have the technologies necessary. That doesn't mean we don't need to develop much more. But we have enough that we shouldn't be waiting. We need action. And so, I'm actually driving the point around the leadership to act and not just to talk."

Siemens committed in 2015 to achieving carbon neutrality by 2030, and by 2020 it had cut emissions by 54% which provided "an indication for me that it's possible and it's not just empty words", said Snabe. Then Maersk committed in 2018 to achieving carbon neutrality by 2050, but "to be carbon neutral in a shipping company is not so easy. We can't just use batteries. It would take 60% of the capacity of the vessel", he said. "We knew we had to have the first vessels sailing in 2030 with a zero-carbon technology, and then we would spend 20 years to replace the entire fleet of vessels, 750 roughly. You can't just pile that up as waste, that would be an even bigger climate disaster. So that's why it was an ambitious plan." Now, Snabe, who calls himself a "concerned optimist", supports setting a global price on carbon. "It has to be a global price, at least in main regions, China, the United States, Europe has to participate. Otherwise, it's moving the problem around, you're not solving it," he said. And he envisions a future in green fuel with demand outstripping supply. "And that, I think, is good news potentially, because when demand is higher than supply, you actually have a wonderful business opportunity for anyone who invests early. And that's maybe my last point. I begin to see that it is becoming good business – you make money – if you invest in sustainable solutions. We have crossed that tipping point where the discussion should not be, can we afford it? It's almost the opposite," he said. "The Stone Age didn't end because we ran out of stone. It ended because there was a better technology. And we are looking into that technology now."

In the audience, Jean-Pierre Danthine, a professor at EPFL, and president of the Paris School of Economics, noted there is near-unanimous agreement among economists that global carbon pricing is the best way to go, but persuading citizens and their elected leaders to go along is harder. "It's the fact that you need to convince the people, not only the businesspeople, but also people on the street, that an extra tax is really necessary. And this is extremely difficult," said Danthine, who was deputy chairman of the Swiss National Bank from 2012 to 2015, partly blaming the problem on a mistrust of scientists and policymakers. "In Switzerland, we got to a 51 per cent vote against the CO_2 tax. It's not that we need a lot more, but I think that we need everyone, including probably the multilateral community, because things have been able to move from multilateralism a bit better than at the national levels."

From the panel, Wendy Lee Queen said her work has convinced her that the key to expanding the use of solar energy is through more use of materials with engineered properties created from specialized processing and synthesis technology, including ceramics, high value-added metals, electronic materials, composites, polymers, and biomaterials. "We know that historically, energy transitions are slow, and so we're going to continue emitting CO_2 from the combustion of fossil fuels for many years to come," said Queen, a chemist and material scientist who focuses on development design and production of hybrid organic and inorganic materials. "And so really at the end of the day, we also need advanced materials to capture that carbon dioxide from large point sources like coal-fired power plants or maybe large-scale transportation like ships. And then we've got another problem. What do we do with that carbon dioxide?" she asked. "If we really want to reach net zero and go negative, we've got to really start pushing negative emissions technologies forward. For instance, direct air capture. You also need advanced materials to remove the carbon dioxide directly from the atmosphere." But, she emphasized, much of her lab work deals in small-scale 'grams' rather than 'tons' – making it difficult to know exactly what might be needed for industry to dramatically scale up its production levels.

Standards can help, said Sergio Mujica, a lawyer with expertise in regulatory affairs from his work with several international organizations. He noted the 165-nation International Organization for Standardization that he heads was created in the aftermath of World War II to help rebuild the world and support economic and social development. "We have a longstanding tradition in contribution to environmental topics, maybe some of you know the 14000 series on environmental management," he said. "We also have a relatively new technical committee on carbon capture and storage. That committee is led by Canada. There are some 20-plus countries participating in that committee and there are already 11 standards that have been produced there and four more in the pipeline. But it's just the top of the pyramid because there is a lot more to do in this area."

Pasztor noted "We keep coming back to this issue: the scale is huge, yet we can do it! It's possible." And there are some positive developments in the private sector and with advanced materials, he said. "There are ways to go ahead. But if we don't get our act together, then it's going to be very serious," said Pasztor. Then we have to say pretty much goodbye to our [UN] Sustainable Development Goals, because we're not going to meet them."

Takeaway Messages

The challenge is to expedite the technology to decarbonize the world by 2050, then reach net zero, then get to net negative, in a way that is fair to everyone.

The 2° Paris target is gone in ten to 15 years; the 1.5° target is already gone.

The "sharpest knife" for accomplishing decarbonization is setting a global price, or tax, on CO_2.

Clean energy provides a better business model than fossil fuels, and business leaders cannot afford to wait any longer to make the transition. Many of the technologies needed are already here.

Research and technology assessment is needed. For many advanced materials, scaling up their use from the lab to industries has not yet been demonstrated.

GESDA can play an active role in communicating the need for global CO_2 pricing and how urgently the world needs to act – and in building trust among all communities.

More information

Session recording on YouTube

Related interviews: Janos Pasztor, Wendy Lee Queen, Gerald Haug

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Decarbonization and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Negative Emission Technologies, Energy Transition, Advanced Materials, Energy Storage

Invited contribution on Managing Solar Radiation

Sustainable Economics and related breakthroughs at five, ten and 25 year: Full breakthrough brief, Managing Climate Externalities, Bootstrapping Circular Economies

Friday 8 October, 8:30–9:30am CET

Reviving the Human Right to Science

Abstract

The notion that everyone has a right to benefit from scientific progress is enshrined in the United Nations' 1948 Universal Declaration of Human Rights. (UDHR), adopted under the guidance of Eleanor Roosevelt, who chaired the drafting committee, and in the UN's 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR) and other international and regional treaties. It is far from clear, however, exactly what freedoms and responsibilities derive from this established right of all people to "share in scientific advancement and its benefits", as the UN declared, and for most of its history, governments have largely allowed this right to remain dormant and neglected. As science and technology take an ever-greater role in our lives, now might be the time to bring this right back to life. An important first step would be to specify just what exactly is meant by the right to science. Proposals for reviving this right include a collective commitment to open science and inclusivity, new forums for data-sharing and the establishment of a deliberative body to ensure the latest scientific evidence is taken into account in policymaking.

- What freedoms and responsibilities does the "right to science" entail?
- How can the right to science be used to benefit humanity?
- How can we make this a "living human right" that is taken seriously by policymakers, and how can we encourage signatories to the UDHR to renew their commitment to the right to science?

Participants

Moderated by:

Samira Kiani, CEO and Founder, GenexGen; Director, Tomorrow.Life Initiative; Associate Professor, Liver Research Center, Department of Pathology, School of Medicine, University of Pittsburgh; Member, GESDA Academic Forum, USA

With:

Michelle Bachelet, UN High Commissioner for Human Rights (OHCHR); Former President of Chile; Member, GESDA Diplomacy Forum, Chile *(remotely)*

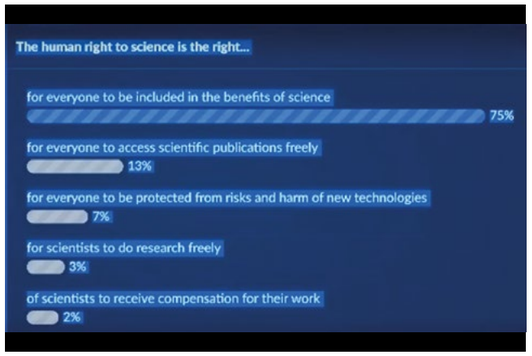
Yvonne Donders, Head, Department of International and European Public Law; Commissioner, Netherlands Human Rights Institute, University of Amsterdam, The Netherlands

Kamila Markram, neuroscientist, cofounder and CEO of Frontiers, Germany

Peter Maurer, President, International Committee of the Red Cross; Member, GESDA Diplomacy Forum, Switzerland

Highlights

In the wake of World War II, leaders saw the need to connect science with human rights, and enshrined this in the Universal Declaration of Human Rights (1948) which states in Article 27 that "everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits". The war's outcome was shaped by rapid science and technological advances like the atomic bomb, cavity magnetron-enhanced radar, faster computers, and large-scale production of penicillin. Each brought benefits but also risks. In 1966, the United Nations adopted two important treaties, the International Covenant on Civil and Political Rights (CCPR) and the International Covenant on Economic, Social and Cultural Rights (CESCR), which has been joined by 170 nations that voluntary assume it as a legal obligation. A poll of the plenary audience found 75% believe this right means science must benefit everyone. Another 13% said it means free access to science publications; 7% defined it as a protection from harm; 3% said it means unhindered research; and 2% called it an assurance that scientific work is compensated. No one chose a sixth option: a belief that it ensures all traditional knowledge must be kept alive.



Vote by the audience on the meaning of the Human Right to Science, at the start of the conference. Note the predominant view that this right is about inclusiveness; it should be invoked to remove barriers to access of the benefits of science.

UN human rights chief Michelle Bachelet said the human right to science is more than just access to knowledge. It is also a tool to facilitate other rights to basic needs and services such as food, water, housing, education, and health. "Sadly, it is still far from being a reality for everyone," she said. "Nowhere is this more visible now than with the case of vaccine injustice, which restricts people's rights to life and health, to development and to the benefits of scientific progress." Despite the unprecedented speed and deployment of COVID-19 vaccines during the pandemic, four-fifths of the doses administered globally went to high- and upper-middle income nations even though they account for less than half of the world's population. Bachelet, a medical doctor who was the first female president of Chile, said the vaccine gap between rich and poor is "a stark example of the severity of inequalities we should never grow accustomed to" but that once again a big segment of the world has been left behind. "As in every right, the right to science must be accessible by all and benefit for everyone's participation, without discrimination," she said. "In addition, it mandates that scientific innovations benefit people, rather than harm them. But here too, there is often a gap between what should happen and what actually happens." Part of the problem, she added, is that the human right to science is not widely known.

Peter Maurer

Because science affects so many areas of our lives, the human right to science has many implications for diplomacy. Even if it does not prevent abuses, it does offer valuable principles that express what societies care about. Science also offers solutions grounded in facts that are key to solving global problems like the pandemic, climate change and major humanitarian crises, said Peter Maurer, a veteran Swiss diplomat who served as ambassador to the UN and a top official in the Swiss foreign ministry before taking the helm of the ICRC. Emerging questions over massively disruptive technologies like autonomous weapons systems and social media-inflamed disinformation and hate speech all illustrate the need for scientists to help frame our responses, he said. "When you see the relationship between multilateral policy and science, you become aware how important it is to have evidence-based policymaking," said Maurer. "The confrontation with the humanitarian challenges and issues today at the ICRC made me such a strong advocate of evidence-based policymaking, which is another word for being an advocate of the human right to science – for having societies take advantage of scientific research in order to solve problems."

There is no lack of published scientific research (including three million articles a year published just in English-language journals), but the question of who has access to this research affects the

human right to science. Legacy publishers kept their old business models in place, so universities and businesses today spend more than $10 billion a year to access science journals that remain behind paywalls. Two-fifths of that revenue goes to US publishers, and the rest is split about evenly between publishers in the EMEA and Asia-Pacific regions. Ironically, scientists created the Internet decades ago partly to reach a wider audience. In the face of these paywalls, an open-source movement has sprang up to unlock millions of science articles.


Yvonne Donders

"When you restrict access to science, the only thing that actually happens is that we slow down our global innovation cycle. Science today is really underpinning every single aspect of our lives," said Kamila Markram, who co-founded a leading open-access academic publisher and social network for researchers. And since no one can afford to subscribe to all of the paid journals, she said, "the consequence is that researchers don't have full access even within their own research fields to the latest science". The same goes for policymakers, medical doctors, patients, innovators, and journalists, and whoever else might benefit from all of this research. By region, access breaks down even further; people living in Eastern Europe, Africa, and South America are more often excluded from the benefits of science, said Markram, the CEO of a large open science enterprise, Frontiers. "On the other hand, what happens when you open up this vast knowledge of science?" she asked, before answering her own question. "Last year, when the pandemic hit us, something happened that none of us had achieved in 20 years of trying. It basically opened up the scientific literature overnight, almost."


Kamila Markram

What happened was that Chinese scientists sequenced the genetic makeup of the novel coronavirus, then made it publicly available at the start of 2020. That triggered a race for vaccines in research labs worldwide. Most scientific journals made COVID-19 research papers freely available; also in March 2020, the White House mandated that all COVID-19 papers must be available through open-access publications; as of December 2021, 500,000 papers were stored in the COVID-19 Open Research Dataset Challenge (CORD-19) and made accessible to all. "Only because all of this science was made open, were scientists able to collaborate now far more effectively and they delivered. They delivered solutions at a speed that we have never seen before in human history," Markram said. "It was the absolutely right policy decision to do that, but I think that policymakers actually need to learn from this experience, because it's not the only emergency we're in." Beyond providing more access to all of this original research, people need more help understanding it all. That puts the onus on scientists to better translate their work. AI and machine learning tools are also needed to sift through the research, which is far more than any one person can digest. "What we need are proper tools – how to make sense out of all of this research," she said. "In COVID, this is what has been happening."


Samira Kiani

One of the major challenges to this human right is that the private sector produces a significant amount of science. When the UDHR was drafted, experts said, the institutions around science were more homogenous, in large part because of a lack of diversity. International legal instruments were not equipped to deal with private institutions; they were designed to address how governments implement science. Framing science as a human right can help illuminate the core issues of how to balance competing interests, provide access to scientific information and protect vulnerable people. It also should help clarify society's values and principles, even if lawyers alone cannot resolve the way forward. GESDA's decision to highlight the human right to science signals that something important is happening, according to Yvonne Donders, a prominent international and human rights law expert. "Ten years ago, nobody would have a session on the human right to science in these kinds of summits," said Donders. "The fact is that nothing really happened with it" in the decades since the right was established, she said, because countries and academics "have not paid a lot of attention" to it until recently. "That has changed over the last years. More academic research is done on this right. There are a lot of legal developments going on in courts."

Takeaway Messages

Reviving the human right to science is a timely and important initiative. GESDA can serve as an appropriate forum to encourage this conversation.

This human right is violated when low-income countries cannot benefit from scientific breakthroughs (like the COVID-19 vaccines).

The existing international legal framework does not appropriately reflect the economic, cultural and social aspects of today's science enterprise.

This right mandates evidence-based policymaking – having society take advantage of scientific research in order to solve problems.

Open and free access to scientific data and publications should be a consequence of this right.

Additional content

Introductory remarks by Michelle Bachelet, UN High Commissioner for Human Rights (OHCHR); Former President of Chile, Chile

I am delighted to be part of this important discussion.

Every day, I feel in awe with scientific and technological progress. Not that long ago, I remember waiting for the morning newspaper, to receive news of the day before.

Now, everything is reported in real time and through ever evolving communications methods and channels.

Today, we share information easily and we even have robots to assist in many spheres of life. With cameras, we can visit anyone, anywhere in the world, and many of us are forever grateful for that, in the recent times away from family and friends during lockdown, but also everyday.

As a medical doctor, I have seen so many advances in medical science – enough to amaze me for the rest of my life.

As they should everyone. It is within our right.

So, what is the human right to science exactly?

You have already shown Article 27 of the Universal Declaration of Human Rights, which states the right of everyone to share in scientific advancement and its benefits. That it reinforced by Article 15 of the International Covenant on Economic, Social, and Cultural Rights (CESCR) which, as of July 2020, had 170 States Parties voluntarily assuming this article as a legal obligation.

As you correctly said, the human right to science is more than access to knowledge. It is also a tool for the realization of other human rights and fundamental freedoms, such as food, water, housing, education, and health.

But, sadly, it is still far from being a reality for everyone.

Nowhere is this more visible now than with the case of vaccine injustice – which restricts people's rights to life and health, to development and to the benefits of scientific progress.

The pace at which we gained scientific knowledge has been extraordinary, and countless lives have been saved. By August 2021, almost five billion vaccine doses had been administered. But the vaccine gap between rich and poor is a stark example of the severity of inequalities we should never grow accustomed to. More than 80% of the doses administered globally had gone to high- and upper-middle income countries, even though they account for less than half of the world's population.

The lack of access to vaccines and medicines puts millions of lives in developing countries in immediate danger. It also poses a threat to people everywhere, as mutating forms of the virus may emerge among largely unvaccinated populations.

The pandemic also has demonstrated that access to digital technology and the internet plays an essential role in disseminating public health information, ensuring incomes during lockdowns and enabling that children to continue their education. But once again, a huge part of the population has been left behind.

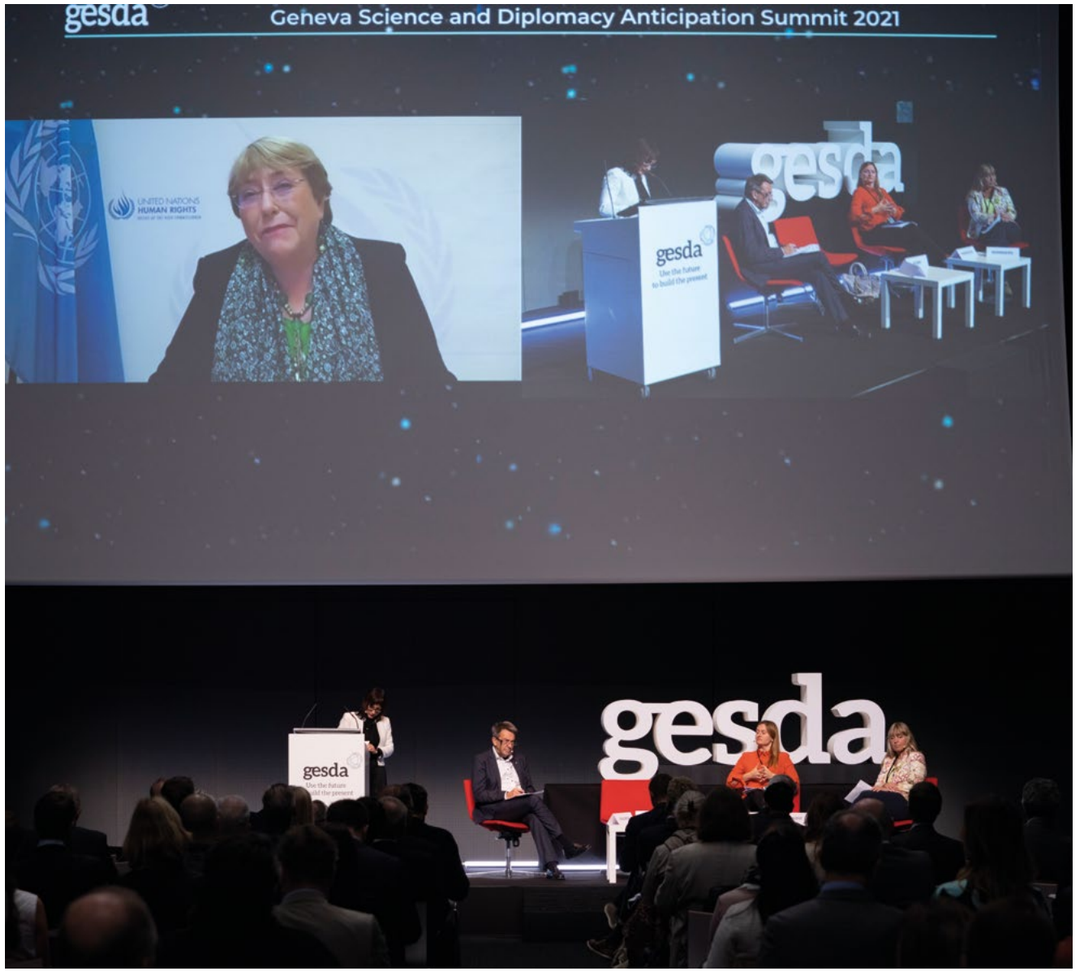
As in every right, the right to science must be accessible by all and benefit for everyone's participation, without discrimination.

In addition, it mandates that scientific innovations benefit people, rather than harm them. But here too, there is often a gap between what should happen and what actually happens.

For example, while artificial intelligence can help improve productivity, monitor epidemics, or support economic growth, it can also have built-in discriminatory effects. Openness and transparency in the development of AI algorithms can help prevent people from being discriminated against, based on characteristics such as their race, age, sex or disability.

It is also important to see that science is developed while respecting human rights. The improvement of public policy and governance through science-policy interface can be undermined if scientists are harassed for speaking out about their findings or been denied fundamental freedoms to carry out their work.

The Right to Science is not widely known and all of us can help change that. Because respecting human rights is essential to creating the world we all want to live in".



More information

Session recording on YouTube

Related interviews: Samira Kiani, Peter Maurer

Tweets related to the session

Michelle Bachelet's remarks

ANTICIPATE

Designing an Economic Compass for Sustainable, Inclusive and Resilient Societies

Abstract

Economic growth has significantly improved material well-being around the world, reduced poverty and closed the gap between rich and poor nations. At the same time, it has led to growing inequality within nations and over-exploitation of the Earth's resources. Global economies face several challenges in the future: first, a wave of technological developments fuelled by artificial intelligence (AI) will further test the limits of today's views about labour, capital and employment. Second, climate change creates an urgent necessity to use natural resources more carefully. Third, there are grounds for a move against globalization and towards more localization that could undo the benefits of international specialization. These developments call for a new economic compass to help us chart a course through the policy challenges ahead. This will help anticipate winners and losers of economic shifts ahead of time, design welfare systems fit to purpose, better understand and counter environmental externalities associated with various economic choices and build more resilience into the global economy.

- Which policy interventions have the best chance to guarantee human employment in meaningful jobs and avoid growing inequalities when intelligent machines become more widespread in the future?
- How can we move rapidly towards a regenerative circular economy that limits the impact of our economic actions on the planet while assuring the well-being of all?
- Can we make globalization more resilient and sustainable without losing the benefits of international specialization?

Participants

Moderated by:

Richard Baldwin, Professor, Graduate Institute Geneva, Switzerland

Organized by:

Jean-Pierre Danthine, E4S Executive Director, University of Lausanne/IMD/EPFL; Member, GESDA Academic Forum, Switzerland

With:

Philippe Aghion, Professor, College de France, INSEAD and London School of Economics, UK

Ian Goldin, Professor, Oxford University, Senior Fellow at the Oxford Martin School, UK

Katheline Schubert, Professor, Paris School of Economics, France

Highlights

Global economies face several challenges in the future. First, a wave of technological developments fuelled by AI will further test the limits of today's views about labour, capital and employment. Second, climate change creates an urgent necessity to use more carefully natural resources within the planetary boundaries. Third, there are grounds for a move towards de-globalization and re-localization that could undo the benefits of international specialization.

Richard Baldwin, a professor of international economics, introduced the first topic, the future of work, through a poll at the beginning of the session that showed many people in the audience were concerned about a future loss of jobs. However, Philippe Aghion, a French economist, expressed an optimistic view of automation. He said he believes it has great potential to improve productivity and employment. Evidence from his own research shows that automation has created substantial benefits for sales and employment of firms that use these technologies. He also emphasized that taxing automation, such as a robot tax, is a bad idea, as it comes at great expense to productivity. Moreover, it is difficult to define what is a robot, he said, and in light of international fiscal competition the enforcement of a robot tax would require a multinational approach. He said he believed automation can be managed through appropriate policymaking in market and educational policies, such as investing in skills and "good jobs". In his view, the "Nordic model" of employment, particularly the Danish flexicurity system, can serve as a model for how the gains of automation can be reaped without creating social inequality.

The second challenge, according to Baldwin, lies with the environment. The poll during the session showed that most people in the audience were not optimistic that governments will adopt policies needed to avoid catastrophic climate and environmental changes. Katheline Schubert, an economics professor, emphasized the challenge of gaining public acceptance for implementing fair climate policies. She also reported advances in how to make climate policies more just, for example by redistributing the gains of CO_2 taxes. She also said that while the costs were clear, policymakers have to clarify the gains from such a tax, in particular for the poor, which could boost the acceptability of their policies. There has been no evidence, she argued, that continual economic growth and sustainability can be simultaneously guaranteed in the future.

The poll also showed that most people in the audience did not believe globalization has peaked. Ian Goldin, a professor of globalization, contended there will be more, not less, globalization in science, digitalization and finance. While physical flows were already peaking before the COVID-19 in line with the decreasing share of goods relative to services in global GDP, the international flows of ideas and financial flows will continue to grow. These are processes that will accelerate and change our lives. These trends have been evident during the COVID-19 pandemic, he said. However, it is important that globalization increases its resilience against systemic risks, the "butterfly defect" of globalization. Stopping globalization will not stop global threats such as climate change, pandemics, or other catastrophic risks but will rather amplify them. Goldin advised using increased international cooperation to counter the threat that rising nationalism poses to economies. In contrast, the recent tendency towards nationalism is itself a threat for our economies, for globalization and for our collective wellbeing. Coordinated global efforts and strengthening organizations are key in his regard: "We have to work together to manage globalization," he said.

Takeaway Messages

Our economies are facing big challenges, but the policy solutions are on the table and have to be implemented.

Automation can be managed without losing potential gains through labour and education policies, such as investing in skills, and good jobs, and by redistributing the gains of automation.

Climate policies that take into account historical contributions to rising emissions are likely to gain wider acceptance by the public.

More research is needed in economics to tackle environmental questions and the circular economy.

Globalization is expected to accelerate but can be managed through more international cooperation.

More information

Related content in the 2021 Science Breakthrough Radar®

Sustainable Economics and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Managing Climate Externalities, Automation and Work, Bootstrapping Circular Economies, Sustainable Global Trade

Friday 8 October, 4:45–5:45am CET

ACCELERATE

Revitalizing Multilateralism through Anticipatory Science and Diplomacy

Abstract

The grand challenges facing humanity in the 21st century will be both global and technical. Climate change, unemployment, hunger, and a host of other issues will require experts of all kinds around the world to come together to solve them. Yet today, trust in science is on the decline and multilateralism in some regions appears to be in retreat. This highlights the need for a revitalization of science diplomacy and a major update to the frameworks that underpin it. This will be crucial, not only for tackling the challenges already before us, but also anticipating future technical and policy developments in time to foster multilateral solutions.

- How can we bring current and anticipated scientific breakthroughs to the forefront of policymaking to tackle emerging grand challenges, and how can we train future leaders to be bilingual in both science and diplomacy?
- In future science diplomacy, what would be the most effective roles for people on the local level or those outside of government?
- How can we reinvigorate trust in science among citizens?

Participants

Moderated by:

Marga Gual Soler, Science Diplomat; Founder, SciDipGLOBAL, Spain

With:

Micheline Calmy-Rey, Former President of the Swiss Confederation; Visiting Professor, University of Geneva; Board Member, GESDA , Switzerland

Yves Flückiger, President, swissuniversities; Rector, University of Geneva; President, Campus Biotech Geneva Foundation, Switzerland

Joël Mesot, President, ETHZ; Co-Chair, GESDA Academic Forum, Switzerland

Nikhil Seth, Executive Director, UNITAR, India

Highlights

Science diplomacy in the service of multilateral institutions represents a resurgence. Perhaps not well-known outside expert circles, it has come into greater focus in recent years as a novel way of fusing expertise about difficult technical challenges with policymaking and more citizen involvement. It is re-emerging in new and updated forms as an anticipatory tool for peace and prosperity through efforts like GESDA, yet examples of its use go back decades, even to the 19th century when two doctors in Geneva helped launch the Red Cross movement.

In 2011, former Swiss President Micheline Calmy-Rey noted, the Swiss government used science diplomacy to forge an agreement between Russia and Georgia that cleared the way for Russia's accession to the World Trade Organization. Calmy-Rey, who travelled to Russia and Georgia to hold direct talks with the Russian and Georgian presidents, recalled turning to negotiation engineering and technology to get past their differences. The Swiss put together a mechanism agreed to by the two countries to regulate customs administration and the supervision of commercial goods. "It was really a political problem. The point of contention had always boiled down to the different understandings the two parties have, had, and still have of what constitutes the Georgian customs area," said Calmy-Rey, a visiting professor at the University of Geneva and member of GESDA's Board of Directors. The solution relied on ingenious ways "to avoid any reference to the Georgian border", she said, along with "trade corridors defined by points of longitude and latitude instead of borders", and new electronic platforms for statistical data coordinated with Geneva-based WTO. "The method is pragmatic, and the problem made manageable," she said. "The Swiss mediation was a success, and it illustrates how the problem-solving mindset of engineering science can be applied to a complex, real-world negotiation."

A decade before that, Joël Mesot recalled, he worked on a UNESCO-brokered project that had relied on science diplomacy to build the Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME), a physics, chemistry and biology lab in Jordan, the only nation that then had diplomatic relations with all the other surrounding founding members. He said the science diplomacy needed to get the lab built resembled that used at CERN in the early 1950s – to get past France-Germany tensions – as the first post-World War II project in which Germans could work again with other European nations. "It seems that we have forgotten about these ways of proceeding. Now, why? What has changed between this time? And I think this is the sense of urgency that something is going to happen. So, GESDA is also about anticipating," said Mesot, president of the Swiss Federal Institute of Technology in Zurich and co-chair of GESDA's Academic Forum.

"We develop technologies in our universities that could help international organizations to move forward. We all know that multilateral organizations have troubles at the moment." Amid populism and disinformation, "the COVID-19 pandemic has been, and continues to be, a kind of a life case study for science diplomacy, revealing deep fractures in the multilateral system and the immense challenges of building effective science policy interfaces at the global level," said Marga Gual Soler, an expert in molecular biosciences who promotes science diplomacy among international organizations. The situation "highlights the need for a revitalization of science diplomacy and a major update on the frameworks that underpin it", she said.

In his dual roles overseeing Geneva's university as its rector and speaking for all Swiss universities as president of swissuniversities, Yves Flückiger urged a multidisciplinary approach to science diplomacy – and to focus on building trust through more outreach and inclusiveness. "I think right now it's impossible just to address a question with a technological solution," he said. "Building trust is not so easy. We need really to make sure that everybody understands how science works and what science can bring to the population." However, the dialogue between science communities and international organizations "has to go both ways", he said, since scientists also need to understand the political and diplomatic challenges. "And the goal of such a platform like GESDA is really to create the dialogue both ways between science and international organizations, but also that international organization are able to bring to the scientific community the challenges that they have to face," he added. "The beauty of GESDA is the fact that they are a public platform, which is open to everybody and every country."

Science and science policy play a "very important" role at the United Nations and other leading international organizations, said Nikhil Seth, who took over the UN Institute for Training and Research (UNITAR) in 2015, and before that was a diplomat and taught economics. "But if you look at the historical record of how political leadership has handled the issue of science and making global policy, I would say it's a very dismal record." The agendas of major organizations like the Group of Seven (G7) or Group of 20 (G20) "normally reflect the crisis of the day", and they may never come around to anticipatory science diplomacy – but there are still opportunities for GESDA to make a mark. More could be done through the World Intellectual Property Organization (WIPO) to share science knowledge, and if Switzerland wins election next year to a two-year seat on the 15-nation UN Security Council in New York, it will have one to two opportunities from 2023–2024 as the monthly revolving council president to set the global

agenda and could use that opportunity to spotlight anticipatory science diplomacy, he said, adding that GESDA also could work "to level the playing field so that the poorer countries and those who collectively make global policy are all equally informed" in the use of science diplomacy and technology. Calmy-Rey similarly urged GESDA to bring more focus on social and political sciences, and for Geneva, as a longstanding hub of international organizations, "to make a diagnosis of all the problems we can find on the international level" that could be remedied with "diplomatic science" and "diplomatic engineering".

The GESDA Science Breakthrough Radar®, is one of the instruments already being translated as an educational and outreach tool. Another new development is the launch of GESDA's Science and Diplomacy Capacity Building Initiative, announced Stéphane Decoutère, GESDA's secretary general, which he said reflects the GESDA's view "on the need for a global learning platform for bottom-up science diplomacy". (Please read on following page). "I believe in it," Mesot said of this flurry of GESDA-initiated science diplomacy based in Geneva. "It is just the seed. It is just the start. But I believe that we might make a change worldwide with this initiative."

Takeaway Messages

Science diplomacy is resurgent but has firm roots with examples in the Red Cross movement, Swiss government and UNESCO that used cutting-edge advances to overcome political hurdles.

Together with the revitalization of science diplomacy, a major update on the frameworks that underpin it is needed. The focus on anticipation should be a key feature of it.

Leading universities such as those in Switzerland can use their educational tools, research, and technologies to help international organizations move forward and keep their relevance.

A multidisciplinary approach to science diplomacy can build trust through outreach and inclusiveness, raise science knowledge and awareness, and educate generations of potential future leaders.

Opportunities exist for GESDA, as a public platform, to create two-way dialogues between science communities and international organizations.

Switzerland could promote anticipatory science diplomacy through a Security Council seat in 2023 and 2024.

More information

Session recording on YouTube

Related interviews: Nikhil Seth & Joël Mesot, Marga Gual Soler

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Science-based Diplomacy and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Computational Diplomacy, Negotiation Engineering, Predictive Peacekeeping, Trust and Co-operation Modelling

Collaborative Science Diplomacy and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Multistakeholder Technology Diplomacy, Integrating Non-State Actors, Diplomacy for Big Science, Managing the Global Commons

Friday 8 October, 4:45–5:45am CET

TRANSLATE

Announcement of GESDA's Science and Diplomacy Capacity Building Initiative

Participants

With:

Stéphane Decoutère, Secretary General, GESDA

Highlights

Excellencies

Dear GESDA guests,

Ladies and gentlemen,

As Secretary General of the Geneva Science and Diplomacy Anticipator, I am pleased and honoured to join on stage two of our very important academic partners, the Rector of the University of Geneva Yves Flückiger and the President of the Swiss Federal Institute of Technology in Zurich (EHTZ), Joël Mesot, who has been co-chairing for two years GESDA Academic Forum.

We are here together to launch GESDA's Science and Diplomacy Capacity Building Initiative in partnership with the Asuera Stiftung, a foundation located in the vicinity of Zurich created by the family of Stefan Schmidheiny, who supports this endeavour.

With this, the GESDA Foundation shares the view on the need of a global learning platform for bottom-up science diplomacy, as underlined yesterday in the opening panel by Minister Naledi Pandor as well as by Maria-Francesca Spatolisano, Achim Steiner, Alondra Nelson, Sir Peter Gluckman, Martina Hirayama and Ambassador Alexandre Fasel.

As a first step in this direction, we have been starting since two years to put together a broad coalition of Geneva, Swiss and global partners in order to launch new capacity-building programs to train anticipatory science diplomacy leaders.

I would like to thank two persons who have been quite instrumental for starting this effort. They are sitting in front of me, first Ms Marga Gual Soler, member of our Academic Forum, a young global leader in this promising field, and my colleague Sandro Giuliani, the Executive Director of our Impact Fund.

Sandro is currently a member of the Board of Directors of the Jacobs Foundation and the Roger Federer Foundation. Since two years, he has been developing GESDA's activities from our outpost in Zurich, in the premises of ETHZ and in close collaboration with the University and the Swiss German-speaking ecosystem, in order to bring to GESDA a full Swiss touch and take advantage of the Swiss diverse types of cultures, language and excellence.

Thank you to both of them and to all the members of the Task Force at the origin of the project.

Let me now quickly highlight some key-figures of this Science and Diplomacy Capacity Building Initiative

- First, GESDA's Science Breakthrough Radar® will provide a key scientific framework for all these programs. That is the main contribution from GESDA to the coalition.
- As displayed on the screen, the partners of GESDA in this initiative already include diplomatic and academic institutions from Geneva, Switzerland and the world.
  - in Geneva:
    - Five academic institutions: the University of Geneva, the Graduate Institute Geneva, CERN, the Geneva Science-Policy Interface (GSPI) and the Geneva Centre for Security Policy (GCSP)
    - Four diplomacy institutions working for the world from Geneva: the Inter-Parliamentary Union (IPU), the SDG Lab to the UN in Geneva, the DiploFoundation, and the UN Institute for Training and Research (UNITAR)
  - in Switzerland: ETHZ and the University of Zurich as well as the already mentioned Asuera Stiftung
  - on the global level, the International Network for Government Science Advice (INGSA) as well as the Foreign Ministries Science and Technology Advice Network (FMSTAN)
- As a first joint activity, the coalition will stage a Geneva Science and Diplomacy Week in May 2022 to provide immersion training for future leaders worldwide and open events for the general public.
  - An online science and diplomacy training course, organized by DiploFoundation with contributions from GSPI and GESDA, that is geared towards diplomats.
  - A new Executive MBA (emba X), organized by ETHZ and the University of St Gallen (HSG), that will use the GESDA Science Breakthrough Radar® as a framework in its future-oriented fireside chat series.
  - And last but not least, the new Laboratory for Science in Diplomacy, launched by the University of Geneva and ETHZ in collaboration with GESDA, that will use Negotiation Engineering and Computational Diplomacy as innovative tools to advance international relations.
- We are honoured that our two partners have chosen this Geneva Science and Diplomacy Anticipation Summit as the platform for the launch of their new initiative and with this, I am pleased to hand over to Joel Mesot and Yves Flückiger for their presentation.

Thank you very much for your attention.

Takeaway Messages

GESDA Foundation shares the view on the need for a global learning platform for bottom-up science diplomacy.

GESDA's Science Breakthrough Radar® will provide a key scientific framework for all these programmes.

GESDA is putting together a broad coalition of Geneva, Swiss and global partners in order to launch new capacity-building programs to train anticipatory science diplomacy leaders.

Among other activities, GESDA will lead the organization of a Geneva Science and Diplomacy Week in May 2022 to provide immersion training for future leaders worldwide and open events for the general public.

More information

Press release on the announcement

Session recording on YouTube

Saturday 9 October, 10:15–11:15am CET

ACCELERATE

Building Digital Models to Navigate the 21st Century's Ecological and Social Systems

Abstract

Humanity created, captured, copied, and consumed more than 64 trillion gigabytes of data last year. This deluge of information is being used to try to model the world around us in unprecedented detail. That includes complex systems like cities, ecosystems, and the climate. Going forward these models will become increasingly intermeshed, creating sprawling socioecological simulations that can provide policymakers with invaluable foresight on the outcomes of economic, environmental and social policies. While those simulations, often referred to as "digital twins", can provide knowledge about the potential evolution of a system, big data and machine learning approaches have so far failed to capture the full complexity of real-world situations and different feedback loops. Finding ways to combine models with different scales and purposes and ensuring that today's biases and prejudices are not baked into them, will require a sustained interdisciplinary effort that includes full engagement among citizens.

- Many initiatives for "digital twins" have been recently launched. To what extent will these initiatives be able to reproduce the complexity of real-world systems?
- Can we combine models of physical reality with those simulating more intangible social phenomena?
- How reliable are today's leading models and how can policy makers use them wisely?
- How can we ensure models used to guide policy are transparent, equitable and explainable?

Participants

Moderated by:

Chris Luebkeman, Leader, Strategic Foresight Hub, Office of the President, ETHZ, USA

With:

Maurice Borgeaud, Head, Department Science Applications and Future Technologies, Directorate, Earth Observation Programmes, European Space Agency, Switzerland

Sean Cleary, Executive Vice-Chair, FutureWorld Foundation; Member, Advisory Board, Carnegie Artificial Intelligence & Equality Initiative; Managing Director, Centre for Advanced Governance; Member, GESDA Diplomacy Forum, South Africa

Neil Davies, Director, University of California's Gump South Pacific Research Station on Moorea (French Polynesia); Research Affiliate, Berkeley Institute for Data Science; Vice President, Tetiaroa Society, USA

Dirk Helbing, Professor, Computational Social Science, Department of Humanities, Social and Political Sciences; Affiliate, Computer Science Department, ETHZ; Member, GESDA Academic Forum, Germany *(remotely)*

Mami Mizutori, Special Representative of the United Nations Secretary-General for Disaster Risk Reduction; Head, UNDRR; Member, GESDA Diplomacy Forum, Japan

Philippe Gillet, Chief Science Officer, SICPA; Former Vice President, EPFL, France

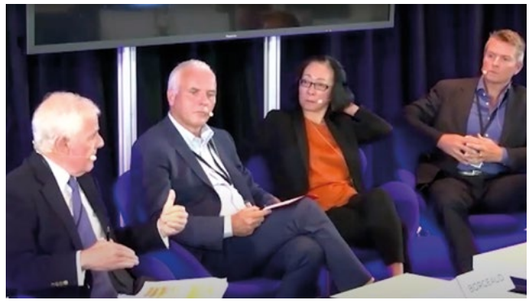
Highlights

A campaign run by the United Nations Office for Disaster Risk Reduction (UNDRR) sums up how human-caused problems increasingly affect our home planet: "There is no such thing as a natural disaster." The slogan also points to how factors such as fossil fuels, nationalism, disregard for developing countries, poverty and urban sprawl all degrade the environment and cause more frequent and intense calamities. "Human beings are now becoming the problem of most of the things in the world of disaster and risk," said Mami Mizutori, a veteran diplomat who heads the agency, emphasizing that 30 million people were displaced by disasters last year, triple the ten million people displaced by conflict. She acknowledged natural hazards like earthquakes and tsunamis, but pointed to humankind's poor stewardship as the cause of more extreme weather events such as storms, floods, and heat waves. "Are they really natural?" she asked. "We do not think so."

These global risks are being studied in digital models and simulations, which can cut across silos of information and data and often include a metric of resilience. To help people prevent hazards from becoming disasters, such models are an "extremely important" tool, Mizutori noted. "Because if we don't know the current situation, the baseline, as well as what happened historically, and what will happen in the future, we won't have good policies to mitigate the risk. And I would think that good models that have the vulnerabilities, the exposure, and the hazards element in it – past, future and importantly current – will really help us understand better what are we living through and what can we do."

Such risk prediction models are one example of the trend that started a few years ago around the use of so-called "digital twins" with complex systems like cities, ecosystems and climate. For example, Maurice Borgeaud, an engineer responsible for science, applications, and climate at the European Space Agency, said his agency, the European Commission, European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), and European Centre for Medium-Range Weather Forecasts (ECMWF) all started examining the use of digital twins about two years ago with forestry and food systems. The project, now called Destination Earth (DestinE), aims to develop a high precision digital model of Earth to monitor and simulate natural phenomena and related human activities.

Some of these tools are being built to deal with global issues, but others are needed at a local scale, too, said Neil Davies, an evolutionary geneticist. About eight years ago, while at ETHZ, he created a digital twin – then called an "island digital ecosystem avatar" – of Mo'orea, an island just off the coast of Tahiti in French Polynesia. The idea was to build a decision support tool that was rooted in science data, and to build in disaster resilience, so that local governments could better prepare and respond. With disaster reliance becoming an increasingly important issue, the question of building climate resilient communities is taking on added urgency.



Those models are particularly useful for dealing with the construct of an Anthropocene era, roughly since the end of World War II, in which humans now have more effect on the environment than the environment affects humanity, creating a vicious and destructive cycle, according to Sean Cleary, reinforcing Mami Mizutori's assertions . An author and lecturer on global corporate strategy with combined expertise in business and diplomacy, Cleary said that "now what we can see all around us in terms of challenges, from pandemics to wildfires in Siberia, to methane emissions, to extreme weather right across all parts of the globe, to the threat to island communities, demands a response. Unfortunately, we can't experiment at scale in the real world. If we could, maybe we'd be able to solve some of these things. But the last 20 months of COVID suggests that we're not terribly good at that. We battle to play catch up when we are caught unawares by a crisis upon us. And the logic behind digital twins, the logic behind digital simulations is potentially to give us anticipatory capability that enables better responses at different scales, enabling society at large, human society, national governments, multilateral institutions of different sorts, to anticipate risk in the context of disaster associated with hazard and vulnerability and exposure, in appropriate ways to work out what we ought to do about it." To Cleary, the advantage of digital twins is that they represent "experimental landscapes within which we attempt to explore what may happen under particular conditions, alternative scenarios in that respect, and what contributions humanity in different ways is making towards these particular problems, and what might be done through policy in order to address those challenges". "That's the logic of this discussion. Now, there are also huge limitations."

These limitations go from being “obstructed by biases, randomness, turbulence, chaos theory, and many other things”, said Dirk Helbing, a professor and physicist. “Creating an accurate digital twin for material structures, which change all over time, is easy. However, it will probably never be possible to produce an exact digital twin of life on Earth, or of our body, or of our health. And we need, therefore, to expect uncertainty. We need to have a complexity science approach on machine learning. The biggest modern machine learning models publicly known today try to learn a trillion parameters or so. However, sometimes simpler models have more predictive power and less data.” And when it comes to building in an AI-powered intelligence system that could help solve the sustainability problems of the planet, that could be risky, he said, because the system “might figure out that the easiest solution would be depopulation. It might trigger an apocalyptic scenario, even though a better future for everyone might exist.”

Not everything can be modelled, said Cleary, but “if we do not have a landscape in which to explore, we are not likely to be able to anticipate and respond appropriately”. Davies said the most important thing is access to data needed to feed models, which depends on politics and diplomacy. “If you want really to make progress in this field, you will have to share information here,” said Borgeaud, agreeing with Davies. “Since 2008, with the Copernicus satellites, we have a full, free and open data policy. This completely changed the way that people are using the data. And it should be the same for models: hiding some of them will not help to move forward.”

For Helbing, it is important to have open models that can be challenged. “This is how we make progress in science,” he said. “Besides, having a pluralistic approach of models is always beneficial” because combining them often brings better results than using each model individually, as shown with tsunami prediction models. “But altogether, uncertainty will remain,” said Helbing. “That means we need to learn to be more flexible, adaptive and responsive as part of what we need to build in terms of the participatory resilience capacity of our systems. We should not plan for systems that will not change over time, but rather design for systems that can flexibly adjust to the circumstances.”

The simulations “simply demonstrate how much we don’t know,” Davies said, after pointing out another aspect of the model he is developing in Mo’orea. “We’re starting at the very, very small scale and connecting it to all these data that are coming from satellites. And today, we’re kind of launching into a second phase. So, this is an opportune time which tries to connect the science more to society and sort of renames the initiative a little bit as now a sort of collective intelligence infrastructure for democratic ecological action. It’s a collective intelligence idea. We need to go much faster to implement that now. And that needs to be implemented from the bottom up as well as from the top down,” he said. “We need to share the data, and what we learn about ourselves, with others. Because we can learn from the misfortunes that might happen to others.”

Mizutori said she recognized the usefulness of scientific digital twins, but found that “models are useful as long as there is a literacy in the communities to translate that into policies. Otherwise, we can have fantastic models, but it won’t work”. Luebkeman said that might be “something where GESDA can help”. Policymakers are not following the science, said Mizutori, exacerbating a vicious circle of disasters, response and recovery. Another problem – which is about the digital divide between North and South – is: “if good policy makers in the South want to listen to the science but have neither the capacities nor the funding to do so, how do we overcome this? If we don’t, on the global scale, we are not going to make it.” To address these issues, Cleary proposed creating something like an observatory of such models, entailing three elements. The first is to allow transparency in capturing the initiatives that are being undertaken, and to include a much wider set of data and information from a variety of organizations (from the International Monetary Fund through the UNDP, WHO, WMO) that feed decision-making. He also proposed adding more oversight of the process and making greater efforts to ensure citizens are actively involved. “The second element is to have some measure of oversight into this process itself, because otherwise, you cannot build the trust, you cannot do the interrogations, you cannot clarify the missions that are at stake,” he said. “One approach is to have, into this observatory, a science lens, a policy lens and finally a public lens, to allow for public participation.” The third element flows from that latter lens: This observatory shall try “to ensure citizen engagement, through a digital agora. We can enable that digitally nowadays, we can enhance the trust around understanding, and potentially make a constructive contribution to the evolution of sensible policies.”

Takeaway Messages

Digital twins function as experimental landscapes that let scientists analyse risks, support decision-making and foster disaster resilience, which is becoming important to adapt to climate change.

The critical thing is not to imagine that scientists are going to be able to model everything and then to be able to draw definitive conclusions.

There are limitations from being obstructed by biases, randomness, turbulence, chaos theory. It will probably never be possible to produce an exact digital twin of life on Earth, or of our body, or of our health. And we need, therefore, to expect uncertainty.

A digital avatar project in French Polynesia, rooted in open science, was aimed at helping local governments better prepare, respond, and build climate resilient communities. Such projects use a collective intelligence infrastructure to possibly spur democratic ecological action.

The transition to open science and a full, free and open data policy have spurred many digital twin initiatives and is vital for such models.

Models are useful as long as there is a literacy in the communities to translate their results into policies. Otherwise, the most fantastic models will remain helpless.

An observatory could be put in place to 1) capture existing initiatives of “digital twins”, 2) include some oversight in the process to increase trust and 3) ensure citizen engagement, through a digital agora.

Additional content

THE “4P” APPROACH, by Neil Davies

Focusing on the goal of helping communities, Neil Davies explained that his approach was largely inspired by medicine, and the so-called “4Ps”. For him, good digital models must be the result of an approach that is:

1/ Personalized

“Every person is different, with a different genome. In the same sense, every place is also different.”

2/ Predictive

“One needs to understand all of the diversity in place, in order to make predictions under different scenarios. This, in order to be…”

3/ Preventive

“We need prevent outcomes so we can maximize wellness, and not just treat sickness [talking about medicine].”

4/ Participatory

“Not only do we need to take some agency in our own health, because if we are all going to monitor our own health we need to take control of that to some extent. But also we need to share the data and what we learn about ourselves with others. Because we can learn from the misfortunes that might happen to others. We can learn ‘I have that kind of genome too, and if you had a bad reaction to that drug it’s useful for me to know that because I might have the same genomic signature and that helps me’.”

“So we try to apply that systems biology approach to social ecological systems. This is for the health of places, people, and natural systems,” he explained

Digital twins (digital models of the world or parts of it): 12 statements, by Dirk Helbing

1/ On data

It has become an attractive idea to create digital twins of everything, including the Earth, the climate and the human body. While the benefits of this approach may be huge, it is also important to realize the limitations. For example: attempts to create an exact digital copy of the world are obstructed by biases, randomness, turbulence, chaos theory, and many other things. This needs to be kept in mind. All in all, we must realize that a data-science rather than a data-driven approach is needed.

2/ On complexity

Creating an accurate digital twin for material structures, which change little over time, is easy. However, it will probably never be possible to produce an exact digital twin of life on Earth, or of our body, or of our health. We are faced with fundamental challenges and measurement limits when models of complex dynamical systems are built. We need, therefore, to expect uncertainty. We need to have a complexity science approach.

3/ On machine learning

The biggest modern machine learning models publicly known today try to learn a trillion parameters or so. However, sometimes, simpler models have more predictive power; less data, or even noisy data, can sometimes generate better models. No matter how many variables are being considered, however, there are many orders of magnitude of interaction effects which are not captured, hence neglected. This can produce a wrong picture and bad forecast, which can be dangerous.

4/ On artificial intelligence

So far, big data has not made the scientific method obsolete, nor do we have a universal AI. And if we had one, this could still be dangerous. Suppose, for example, one would task an intelligent system to solve the sustainability problems of the planet. It might figure out that the easiest solution would be depopulation. And it might trigger an apocalyptic scenario, even though a better future for everyone might exist. Moreover, as many of today’s AI systems operate like ‘black boxes’, we may not realize some of the harmful effects AI systems are causing.

5/ On optimization

The concept of ‘optimizing the world’ is highly problematic because there is no science that could tell us what is the right goal function to choose: should it be GDP per capita, or sustainability, life expectancy, health or quality of life. The problem is that optimization tries to map the complexity of the entire world to a one-dimensional function. This leads to gross oversimplifications and to the neglection of secondary goals, which is likely to cause other problems in the future. Using a co-evolutionary approach would probably be a better strategy than optimization. And coordination approaches may be more successful than control approaches.

6/ On qualities

A largely data-driven society is expected to perform poorly with regard to hardly measurable qualities that we care about. This includes freedom, dignity, love, creativity, meaning, culture – in short: quality of life.

7/ On innovation

Something like a ‘digital crystal ball’ is unlikely to see disruptive innovations which are not included in the data of the past. Hence predictions could be overly pessimistic and misleading. For example, consider the forecast of world’s population. According to some future projections, about one-third of the world’s population is claimed to be ‘overpopulation’. These people are in danger of dying early of resource shortages. However, such projections do not sufficiently consider alternative forms of running our economy. Perhaps ‘overpopulation’ is not the main problem, but the lack of economic (re-)organization.

8/ Humans *versus* things

In a highly networked, complex world, where almost everything has ‘side effects’, feedback effects and cascading effects, ethical challenges abound. For example: people should not be managed like things. In times where many argue with ‘trolley problems’ and ‘lesser evils’, if there’s just a big enough disaster, problem, or threat, any ethical principle or law might be overruled, including human rights and even the right to life. Such developments can end with crimes against humanity, and that needs to be avoided.

9/ On dual use

A powerful tool, particularly when applied on a global scale, may cause serious large-scale damage. It is therefore necessary to map out undesired side effects of technologies in their use. Effective measures must be taken to prevent large-scale accidents and dual use. Among others, this calls for decentralized data storage and distributed control. Moreover, transparency and accountability for the use of data and algorithms must be dramatically improved.

10/ On alternatives

We should carefully consider alternative uses of technology. I very much would like to push for the idea of creating a socio-ecological finance system, that would use the Internet of Things to measure externalities that decisions of people and companies cause. This novel real-time feedback would promote the core evolution towards circular economy and sharing economy. So this would be really oriented at change and action, rather than just observation and prediction.

11/ On governance

As people are increasingly an integral part of socio-technical systems, a technology-driven approach is not enough. We first and foremost need social innovation to unlock the benefits of the digital age for everyone. A platform supporting true informational self-determination is virtually needed. And rather than a ‘war room’ approach, we need a ‘peace room’ approach, which requires, among others, an interdisciplinary, ethical, multi-perspective approach. In other words, a new multi-stakeholder approach to achieve better insights and participatory resilience.

So, in conclusion: smart societies cannot be operated like fully automated machines – and there’s a strong imperative not to attempt it. When designed and operated without sufficient insight, digital twins may create a ‘matrix world’ and technological totalitarianism. But designed and operated it well, digital models of the world – or certain aspects of it – can offer a formidable policy instrument, not only for the management of cities and societies, but also for the co-evolution of evidence- and data-based information ecosystems that can foster a new collaborative relationship between citizens and policy makers. And that’s what we’re aiming for.

More information

Session recording on YouTube

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

World Simulation and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Physical Models, Ecological Models, Socio-economic Models, Integration and Coupling

Complex Systems for Social Enhancement and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Computational Social Science, Collective Intelligence, Design for Values

Friday 8 October, 11:15am–12:30pm CET

TRANSLATE

Enriching Science with Citizen Voices and Values

Abstract

Emerging fields of science like advanced artificial intelligence (AI), human genome engineering and longevity research will all have profound impacts on people's everyday lives. That makes it an imperative to involve citizens in the scientific process and incorporate their experiences and perspectives into the way research is done. Ensuring all citizens are informed of the latest advances and how these relate to their lives is a crucial first step. The development of a global sounding board designed to gather citizens' voices and values will enrich science by unearthing the breakthroughs people most need and helping co-develop regulatory frameworks that are fit for purpose. Cooperative research can also help scientists break out of dogmatic ways of thinking and rediscover valuable traditional knowledge.

- What are the best ways to involve citizens in the scientific process?
- What can and should citizens contribute to the most advanced scientific disciplines?
- How can policymakers design frameworks that help scientists and citizens to interact?

Participants

Moderated by:

Alain Kaufmann, Director, ColLaboratoire, University of Lausanne, Projet SantéPerSo, Switzerland

With:

Claudia Chwalisz, Policy Analyst, Leading work on innovative citizen participation, OECD Open Government Unit; Author; Member, Democracy R&D Network, France

Nicola Forster, Co-Founder, Foraus think tank, Switzerland *(remotely)*

Samira Kiani, CEO and Founder, GenexGen; Director, Tomorrow.Life Initiative; Associate Professor, Liver Research Center, Department of Pathology, School of Medicine, University of Pittsburgh; Member, GESDA Academic Forum, USA

Simon Niemeyer, Associate Dean, Research, Faculty of Business, Government and Law, University of Canberra; Project Leader, Global Citizens' Assembly on Genome Editing, Australia *(remotely)*

Mamokgethi Phakeng, Vice-Chancellor, University of Cape Town; Board Member, GESDA, South Africa *(remotely)*

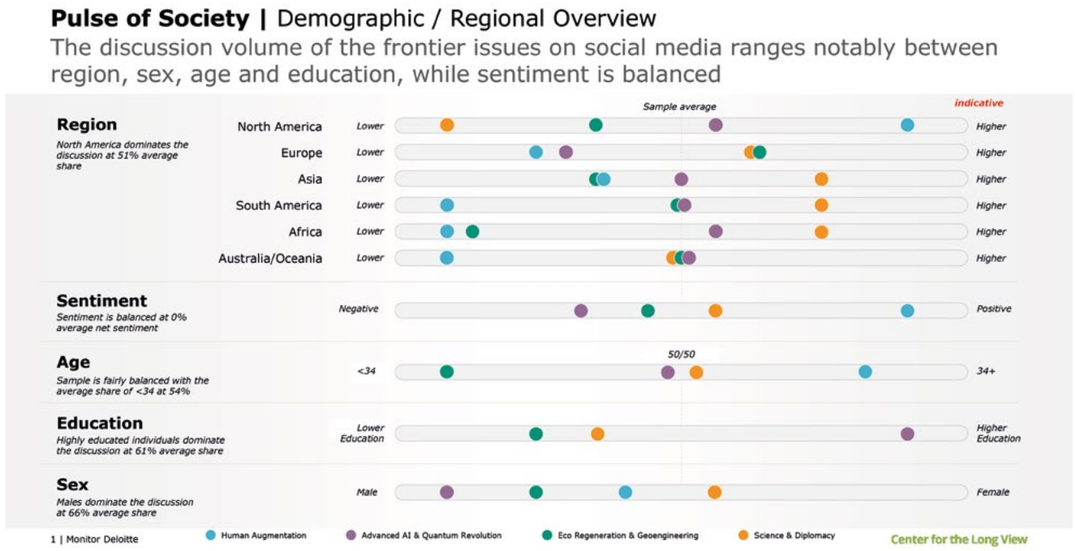
Highlights

Many experts agree that more public engagement with science is needed, not only as a top-down approach in which scientists spout their brilliant ideas and solutions to the most pressing challenges of the day, but also as a genuine dialogue and opportunity for mutual learning. More disagreement exists over just how to accomplish that. Mutual learning involves gathering broad perspectives and spreading awareness about how science and technology dominate seemingly every aspect of our modern lives, in ways both liberating and terrifying. Done well, public engagement can serve as a democratic platform for citizens to join with scientists and policymakers in decision-making. "We have to discuss deeply the issue of articulating academic and scientific excellence with social relevance – social relevance considered as a bottom-up issue – and to ask how diplomacy could help in this endeavour," summed up Alain Kaufmann, whose research and teaching focus on the sociology of science and technology, scientific communication and mediation, technological risks, research ethics, public participation, action research, and some aspects of biomedical research. "It requires all kinds of approaches aimed at informing, but we know that simply informing people is not sufficient."

For a project launched by GESDA with the Center for the Long View (CLV), Nicola Forster said a new AI-based tool was developed that "combines machine objectivity with human intuition". He said it was used to sift through more than 11 million documents on social media that indicate citizens' views on science, and the results were used in GESDA's Science Breakthrough Radar® as a reflection of those who are interested in science and what differences there might be among them according to demographic and geographic variables.

It included a "sentiment analysis" to find what people considered controversial, positive, or negative, Forster said, but its purpose ultimately was to find out "where we should build bridges" between scientists and the general public.

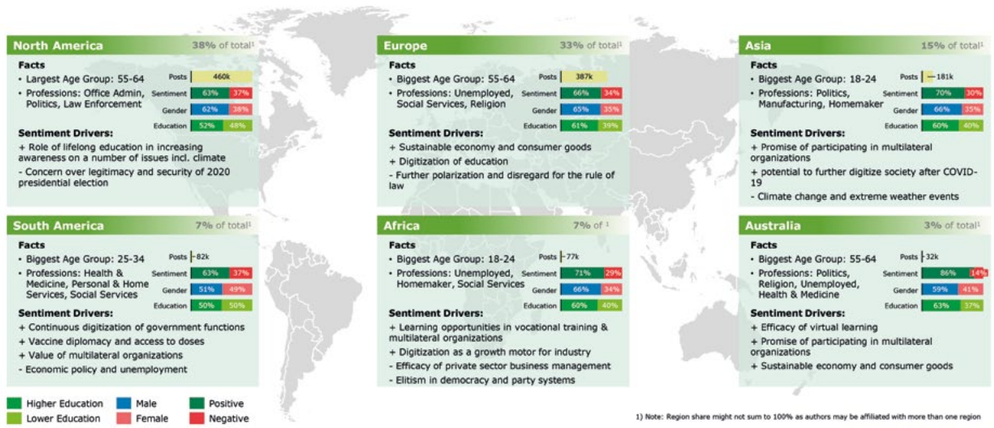
Among the findings were that North America and Europe dominate the global discussion, with a bias towards English-language publications; eco-regeneration and geoengineering generally figure positively in people's conversations, while "people are much more afraid" of the quantum revolution and advanced AI, he said. Younger people tend to talk more about the environment, eco-regeneration, and geoengineering, he added. The most highly educated among them were more engaged with quantum computing and advanced AI, and conversations were dominated by males, who made up two-thirds of those who expressed views about the Radar. On the topics of science and diplomacy, mostly people over 55 years old engaged on the topic in North America. By comparison, in Asia most people in their late teens and early 20s were the most engaged on that topic. There was some negative sentiment on digital democracy, particularly regarding e-voting systems in Africa. Other people feared losing their jobs due to automation. Many people, unsurprisingly, focused on COVID-19.



Social Media

Science & Diplomacy | Demographic Differences by Region

Where is the discussion taking place and who is driving it?

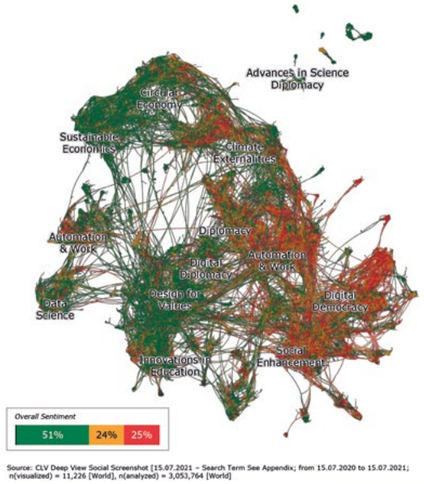


1) Note: Region share might not sum to 100% as authors may be affiliated with more than one region

Center for the Long View

Social Media

Social Media | Science & Diplomacy Sentiment View



Source: CLV Deep View Social Screenshot [15.07.2021 – Search Term See Appendix; from 15.07.2020 to 15.07.2021; n(visualized) = 11,226 [World], n(analyzed) = 3,053,764 [World]

Sentiment Drivers

Positive sentiment is centered around:

- **Sustainable Economics** specifically around sustainable consumer goods (e.g. fashion, cosmetics) as well as recyclable materials, plastic-free living
- **Innovations in Education** specifically in digital, decentralized education as well as the gender diversity in education (e.g. female, LGBTQ+ education)
- **Design for Values** with regard to charity systems focusing on providing education to minority groups and those in need
- **Advances in Science Diplomacy** primarily regarding the integration of non-state actors in diplomacy through educational programs such as e.g. International Model United Nations

Neutral/mixed sentiment is centered around:

- **Climate Externalities** through a number of reports on nature protection projects and studies
- **Diplomacy** focusing on US-Middle East and US-Russia relationship

Negative sentiment is centered around:

- **Digital Democracy,** voting safety, validity and E-Voting Systems as well as general authority are being discussed negatively, driven by the US elections
- **Automation & Work** in the form of employment instability, fear of losing employment, amplified by COVID-19 lay-offs
- **Climate Externalities** such as extreme weather events (e.g. Forest Fires, Floods) and slowly dissipating ecosystems (e.g. Amazon, Permafrost)

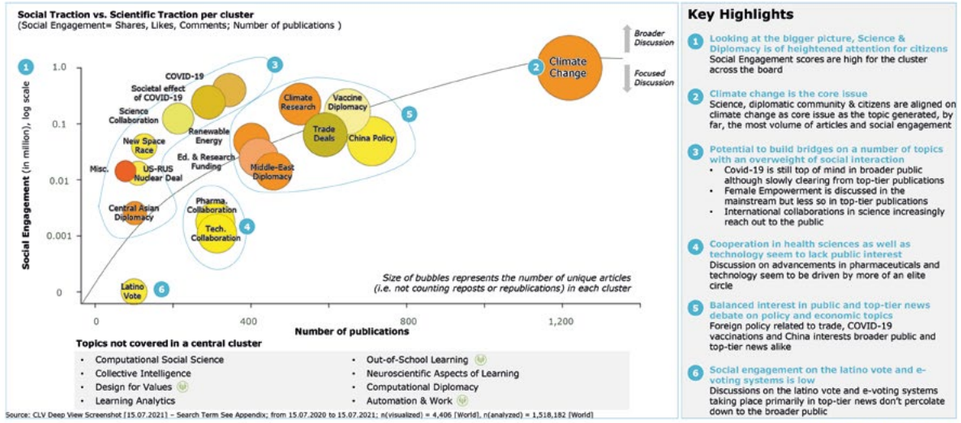
Community dominant in the discussion: Citizens Public Sector Academia Private Sector

Center for the Long View

News & Blogs

Science & Diplomacy | Social Engagement per Cluster

Is there a disconnect between society and experts?



Key Highlights

1. **Looking at the bigger picture, Science & Diplomacy is of heightened attention for citizens**
   Social Engagement scores are high for the cluster across the board
2. **Climate change is the core issue**
   Science, diplomatic community & citizens are aligned on climate change as core issue as the topic generated, by far, the most volume of articles and social engagement
3. **Potential to build bridges on a number of topics with an overweight of social interaction**
   - Covid-19 is still top of mind in broader public although slowly clearing from top-tier publications
   - Female Empowerment is discussed in the mainstream but less so in top-tier publications
   - International collaborations in science increasingly reach out to the public
4. **Cooperation in health sciences as well as technology seem to lack public interest**
   Discussion on advancements in pharmaceuticals and technology seem to be driven by more of an elite circle
5. **Balanced interest in public and top-tier news debate on policy and economic topics**
   Foreign policy related to trade, COVID-19 vaccinations and China interests broader public and top-tier news alike
6. **Social engagement on the latino vote and e-voting systems is low**
   Discussions on the latino vote and e-voting systems taking place primarily in top-tier news don't percolate down to the broader public

Source: CLV Deep View Screenshot [15.07.2021 – Search Term See Appendix; from 15.07.2020 to 15.07.2021; n(visualized) = 4,406 [World], n(analyzed) = 1,518,182 [World]

Topic covered on social media

Center for the Long View

"If something is high up on the scientific agenda but not on the public agenda, probably there's a need to engage in more discussions and try to build bridges between the public, the broader public, and science," said Forster, a social entrepreneur who has initiated and moderated innovation and participation processes in various foreign ministries, foundations, and international organizations. "And I think today, there's a big need for building bridges between the silos. And obviously Switzerland is a place with great universities but also all these international organizations, countries which are represented in Geneva. It can be the place for GESDA to emerge and play a positive role for everyone. This can be part of the answer why it can be an honest broker."

Mamokgethi Phakeng said what makes GESDA an honest broker as it tries to start more conversations among voices from around the world is partly that "Geneva is probably the most trusted to do this." A poll of the session audience found 68% of respondents favoured action and community-based research, and other types of knowledge co-production from among the different approaches to include citizen's participation in the "making" of science, taking into consideration time, finances, geographical limitations, and other respective impacts. Some 42% favoured citizen conferences or juries, deliberative polls, focus groups and other forms of consultation; 21% favoured social networks, websites, and other forms of data mining; and 11% favoured the use of citizen science such as Galaxy Zoo, Foldit and iNaturalist.

As people tire of COVID-19 pandemic lockdowns and government-ordered restrictions, the anti-vaccination movement has also shown that a "correlation" exists between those who mistrust vaccines and those who mistrust government, Kaufmann noted, adding that if the movement were seen as an "experiment" it might also demonstrate that a top-down approach to spreading scientific expertise "is not producing any effect". To make citizen engagement effective, said Phakeng, the first question that must be answered is why involve society? "Because once we get to the why, then we can ask other questions," she said. "Then we would say, who in society do we want to engage? And how do we engage them, and what does that engagement look like?" Phakeng, an expert in mathematics education who has won awards for her research and community work, pointed to the benefits of a university-run community centre for youth and women that could encourage more widespread participation in science research without an underlying sense of obligation. Building community centres for science is crucial, she noted, since everyone can contribute something to the scientific effort and to the community. And "who reaches out" matters. "And we saw we have a lot of lessons from HIV/AIDS in our country, in South Africa. For example, when we involved [South African Anglican cleric and theologian, known for his work as an anti-apartheid and human rights activist, also Bishop of Johannesburg] Desmond Tutu, and him lending his name to HIV research, but also to research at our university in Cape Town," she said. "Because trust is key. We want people to be involved and to engage for different kinds of reasons. But if they do not trust, they pull back."

The usual approach towards citizen engagement with science, particularly with public crises, is outreach aimed at educating the public. With the rise of disinformation and widespread mistrust in governance and media, however, such an approach too often falls on deaf ears. True engagement and participation depend largely on communication. For that reason, Samira Kiani said she joined with filmmaker Cody Sheehy, CEO of the US-based Filmstacker, in starting "Tomorrow.life", an initiative with a mission to expand public engagement with science through connecting scientists and people with stories with filmmakers. People are asked to film themselves on their phones, upload that to an online platform where other video contents on science issues already are at disposal, and create video stories with that entire material, then share them to share on social media. "We started to question how humans connect?" she said. "And one of the cores of these connections is this emotional connection that we can build between us, and one of the elements of that is the power of the storytelling. Because all of us connect with the stories and especially visual stories." It represents an effort to connect scientists with citizens, said Kiani, a medical doctor whose career is built around her passion for applying Crispr technology to synthetic biology and "to rebuild the trust toward the scientific research," she said. "I wanted to humanize scientists, basically."

To illustrate the problem, Simon Niemeyer shared a project that showed a film producer's view of gene editing as a powerful new tool that could bring alarming results as a "Pandora's box" that could "get out of control". The project looked at who should get to decide these scientific questions. "We aimed to demonstrate that meaningful global citizen deliberation can be possible on such a big and complex issue," he said. "We actually work best when we're acting together, developing a sort of diversity in terms of the understanding, the knowledge, but also the values and aspirations. And the best science is actually one where we integrate a wide set of considerations into more sophisticated models, if you like, and the same is true for deliberation."

But no single approach alone can bridge the divide between scientists and citizens, said Niemeyer, a social scientist and professor whose research interests focus on the broad fields of deliberative democracy. "It is our argument and belief that any process that can achieve that actually produces better outcomes in terms of the decisions we make," he said. "We're talking about a portfolio of approaches to a very complex set of challenges."

Mamokgethi Phakeng

Through her work, Claudia Chwalisz said she has learned that connecting public input into decision-making is about creating the conditions for diverse populations to grapple with complexity and then to work deliberatively to find common ground in a collective effort. "One of the reasons why public deliberation is so important on this is that these are not just technical issues. These questions are really about what kind of society do we want? And so those raise moral questions, ethical questions," said Chwalisz, who leads the OECD's innovative citizen participation, which explores how to bring public judgment to improve decision-making and strengthen democracy. "These are questions for political and societal debate, and I think that what we've seen as part of the rise of populism, part of the rise of distrust in governments and also in experts, is because a lot of these political questions have been put to a more technocratic approach of let's just deal with them with the experts," she said. "There's a demand for more innovation and more experimentation – and in a way that genuinely, meaningfully gives people a voice, not just in a consultative, 'tick box' kind of way."

Simon Niemeyer

Takeaway Messages

More citizen engagement is needed when something is high on the scientific agenda but not on the public agenda. GESDA, as part of International Geneva, has the credibility to play a positive role. Diversity of involved citizenry is key.

A correlation exists between the anti-vaccination movement and those who mistrust government, further showing that a top-down approach to spreading scientific expertise won't work. What is needed is building trust by first examining why and how citizens should become more engaged.

With the rise of disinformation and widespread mistrust in governance and media, true engagement and participation depends largely on communication and storytelling that humanizes scientists.

The person who communicates is also a message in him/herself! Is it a trusted person? Is it a person with whom society can identify?

No single approach in terms of citizen involvement in science processes can bridge the divide between scientists and citizens, which could improve as people learn to grapple with complexity and find common ground.

More information

Session recording on YouTube

Related interviews: Claudia Chwalisz, Samira Kiani

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

The Pulse of Society on Three Questions for Tomorrow, Overview of the Analysis, Who are we?, How are we going to live together?, How can we ensure humanity's wellbeing while sustaining the health of our planet?, The Pulse of Society on Frontier Issues, Overview of the Analysis, Quantum Revolution and Advanced AI, Human Augmentation, Eco-Regeneration and Geo-Engineering, Science and Diplomacy

Complex Systems for Social Enhancement and related breakthroughs at five, ten and 25 years: Full breakthrough brief, Digital Democracy, Collective Intelligence, Design for Values

Friday 8 October, 1:30–2:45pm CET

TRANSLATE

Making Sense of Science Anticipation for Concrete Impact

Abstract

Anticipating breakthroughs in science and technology is of little use if you can't act on that foresight. Putting ideas into practice is complex and requires properly framing the challenge and need for action, tapping innovative solutions and finding resourceful partners. Bringing all of these functions together in one place could create a powerful new model for translating anticipatory science into benefits for humanity. Geneva and GEDSA are ideally placed to act as such a hub that can bring together businesses, innovators, academics, citizens and diplomats to share their knowledge and resources and develop solutions to tomorrow's most pressing challenges.

- Drawing on two examples from GESDA's Breakthrough Radar, how are the anticipated scientific advancements in quantum and neuroscience most relevant for society?
- What roles can business, government, philanthropy and civil society play?
- What type of actions are needed to facilitate the process from labs to solutions?

Participants

Moderated by:

Karin Jestin, Strategic Philanthropy Advisor, Philanthropic & Humanitarian Initiatives, Switzerland

With:

Patrick Aebischer, President Emeritus, EPFL, Vice-Chairman GESDA, Switzerland

Anousheh Ansari, CEO, XPRIZE Foundation; Member, GESDA Diplomacy Forum, US/Iran

Maria Cattaui, Global Board Member, Open Society Foundations, Greece/Switzerland

Joseph D'Cruz, Special Advisor, Strategic Planning & Innovation, Executive Office of the Administrator, United Nations Development Program, Malaysia

Highlights

The Swiss and Geneva governments created GESDA out of a belief that the speed at which technology evolves due to the convergence of different scientific fields and the number of technological advances that we need to keep an eye on, pose huge challenges. With international treaties under attack – small nations rely on international law for protection – the Swiss focused on anticipatory science diplomacy as the best way to renew multilateralism and position Switzerland, and especially Geneva, as a neutral place where diplomats, politicians, and scientists can think together about the future.

Swiss neutrality, and Switzerland's geographic location and scientific environment, also were important factors in why CERN, the European Organization for Nuclear Research, which also uses science as a tool for peace diplomacy, was built on the outskirts of Geneva, along the French border. The Swiss know there are strong links between the economy and science, and hope that anticipatory science diplomacy can rebuild trust towards the scientific community in a dystopic age of disinformation.

Putting these ideas into practice, however, means translating the expected scientific advances highlighted in the GESDA Science Breakthrough Radar® into actions that serve society well in a global, inclusive and ethical framework. Rather than rely on top-down regulations, GESDA was created to be an "honest broker" and neutral platform for tailor-made solutions shaped by an inclusive process and discussions. "It's to bring the discoveries of laboratories to us, so that they can be used by the society in general," said Patrick Aebischer, GESDA's vice-chairman, citing quantum computing and cognitive enhancement – which, in a few years from now, could impart a degree of something like consciousness to robots – as among the most challenging and important of potential advances. "In universities we have three missions: typically to discover, which is the research part; the transmission of the education; but I think we have this third very important mission, which is translation" and a central theme in GESDA's "philosophy" that all such efforts must give back to society. He suggested that another part of GESDA's reason for being – convening stakeholders to find solutions – is easier to accomplish in Geneva where many multilateral institutions are "just a couple of hundred meters away".

With the launch of the GESDA-XPRIZE Quantum competition, the two foundations aim to democratize quantum technologies by enabling broader involvement among scientists and researchers, accelerating the pace of discoveries, and improving inclusiveness and SDG alignment of quantum applications with the aims of the United Nations 17 Sustainable Development Goals, or SDGs, for 2030. Moonshot competitions like this drive innovation, raise awareness and have a multiplier effect, as XPRIZE has demonstrated through competitions over the last 25 years. Ansari said GESDA's mission "aligned with our work perfectly" to engage teams, universities, and partners globally. Quantum software is developing much faster than its hardware, and its applications, particularly when joined with AI, will be far-reaching in fields such as health and climate, material sciences, and encryption, she said, which is why it is important "we're not left with our entire banking system and financial system and governments in jeopardy. And these are the areas that we're considering for a quantum competition". Peter Brabeck-Letmathe, GESDA's chairman, called the partnership a "wonderful" example of how anticipatory science can drive concrete impacts because it will help ensure quantum technology "doesn't stay in the hands of two or three multinationals or three or four governments".

Anticipating science and technology advances and figuring out how to apply their emerging uses locally is a big challenge for the UNDP's operations in 170 locations worldwide, according to one of its top strategic planners, Joseph D'Cruz, whose background is in political economy and management consulting. "Science needs to understand what society values and what society aspires to. Society needs to better understand what the potential of science is so we can make the choices collectively about how to use that. Neither of those is happening right now," he said. Three years ago, UNDP published an update to its "Foresight Manual" to apply the uses of strategic foresight methodologies towards public service and the implementation of the SDGs. "The reason we find the work of GESDA and initiatives like this really interesting, is because one of our biggest challenges is being able to contextualize, in those local contexts, what's coming at us as a result of the technological developments in the pipeline, so that we have the ability to build those conversations in the solution

spaces on the ground, before these technologies overwhelm them," said D'Cruz. "Not just in tech hubs, but you know, in Sudan, and in Chad, and in Somalia, and in Bolivia and Colombia. The thing that always excites me is the unexpectedness of it. Given the capacity, given the connection, people on the ground find problems to solve [things] that we had never even seen" which is demonstrated proven by the results of UNDP's Accelerator Labs.

Governance can be strengthened by including more people in all phases in science and technology development. The Open Society Foundations, which promotes economic development that advances social and racial justice, sustainability, and democracy, partnered with GESDA in a preliminary grant. "We certainly will be continuing such support in the future. But even more important, we want to work very closely with GESDA in exactly this area, the translation," said Maria Cattaui, a former secretary general of the International Chamber of Commerce and ex-managing director of the World Economic Forum. "Quantum is not a purpose. It's a use. It's a powerful, powerful tool. And its interface with AI is probably going to be extremely important. We mustn't forget the other side, which is called the software side, and which is the interface with something that we do have some experience about, and which I think that we also know some of the problems involved in." Cattaui said one of the worst results would be if vastly more powerful computing power were to lead to more central planning. Recalling the long history of nuclear physics research that preceded World War II, Ansari pointed out that not only quantum computing and AI but "any of the exponential technologies we talk about can have a negative impact on the world. If we look at the development of the nuclear bomb and nuclear weapons, it was not intended – but it was an unintended consequence of research that happened. But until everyone understood the potential destructive nature of it and could personalize it, it was still something that was okay". This is why anticipating the positive and negative impacts of the future breakthrough technologies is so important to give society more time to prepare effective framing mechanisms.

Less-wealthy nations often have to focus their limited resources on basic problems even if the idea of fostering global standards and consensual understandings is appealing, said Maricela Muñoz, a former diplomat at the Costa Rican mission to the United Nations in Geneva from 2016 to 2021. "Coming from the developing world, I can tell you that that's a big challenge because, of course, we have other priorities at hand," she said, adding that it is "sometimes very difficult to sell this idea of foresight planning". There also are lessons to draw from wealthy nations like Switzerland, which tends to entrust its citizens with making complicated decisions through its frequent initiatives and referendums that are an essential part of the Swiss system of direct democracy, according to Bernhard Fuhrer, director of the Swiss Network for International Studies, which promotes academic research in the interdisciplinary area of international studies with an interest in phenomena that transcend traditional nation-state boundaries. He suggested that GESDA might want to take a cue from the Swiss approach by ensuring that the "translation" part of the mission becomes a genuine two-way dialogue undertaken with openness and humility among all sides. "Translation could be re-baptized dialogue, couldn't it?" he asked. "It isn't just about getting people to know what you know. It may be also about listening."

Takeaway Messages

The expected scientific advances highlighted in the GESDA Science Breakthrough Radar® must be translated into actions that serve society well in a global, inclusive, and ethical framework.

Science needs to understand what society values and what society aspires to; society needs to better understand the potential of science to make better choices collectively about how to use it.

Closing the governance gap to bring everyone to the table means creating opportunities for scientific, diplomatic and public communities to be part of a dialogue at all phases.

Powerful new technologies often have unforeseen implications, including negative consequences, that could be mitigated through a more anticipatory and inclusive process of development.

So-called "moonshot" competitions like the GESDA-XPRIZE Quantum competition can drive innovation, raise awareness and have a multiplier effect by drawing major investment in research and its application.

Anticipatory science can drive concrete impacts on democracies because it will help ensure quantum technology does not remain in the hands of a few multinationals and governments and is also geared towards use cases with a high societal relevance (e.g. health, food, climate).

Not all nations have the resources to focus on anticipatory science diplomacy; GESDA would benefit from more emphasis on dialogue that includes listening by all sides.

More information

Session recording on YouTube

Related interviews: Patrick Aebischer, Anousheh Ansari

Tweets related to the session

Related content in the 2021 Science Breakthrough Radar®

Getting Value from Science Anticipation – essay by the Advisory Board to the Science Breakthrough Radar®, Taking the pulse of Diplomacy – Tackling the global challenges of multilateralism, Anticipatory Science Diplomacy in Practice – Examples of International Organizations

Quantum Technologies and related breakthroughs at five, ten and 25 years: Full breakthrough brief

Cognitive Enhancement and related breakthroughs at five, ten and 25 years: Full breakthrough brief

Consciousness Augmentation and related breakthroughs at five, ten and 25 years: Full breakthrough brief

TRANSLATE

Announcement of the GESDA-XPRIZE Partnership

Participants

With:

Peter Brabeck-Letmathe, Chairman, GESDA Board of Directors, Austria

Anousheh Ansari, CEO, XPRIZE Foundation; Member, GESDA Diplomacy Forum, USA/Iran

Highlights

Peter Brabeck-Letmathe introduced the Translate Plenary Session called "Making Sense of Science Anticipation for Concrete Impact" by underlining the importance for GESDA to develop partnerships. Along with providing support for GESDA, partners can help accelerate solutions generated by the foundation's work. GESDA is establishing an Impact Forum to develop more partnerships.

GESDA and the XPRIZE Foundation revealed their partnership during the First Geneva Science and Diplomacy Anticipation Summit.

Anousheh Ansari, the XPRIZE CEO, emphasized the two foundations are aligned, in their philosophy, work methods, and belief there is reason to have hope for the future.

She explained that XPRIZE tries to serve as a co-architect for a better world, a world that we all desire, helpful and abundant for everyone. They do so by identifying helpful breakthroughs and designing moonshot competitions. Its 26 years of operations show that competition can drive innovation through investment, awareness, and policy change.

XPRIZE is looking at new, complex issues to be solved – climate and energy, artificial intelligence (AI) and deep-tech, food, wastewater, and health – and at new ways to increase engagement around the world, Ansari said. It clearly aligns with GESDA's vision, she said, and this was key to the decision to expand XPRIZE's footprint for the first time outside the United States by establishing its European headquarters in Geneva.

The GESDA-XPRIZE partnership will initially focus on the quantum competition. Ansari said it is essential to stay ahead of potential pitfalls, unlike the development of AI that has outpaced policy.

Peter Brabeck-Letmathe, the chair of GESDA, agreed that their partnership will help to democratize the development of quantum technology. He emphasized the importance of keeping it from becoming the sole dominion of just several multinationals or governments, saying the competition they plan can help achieve that.

GESDA also was created to expand the presence of multilateral institutions in Geneva, he said, and XPRIZE's decision to base its European operations at Campus Biotech in Geneva showed GESDA can deliver on that mission.

Takeaway Messages

GESDA and XPRIZE became partners out of a shared vision for anticipating future developments and accelerating positive developments in science and technology.

Their plans to launch a joint quantum competition that can help fulfil the Sustainable Development Goals will help to solidify the partnership.

The establishment of the XPRIZE Foundation's European headquarters at Campus Biotech shows, GESDA can attract more global institutions to Geneva.

More information

Press release on the announcement

Session recording on YouTube

Friday 8 October, 3:15–4:15pm CET

TRANSLATE

Catalyzing Inclusive Growth through Anticipatory Science

Abstract

The number of people living in countries the United Nations classifies as least developed will hit 1.9 billion, or nearly a fifth of the world's population, by 2050. As rapid demographic changes in the world's poorest regions accelerate, there are growing calls to look beyond traditional measures of development and to focus on inclusive growth. Anticipatory science can play a crucial role in this transition. Technologies like wireless internet, mobile payments and drones are already allowing emerging economies to leapfrog stages of development by putting affordable and powerful new tools in the hands of their citizens. Anticipating where the next such technological and scientific opportunities will come from could help map a path towards economic emergence that is both equitable and inclusive.

- Where will the next great leapfrogging opportunity come from?
- How can we ensure equitable access to resource-intensive emerging technologies and innovation infrastructures?
- What is the role of the private sector and local entrepreneurship in catalyzing inclusive growth?

Participants

Moderated by:

Nanjira Sambuli, Policy Analyst, Advocacy Strategist, Fellow; Board member, Digital Impact Alliance, Development Gateway and The New Humanitarian; Member, GESDA Diplomacy Forum, Kenya

With:

Uzodinma Iweala, CEO, The Africa Center NY, Nigeria

Mami Mizutori, Special Representative of the Secretary-General for Disaster Risk Reduction; Head of the United Nations Office of Disaster Risk Reduction; Member, GESDA Diplomacy Forum, Japan

Rebecca Enonchong, Founder and CEO, AppsTech, Cameroon

Momar Dieng, Chief Strategy and Partnership Officer, African Institute for Mathematical Sciences, Senegal

Geoff Mulgan, Professor of Collective Intelligence, Public Policy and Social Innovation, University College London, UK

Highlights

Innovation drives economic growth but does not benefit everyone equally. Inclusive growth – economic growth that is distributed fairly across society and creates opportunities for all – is a major tenet of the United Nations 2030 Sustainable Development Agenda. Before anticipatory science can advance green development in a way that does not leave some behind, a clearer understanding of what constitutes 'innovation' and 'growth' is needed. "You have to ask yourself: 'What are we building capacity for?'" said Momar Dieng, a mathematician with expertise in African politics and election statistics. Capacity-building reflects "agency and the ability to imagine a new future", he said, and requires more community-level effort. By extending GESDA's science outreach beyond the academic setting and its diplomatic outreach beyond "governmental diplomacy" to include more of civil society, he added, "we can maybe use the forces of capitalism in a productive way".

The 2008 financial crisis was a dramatic wake-up call that showed growth as we know it does not work for all and puts everyone's well-being at risk, according to the Organization for Economic Cooperation and Development (OECD). The pandemic further inflamed the world's many inequalities, ranging from vaccine access to extreme poverty. World Bank statistics show the pandemic added 97 million more people to the ranks of the impoverished in 2020, a historically unprecedented increase in global poverty. An informal online poll of the audience showed only a "moderate" level of optimism among respondents that scientific or technological development could eventually help accelerate inclusive growth. There also remain "huge imbalances" among the places where scientific research is conducted and the fields that are prioritized for research, said Geoff Mulgan, a telecommunications expert, author, journalist, and organizational co-founder, who is part of a United Nations project gathering data about scientific research related to the UN's 17 Sustainable Development Goals, or SDGs, for 2030. For anticipatory science to address these disparities, science and tech education in less-developed nations will need to be improved. Doing so would chip away at some of the patronizing attitudes towards startups in developing countries, according to Nanjira Sambuli, a Kenyan policy analyst who sits on several high-level advisory boards of the UN and other international organizations. She said scientists and diplomats also need to listen better to Africans by tapping into their oral traditions.

It will take some time to change entrenched Western preconceptions about how to get past traditional development measures, according to Rebecca Enonchong, a Cameroonian-born entrepreneur who splits time between her US and African ventures. She pointed to a spate of pandemic-fuelled funding that encouraged African entrepreneurs to create apps that she said were not really needed. "We are replicating the Silicon Valley model, which is very little money going to diverse founders, and we are applying it to Africa, where we are saying that this is what a successful founder looks like: he looks like Mark Zuckerberg," she said of Facebook's founder. How to proceed then? "Very uncomfortable discussions", Enonchong advised as a way to address racist tropes and stereotypes. "GESDA is perfect for this kind of uncomfortable conversation, where science cannot be put in a silo. And the definition of science cannot be 'Einstein', because that really limits who can be a scientist."

As a medical doctor and novelist, Uzodinma Iweala said he sees how much of science is culturally constructed "by the way you are trained to see the world", and how startup resources often are awarded based on who "looks like" an innovator. It reflects a historically uneven distribution of wealth and double standards towards failure: okay for Westerners, not so for Africans. "Everybody hates to talk about the reason for why the money is with Silicon Valley folks, or the money is with American or British or Swiss foundations," he said. "But let us not fool ourselves into then suggesting that a certain population is not capable."

He also pointed to the examples of an enslaved West African man who introduced the idea of inoculation to the United States in the early 1700s, and to the Black female slaves that were subjected to early U.S. gyneacological experiments without anaesthesia. In both cases, prominent white men were credited with major scientific advances. "So, who is the scientist?" Iweala asked. "I think it is a question that we legitimately have to ask." Enonchong agreed, citing as an example her work as board chair of AfriLabs, a pan-African network of more than 300 innovation centres across 50 African countries. It provides basic support –internet access, rent, or a garage for experimenting – and promotes a new mindset on the continent. "We need to introduce into our culture the ability to fail, that it is okay to fail," she said. "If you

can take failure as a lesson, it will help you evolve."

An even more basic requirement of inclusive growth is the need to reduce disaster risks that plague developing nations, said Mami Mizutori, a veteran Japanese diplomat and lawyer who heads UNDRR, and anticipatory science could play an important role in accomplishing that. Her agency has one science-driven project for at-risk countries that looks at gaps in their data and tries to determine how more investment in resilience prevention could pay off. "It is not very easy to give accurate metrics about resilience," she said. "That is why we invest a lot in climate mitigation, but not much in climate adaptation or resilience." The solution? More open-source data and efforts to boost scientific literacy, she said, which requires international cooperation.

Takeaway Messages

New definitions of innovation and growth are needed to promote inclusivity.

Crowdsourcing and capacity-building at the local level are important tools.

Closer examination of the relationship between science and culture is needed, including the idea it is okay for up-and-coming entrepreneurs to repeatedly fail before encountering success.

More efforts are needed to cultivate young leaders in science, technology, and diplomacy.

The history of science and technology reflects culture, prejudice and, sometimes, brutality.

More "uncomfortable" conversations are needed among leaders in science, technology, and diplomacy to promote more diversity, equity and inclusion.

More information

Session recording on YouTube

Related interviews: Nanjira Sambuli (part one), Nanjira Sambuli (part two), Rebecca Enonchong & Uzodinma Iweala

Tweets related to the session

Saturday 9 October, 11:45am–1pm CET

Closing Plenary

Closing Plenary

Panel: Science as a Booster for the Future of Cities

Abstract

Cities are at the forefront of people's concrete concerns, for example in terms of climate change or digitalization. Scientific and technological advances are already being used by some cities to innovate in this area. Others have already initiated complex modelling processes or are working on the implementation of digital democracy and are asking their inhabitants to collect data in order to better understand how they live in the city. Overall, how can science help cities and their leaders to address concrete concerns for their residents?

Participants

Moderated by:

Niniane Paeffgen, Managing Director, Swiss Digital Initiative, Switzerland

With:

Sami Kanaan, President, Geneva Cities Hub; President, Swiss Youth Commission, Switzerland

Maimunah Mohd Sharif, Executive Director, UN-Habitat, Malaysia

Discussion

The world's gradual shift from rural to urban areas – particularly in China, India and Nigeria – is expected to accelerate in the 21st century. By 2050, some 68% are projected to live in and around cities, up from 55% today, adding to pressure for scientific and technological advances that can help cities deliver clean energy, education, health care, housing, jobs, transportation and other basic services. Many of the United Nations 17 Sustainable Development Goals for 2030 may depend largely on how well cities innovate. As a result, UN-Habitat, the United Nations agency focused on improving quality of life in an "urbanizing world", supported urban policy development that addresses inequalities in nations such as Brazil, China and South Africa. That included sharing best practices and advice on how to involve more citizens in urban planning. Cities are not only an engine of growth, said Maimunah Mohd Sharif, an urban planner and former mayor who heads the agency, they also are an innovation hub in areas like arts, culture, heritage and sciences. Introducing more "hardware" – digital equipment and facilities – helps cities innovate, she said, "but the software is the people in the cities" who put knowledge and science to use. "Without the knowledge at the local level, we don't have the capacity to absorb, to analyse, to implement, to manage and to maintain," she said. "Then science will be nothing."

As the size of our planetary footprint swells to nearly ten billion people by mid-century, as many as 2.5 billion more are expected to be urban dwellers by then with 90% of that increase occurring in Asia and Africa, according to UN projections. "Cities without digitalization, without Internet, without the technology, suffer in terms of revenue," said Sharif. Things changed dramatically since she grew up in a Malaysian village with no running water or electricity, and no telephone of any kind in the 1960s, she recalled. Even with the modernization of sanitation, power grids, and telecommunications, just "half of the world is offline" and developing countries need help, according to Sharif. "Science data is one thing, but it's the implementation and bringing the technology to the cities," she said. "It's very important to look into the engagement of the people to show where the data and where digitalization is in the complex environment of cities, for people, for housing, for mobility, for education, for industry, agriculture, tourism and culture, you name it."

Since the pandemic began, cities had higher COVID-19 transmission rates. Groups and communities that experience discrimination and exclusion have been vulnerable. The pandemic has "shown our weaknesses", said Sharif, but those insights are valuable because "COVID-19 gave us an opportunity to look into the new design, new way of thinking, new way of looking at the function and form of cities. And also, a new way of looking at the leaders. So that the leaders have to walk their talk." By the end of this decade, the world is projected to have 43 megacities – each hosting at least ten million inhabitants. At present, Tokyo, the world's largest city, is more than three and a half times that size; New Delhi has about triple that amount and Mexico City, São Paulo, and Shanghai each have well more than double that. Not far behind in size are Beijing, Cairo, Dhaka, and Mumbai. However, about half of the

world's population lives in cities of less than 500,000 people.

The concept of "smart cities" has become a buzzword for intelligent growth; it signifies urban areas where digital technologies have made its services more attractive, energy efficient and environmentally friendly. Data-driven smart sustainable cities is a new area of research that is still in its infancy, however, as urban planners strive to fulfil one of the United Nations 2030 goals to make cities inclusive, resilient, safe and sustainable. Even in wealthy Geneva, where Sami Kanaan works to connect its longstanding international traditions with those of other cities globally, "we also have people who are not connected, or who do not understand how to deal with that", he said. "And so, we don't have to add a digital divide to the social divide or economic divide. It's an opportunity if we make it very inclusive and with a very transparent and ethical tool." Kanaan, a local politician and city official who has a background in physics and political science, described GESDA's mission of promoting anticipatory science diplomacy and boosting multilateralism in Geneva, and the GESDA Science Breakthrough Radar®, which is identifying anticipated advances in the next five, 10 and 25 years, as valuable tools for the city. "Science can help us bring more understanding, more mutual understanding, more awareness, as long as we take all people together," he said. "We need definitely more and more local democracy."

Takeaway Messages

Cities are not only an engine of growth; they also are an innovation hub.

If digital equipment and facilities are the hardware to help cities innovate, people are the software who put knowledge and science to use.

Cities without digitalization or internet suffer from lack of revenue.

Science data is important; more meaningful is its implementation and bringing technology to cities.

The pandemic gave us an opportunity to look into new designs, functions and forms of cities.

Digitalizing cities is an opportunity if it does not exacerbate social and economic divides.

GESDA's mission and Science Breakthrough Radar® can provide valuable lessons for urban planners and help democratize the future of cities.

More information

Session recording on YouTube

Tweets related to the session

Saturday 9 October, 11:45am–1pm CET

Closing Plenary

Summit Reporting Panel

Abstract

Three students in science, diplomacy and business report on their experience at the GESDA Science and Diplomacy Anticipation Summit 2021.

Participants

Moderated by:

David Goodhart, Journalist, Author and Think-Tanker; Head, Demography Unit, Policy Exchange (think-tank); Member, GESDA Diplomacy Forum, UK

With:

Joseph Maggiore, Ph.D. Student in Bioengineering Medicine, University of Pittsburgh, US

Hannah Tickle, Master's Student in Social & Organizational Psychology, University of Lausanne and London School of Economics, Switzerland/UK

Keshav Khanna, Master's Student in International Affairs, Graduate Institute Geneva, India

Discussion

Three students, all aged 25 and under, told the Summit's Closing Plenary that their experiences of the summit over the past three days had been, by turns, educational, overwhelming, fascinating, concerning and encouraging that older generations acknowledged many of the enormous challenges that will be left to youth to confront.

"It is very refreshing to see older generations think about our future and not only about more short-term consequences, in terms of governance and science," said Hannah Tickle, a Swiss-British dual national who, like the other panellists, noted that most of the summit participants seemed to be much older than them. She was enthusiastic when asked if she would sit on a GESDA youth advisory board if one were created. "In terms of key takeaways, the two things which stand out for me, which probably connect to my background in social science, is the act of translation between science and the more general public. I think it's something for a very long time which has not been taken seriously enough, or set in smaller circles," she said. "And it's important to use a more accessible vocabulary. And on the note about inclusion and accessibility, translation is going to be very important in order to include people from diverse locations, but also age groups and educational backgrounds in order to just make sure everybody is part of the conversation."

As a graduate student in Switzerland, Keshav Khanna, who hails from India, said it was incredible to be surrounded by so many diplomats. "This is like Comic-Con to me. The younger people in the audience laughed, so I'm good," he said of his reference to the popular comic books convention in San Diego, California. "It's fantastic to have this sort of environment where not only as young people, we can learn from everybody and their years and years of expertise, but also sort of understand the applications that are possible for advancing technologies. I have attended a lot of very interesting sessions." Khanna's biggest takeaway, he said, was that the level of science going on in the world is staggering but the world's governance systems may not keep pace. "And this reminds me of a session where this gentleman was talking about the G-20 and G-7, and he said that the G-20 and G-7 are designed explicitly to solve the problems of today. So, then, who's thinking about the problems of tomorrow? And with that, I feel GESDA is a fantastic platform for that sort of thing. Because you're thinking five, ten, 25 years in the future, and you are trying to solve problems before they even happen. I honestly wish that that is coupled with the sort of political reform we need and not just domestic context, but also international institutions, and we are able to bring these two things together and make a real difference."

Khanna said he worried about science "splintering" along political divisions if the world returns to a "sort of Cold War science development only for the benefit of geopolitical advances" or to science as a competition rather than "for the sake of it" as a worthwhile pursuit. In an opening address, Swiss Foreign Minister Ignazio Cassis had told the summit that geopolitical considerations – what he called "a growing feeling that a new 'Cold War' is about to be fought over science and technology and the power they confer to the states that master them" – prompted the Swiss and Geneva governments to create GESDA as a Swiss foundation and public-private partnership in 2019. Cassis said GESDA could serve as a bridge among scientists and policymakers worldwide and as an "honest broker" helping ensure that all nations, rich and poor, enjoy the benefits of science and technology.

Joseph Maggiore observed there were "not that many people" at the summit as young as him, so it was overwhelming to realize the Science Breakthrough Radar® identified things that may occur when he is 30, 35 and 50 years old – and so many things need to get done before then. "We are the people that are really going to be responsible for [accomplishing] these," he said. The summit marked

a step for him: “Hearing these sessions when it came to the science, I felt very confident about what is the right way to move forward. But it is frankly shocking that, me being in this place of privilege with the education I am receiving, this is the first time that I have ever heard the word multilateralism,” he said, adding that GESDA’s science and diplomacy programmes also could help train “scientists who want to create global change”.

Khanna said he also worried about another issue: trust. “Not just in our generation, but in our societies that we are coming from, we see that trust has been broken in science, in governance institutions,” he said. “And that is resulting in catastrophic difficulties in trying to get people vaccinated or trying to stop some sort of conflict within societies. And I am very curious to see what sort of solutions GESDA can bring to the table for that, and how they can sort of assist different nation-states, different community actors, in building a more coherent trust through to confidence building measures in our societies.”

He agreed with Khanna that trusting older generations is a big issue because “there is an intense distrust when there is not an acknowledgment from leaders of really what is going on in a situation.” When he observed some summit participants acknowledge the possibility that technology can be used for “evil”, however, it restored some of his faith in their objectivity. “Some people just want to see the world burn,” said Maggiore. “I feel like the biggest power is in acknowledging that these forces may exist and acknowledging these boundaries and that GESDA may be in a situation where we can provide incentives for good behaviour, and that we should acknowledge that we can all talk about a lot of these things. But how can we get academics and industry members to be excited about creating global diplomacy? The reality of it may be that they are not that interested,” he said, but “having GESDA play a role in incentivizing that” could spark interest.

Takeaway Messages

Younger participants felt encouraged that older generations acknowledged the challenges youth will confront – and were enthusiastic about the idea of a GESDA youth advisory board.

Translation between science and the general public can use a more inclusive and accessible vocabulary.

Unlike some other multilateral institutions, GESDA’s focus is ‘thinking about the problems of tomorrow’.

GESDA could help train and incentivize academics and businesspeople to become more agile in the world of global diplomacy, and vice versa with diplomats in the worlds of academia and business.

Trust in scientists and diplomats can be built up by acknowledging worst-case scenarios.

More information

Session recording on YouTube

Related interviews: Voices from the #GESDASummit

Tweets related to the session

Review about the Summit “On the confluence of science and diplomacy”, written by Keshav Khana, published on the Graduate Institute Geneva website.

Saturday 9 October, 11:30–12:30pm CET

Closing Plenary

Didier Queloz

Professor of Astrophysics at ETH Zurich and Cambridge University, 2019 Nobel Prize laureate in Physics, Switzerland

Closing Keynote Lecture

The origin of life: how science is addressing one of humanity's most complex and profound questions

"I would like to share with you some thoughts about one of the very profound question in science nowadays: the origin of life.

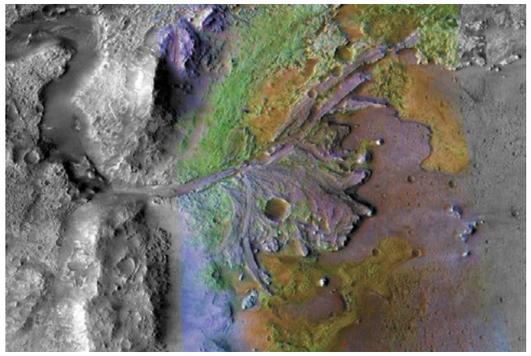
If you think about science, about knowledge, I think that, as a scientist, we can identify ourselves along with these three topics: either we are dealing with 'matter', or with 'life', or with 'consciousness'. But look closer, and you will realize that these three topics still are at the fundamental level of key questions – this even about 'the matter', of which we have an amazing understanding right now. We actually have to face the very embarrassing reality that we have no idea of what the biggest part of our Universe consists of. And for life, that is also true: we are curing diseases, we have an amazing understanding of the working mechanisms of life, but do we understand anything about the origin of life? Finally, consciousness is certainly the most profound element here. So, if we are asking ourselves about what we know about these three topics, well, the answer is very simple: not very much, actually.

I would like, today, to spend a bit of time talking about life because I think there is something happening right now, a kind of paradigm shift. Let us address these very simple and generic questions: how did life (as we know it today) start on Earth? What can we say about other forms of life in the Universe which includes our solar system? And can we know something about the nature of life? Is life always made exactly the very same? These kinds of topics seem a bit extravagant, close to science fiction. But actually, they are taken very seriously right now, and scientists are making tremendous progress. I am even taking a bet here that this century will be the one when massive changes and gains of knowledge will be made on that topic.

Similarly, if you look back at the previous times, main achievements were done in understanding the matter around the end of the 19th century. One of the most visible advances is that we are now able to reproduce on Earth – unfortunately to us – what is taking place in the sun with the thermonuclear power. Similarly, we may end up during this 21st century by being able to make life from scratch. This will drive a lot of interesting questions and fascinating societal impacts.

So, starting at the very early stage of the Earth formation, there is all this dust and rocky material being brought together. Then the Earth cools down, through a very complex geophysical evolution. But this evolution, at some point, turns out to form the location where life can begin. This is a general development that we describe. But when we look at a planet around another start [a so-called exoplanet], we can study the atmosphere of this planet; this can be done at three different stages, which we can trace down, remotely. And many big questions appear during such observations. For example: why do we have so much oxygen at some point? We know it is because of life, but why exactly? What is the consequence of that? Because it has cooled down the Earth, etc. There are a lot of very interesting effect that we can study there. On top of that, what is going to happen in the first billion years, in the case of the Earth, is the building up of life. If we want to simplify the concept, we essentially have to start from scratch. Then we have to build up the complexity, until we have something that would qualify of being alive. We know very little of that, but tremendous progress are being done these days in laboratories in combination with what we start learning on other planets.

The obvious 'origin of life' mechanism that we have some idea about, is when we have on Earth enough water, enough volcanic activity, enough of infalling comets bringing these necessary acids (which are not the most obvious gas one would think about for the origin of life) and enough UV radiation from the sun. We are then doing a very fascinating chemistry. Not so long ago, there were a couple of projects which developed a first set of chemical reactions establishing the foundations of the origin of life – and one of the most famous, done in 2015, might eventually be awarded a Nobel Prize in ten to 15 years. And what is fascinating about that is that we can test all this, in very different ways. This is a big change because science is not about ideas, it is about facts, about data.



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Let us move a bit. We are on Mars right now: we have a robot right sitting in a very precise location [inside giant Jezero crater, see image above]. You do not need to be a geophysicist to recognize that what the rover stands on is a delta of the river. And this is what Mars looked like three billion years ago. But what is fascinating is that, if you take the first billion years on Mars, this is exactly also the time at which life started on Earth. So there is a serious hint that we are going to see [on Mars] some fascinating chemistry, which is related to the origin of life. The gift of having Mars, which was almost the same as the Earth [when both planet were been created with the solar system about 4,5 billion years ago], is that it stopped its evolution as a planet, while the evolution of the Earth went on –. We have no clue exactly what Earth was like at that time, three billion years ago, but we have Mars: this is why we are so eager to bring back [Martian] rocks. You may expect tremendous changes of concept. Think about the fact that maybe there has been some life on Mars and the life would be different or the same – about the chemistry you are thinking for life on Earth. This breakthrough is going to happen. This is what will come in the next 15 years, really tomorrow in terms of science.

Now, the other big revolution, which is related to my work, is that we know there are planets everywhere. It has been a massive revolution for astrophysics. And then, of course, the obvious question is what it means for life? And do we have life on these many planets? And this reflexion comes back again and again. Therefore, this is very central to our topic to find out what we understand through 'life'.

But the clue here relates back to the atmosphere of these exoplanets I mentioned before. Any event related to the formation of life leaves traces in them, which we can read in the infrared light that we observe [of those exoplanets]: big volcanic events, big impacts [of a celestial body] make an imprint on the planet. So looking for life on the planet is not just looking for extraterrestrial radio [signals], it is looking for the signatures of life that could be at different stages of life evolution. So, now that we are also moving from one planetary system [our own] to many, we may end up having a complete understanding of the diversity of life – or not. And that, too, will be happening, in this century.

The challenge here – and I think this is the relevant element for our discussion – is that to make it work, we have to bring a couple of disciplines together: chemistry, biochemistry, geophysics, physics and a lot of technology (with these big telescopes that we are dreaming to fly, or set on the Moon). There are a whole lot of disciplines involved. But when you start embarking on this topic, you realize that the main problem is the lack of bridges between these disciplines. It is impossible for an astrophysicist to understand life if he does not talk a biologist. Well, try to explain astrophysics to biologists. Try to do experiments involving biology, chemistry and physics. In my own experience as a physicist, for example, we have something we call 'error bars' [to go with every measurement]. We love error bars in statistics. But, when you talk to a chemist, they can look at you like stubbornly and ask: 'What are you talking about?' There is a lot, lot of jargon, of language, of definitions that we have to go through. And it turns out it is not the topic which is limiting the progress, but it is the structure of the way the topic is being organized.

And it goes even further than that. The communication channels between disciplines are difficult because the way science is being organized is the same as it was in the Victorian age. We have not made very much progress. Look at the universities: they still organize themselves the same way. It is very difficult to implement a joint lectureship, or a joint programme, or a joint PhD. Try to make a proposal that brings physicists and chemists together: either one part of the panel – the physicists – will tell you the physics is not good enough or the panel of chemists will tell you the chemistry is not good enough. You will never get it to work, because both sides expect a very targeted kind of science. I think our programme [on the origin of life, that we develop at ETHZ] can certainly be applied to other kinds of topics.

That said, the most interesting aspect that I start discovering with this effort is what I call the 'philosophical preconceptions'. When you do science, you embed into your science programme your social background, your language, your education and the global perceptions about how you are reflecting about the society. It is even more profound for some topics which are directly controversial, like genetics. But already when you are dealing with the origin of life, you are entering into a fascinating debate and you cannot do science without bringing this reflection in the game. What I am telling you right now is absolutely heretical. It means bringing art and humanities together with hard-core sciences. We barely start to bring the latter into what is described as 'soft sciences', that is the social sciences. It is now getting together slowly, but to move fully to the art and humanities, there still is a bigger bridge to cross. But we may have to do that as well. And of course, it is not interest on the side of the researchers that is lacking, it is the will to make a change into the structure of the science. I am addressing this to people who are part of the national agencies, which are sponsoring science, or foundations. We all can do something here. While we know this will be fixed one day, we should all try to understand that the future is not anymore in this many silos of disciplines.

Actually, we have to bring back something that dates back to the 17th century. Let us look at Leonardo da Vinci, for example. He was a painter, an engineer and a physicist – no big deal at that time. Well, why not try to implement this in terms of structural design into science? We do not have to build a science entirely on that idea, but bringing a lot of more flexibility is needed. So I think some kind of polymath skill and training will be necessary.

All in all, if I want to give a very short message to this assembly, it is the following: this topic of 'life in the universe', which we are going to organize ourselves around at ETHZ, will also be at the heart of the other centres, at the University of Cambridge in the UK, but also at Harvard in the United States, at Princeton, at the Carnegie Institution, because they all understand the same needs now. This very same structural idea should be used on other topics to really think more globally, and embark on more global programmes.

I thank you for your attention."

Discussion

Niniane Paeffgen: You mentioned it in your talk, it is, for scientists, already very difficult to work together in a transversal way, understand the other scientists are doing in their fields. There is a need for bridges to be built, to explain the science, this also to a broader public. How can we explain what is happening within the science and reach to a more broader public?

Didier Queloz: That is a vast question. First, I believe science is an organic body: I do not think one can conduct science. Any programme that tends to be conducting science is going to fail – and there are a couple of massive failure when programme being too much oriented led to absolute catastrophes. Science is closer to arts, in terms of pure energy. So let the science do the science. Let the scientists do what they need to do. Stop telling them what to do. Stop bring in limitations, red tape and all this administrative burden. Just ask them what they want to do. And that is something that is related to the second part of the question: what about society? Well, we are all part of society! And we all feel that we are fortunate to be very educated people – especially in this audience, which is amazingly educated. I think the more educated you are, the more you feel responsible and should give back time to society. And this is something we can do much better. Sometimes, when talking to private industries, they say: "We are paying enough tax, so I do not see why we should do better". Well – I reply – you should do better because if you stop, if you keep disconnecting from the society, sooner or later, society will come back to you. And that will be really bad. We already see a little bit that problem of the disconnection between the science of knowledge and society. And I think this is something we should respect, while we tend to send all those people as not knowing what they are talking about. But I think these people, they are talking about something that they feel is important for them. As a scientist, as an educated person, as someone responsible for an institution, I feel like we do not do enough. We never do enough. We should really acknowledge that. Maybe all the entities which are spreading and funding knowledge, should consider making way more effort. And that cannot go without the help of the social sciences, through understanding the psychology of society of these topics.

More information

Video recording of the Session on YouTube

Saturday 9 October, 11:30–12:30pm CET

Closing Plenary

Peter Brabeck-Letmathe

**Chairman,
GESDA Board of Directors,
Austria**

Closing Address

Ladies and gentlemen

We are arriving at the end of three very intensive days of discussions, of explanations and of propositions. I think we can say the agenda is exhausted, and perhaps some of us are exhausted too. Let me thank you.

Thank you to the over 900 active participants, and specifically also the students – not only those who were with us on stage, but also the others who have been with us during the three days and have been participating actively. And we had participation really from all over the world, which had also an impact worldwide on the social media. We had invaluable inputs. We had creative and motivating comments and messages. And they were full of knowledge and of wisdom. And all that with – highly appreciated from me – the intention to help GESDA to find its way into the future.

We listened to 108 speakers from 33 countries under the guidance of fantastic moderators – and I know that the quality of the panel depends on the moderators. And there the quality was extremely high. And we profited from the wealth of their knowledge, foresight and anticipation.

The basis for all of our discussions was the first GESDA Science Breakthrough Radar®, which itself is a result of the intensive work of our Academic Forum, under the leadership of Joël Mesot and Martin Vetterli. I don't know whether you have had the time to read it, but I'm sure you will. For me, the important thing is that it has been signed by 543 scientists. As a matter of credibility, this is extremely important, because it certifies that what we are putting in there has been checked and is the reflection of the reality, of what is happening. And not only do we have here the analysis of what is cooking in the laboratories, we also have in this Radar the scientific opinion of what those breakthroughs will bring to our daily life in the next five, ten or 25 years.

This document – I am sure – will be of interest not only to the scientific community, to universities. I also believe that policy makers should have a deep look into it, as well as private corporations. If I were in charge of the research institute at a private company, believe me, I would look into this document because it shows me where the real breakthroughs will come through.

The first qualitative comments which accompanied the Radar are the results of these confrontations that we had during the last year between the Academic and the Diplomacy Forum (the latter one presided so efficiently by Michael Møller), in what we have called the "Situation Room". This Situation Room offers a constructive environment for those encounters of communities which have a quite different language – as we have heard just in the last presentation – but also a different agenda and different interests.

All this, ladies and gentlemen, would not have happened without our outstandingly small but highly professional team, under the leadership of our Secretary General Stéphane Decoutère, and under the guidance of our deeply engaged Board of Directors, all of whom have participated in the different panels during these three days. So to all of you, my very warm thanks for your engagement in favour of GESDA.

The objective of this first Summit was, for the first time, to offer to the public a presentation of what GESDA is, but also – I hope – of what GESDA is not. Which is for me as important. And to that purpose, we presented you our first Science Breakthrough Radar®, and we created a Situation Room. I have been asked many times: "What is this Situation Room?" Well, a situation room is a process which allows this confrontation between science and diplomacy and politics. And the Summit itself was a situation room. You were sitting in a situation room, you were participating in it. That's what we are doing all year long, confronting, discussing and understanding better those different problems. And we also explained the basics of our policy of partnerships. I see different partnerships, which are available for those who are interested to work with us – and we wanted to hear from you whether GESDA could be relevant for all stakeholders interested in scientific diplomacy and multilateralism.

From what I have heard from all of you, I would be arrogant to deduce that we have received a clear "yes" from you. Yes, GESDA can be and should be relevant for all stakeholders. But then I also know very well that the relevancy will only last as long as you have trust in our work. Trust in GESDA as an honest broker which works in a fact-based, transparent and inclusive way. Those are the fundamental conditions, at which GESDA can perform its duty as a builder of bridges between the scientists and the politics, but also with the involvement of the civil communities from all over the world and in the respect of cultural diversity.

What can you expect from GESDA in a year from now? First of all, as we have pointed out, the Science Breakthrough Radar® is a rolling forecasting exercise of what is happening. So next year, you should receive the second Science Breakthrough Radar®. Some of its content will be what we have here, some other content might have been dropped out. And hopefully there will be some new content, because – as we are always saying – the speed with which science develops is enormous and accelerating. In that sense, this document can only be valid, relevant and trustful if we update it all the time.

The second thing is – you will see in the coming month – an increased work of the Situation Room. As I said, the starting point is the input that we have received from all of you. This will go now, together with all the input which are coming through the Digital Platform, into the situation rooms, in this confrontation between science and diplomacy. And I am hopeful that by next year, we will be able to present you two to three solutions. That would be the next step for GESDA. And I put this expectation out clearly: we cannot credibly be the answer to all the problems that we have been discussing. We have to be very clear that, by limiting our expectations, we might stay more trustful and relevant. So our expectation is: let us hopefully find two or three solutions for next year that we can present, that we can discuss. And afterwards, hopefully, we can also strengthen and widen, during this coming year, our partnerships so that perhaps next year we can already bring new partners into our work, that would then be the ones who are going to work under the guidance of GESDA towards the implementation of these ideas.

GESDA is a Swiss-founded foundation, and over the next year, we will have to talk to our founders, whom you all have met – from the Swiss government to the governments of the Canton and the City of Geneva. We have to talk to them and to convince them that GESDA can have a life after the first three years which were given to us when we started GESDA.

GESDA is Geneva-based, and I consider personally that our founders are very important for the credibility of our work. And Geneva is the right place to do it for all the reasons we have heard during those recent days. But at the same time, I also have to tell our founders that they should not forget that GESDA is an open, worldwide institution, working for all people of this world. Yes, GESDA is Geneva-based, but with an impact and solutions that are for the world. Thanks to this overwhelming quality of your participation, I have little doubt that our founders will wholeheartedly support the future of GESDA. So thank you, to all of you, very much, for the impressive participation you have showed during those days, and let us use together the future to build a better present.

Thank you very much.

More information

Video recording of the Session on YouTube

Léman Bleu TV Studio

A professional TV studio was set up and managed by Léman Bleu, a popular local media company in Geneva that was hired to help report on the inaugural GESDA Summit from 7 to 9 October 2021. The objective was to briefly interview attending speakers and guests, capture a sense of how they felt about the Summit and gather their opinions about GESDA and its relevance to science diplomacy and Geneva's hub of multilateralism. Their respective inputs were overwhelmingly positive.

A team of five technicians, one manager, two journalists and one make-up artist recorded 33 interviews over three days. The interviews, conducted with individuals, pairs and three people, provided important insights for GESDA, including how young people viewed its efforts. A selection of these interviews were shared on social media during the Summit, and the full videos were uploaded on GESDA's YouTube channel soon after it ended.

The 40 interviewed speakers and guests were (in alphabetical order):

Patrick Aebischer, President Emeritus, EPFL; Vice-Chairman GESDA

Anousheh Ansari, CEO, XPRIZE Foundation; Member GESDA Academic Forum; Member, GESDA Diplomacy Forum

Olaf Blanke, Professor of Neurosciences; Bertarelli Chair, Cognitive Neuroprosthetics; Director, Laboratory of Cognitive Neuroscience, EPFL/Campus Biotech; Professor, Neurology, Department of Neurology, University Hospital of Geneva; Member GESDA Academic Forum

Patrick Brabeck-Letmathe (part one and part two), Chairman, GESDA Board of Directors

Claudia Chwalisz, Policy Analyst, Leading work on innovative citizen participation, OECD Open Government Unit; Author; Member, Democracy R&D Network

Joseph D'Cruz, Special Advisor, Strategic Planning & Innovation, Executive Office of the Administrator, United Nations Development Program

Roger de Weck, editorialist, journalist and author

Rebecca Enonchong, Founder and CEO, AppsTech
Jeremy Farrar, Director, Wellcome Trust

Marga Gual Soler, Science Diplomat; Founder, SciDipGLOBAL; Senior Science Diplomacy Advisor at GESDA

Gerald Haug, President, German National Academy of Sciences Leopoldina; Ordinary Professor, Climate Geology, ETHZ; Director, Climate Geochemistry Department; Scientific Member, Max Planck Institute; Member GESDA Academic Forum

Martina Hirayama, Swiss State Secretary for Education, Research and Innovation

Marcello Ienca, Group Leader, EPFL; Senior Research Fellow, ETHZ

Nadia Isler, Director and Founder, SDG Lab, Office of the Director General of the United Nations Office at Geneva

Uzodinma Iweala, CEO, The Africa Center NY

Elham Kashefi, Professor of Computer Science; Personal Chair, Quantum Computing, School of Informatics, University of Edinburgh; Director, CNRS, Sorbonne University; Co-Founder, VeriQloud

Samira Kiani, CEO and Founder, GenexGen; Director, Tomorrow.Life Initiative; Associate Professor, Liver Research Center, Department of Pathology, School of Medicine, University of Pittsburgh; Member GESDA Academic Forum

Wendy Lee Queen, Tenure Track Assistant Professor, Laboratory of Functional Inorganic Materials, EPFL

Peter Maurer, President, International Committee of the Red Cross; Member GESDA Diplomacy Forum

Anders Meibom, Professor, EPFL's Laboratory for Biological Geochemistry; Professor ad personam, Institute of Earth Sciences, University of Lausanne

Joël Mesot, President, ETHZ; Co-Chair, GESDA Academic Forum

Patrick Michel, Senior Researcher, CNRS (Observatoire de la Côte d'Azur), Team Leader, TOP (Théories et Observations en Planétologie)

Janos Pasztor, Executive Director, Carnegie Climate Governance Initiative C2G

Guillaume Pictet, Vice President, Fondation pour Genève

Didier Queloz, Professor of Astronomy, Cambridge University and ETHZ, 2019 Nobel Prize in Physics

Vladimir Ryabinin, Executive Secretary, Intergovernmental Oceanographic Commission (IOC) of UNESCO

Guy Ryder, Director-General, International Labour Office; Member GEDSA Diplomacy Forum

Nanjira Sambuli (part one and part two), Policy Analyst, Advocacy Strategist; Board Memer, Digital Impact Alliance, Development Gateway and The New Humanitarian; Member GESDA Diplomacy Forum

Nikhil Seth, Executive Director, UNITAR

Maria-Francesca Spatolisano, Officer-in-Charge, Office of the Secretary-General's Envoy on Technology; Assistant Secretary-General, Policy Coordination and Inter-Agency Affairs, Department of Economic and Social Affairs (DESA)

Vincent Subilia, Director general, Geneva Chamber of Commerce and Industry

Soumya Swaminathan, Chief Scientist, World Health Organization

Chorh Chuan Tan, Chief Health Scientist & Executive Director, Office for Healthcare Transformation, Ministry of Health, Singapore; Board Member, GESDA

Daren Tang, Director General, World Intellectual Property Organization; Member GESDA Diplomacy Forum

Rüdiger Urbanke, Professor of Communication Theory, EPFL; Member GESDA Academic Forum

Tatiana Valovaya, Director-General, United Nations Office at Geneva

Fokko Wientjes, Vice-President Nutrition in Emerging Markets, Royal DSM

And students:

- **Joe Maggiore**, PhD Student in Bioengineering Medicine, University of Pittsburgh, USA
- **Hannah Tickle**, Master Student in Social & Organizational Psychology, University of Lausanne and London School of Economics, Switzerland
- **Keshav Khanna**, Master Student in International Affairs, Graduate Institute Geneva, India

Science and theatre: an experiment with *The Frozen Sea*

Can AI create art pieces? Theatre as a medium to provoke technology discussions

This unique session will consist of two parts: first, a dramatic reading of *The Frozen Sea*, a comedic play in development by San Francisco playwright Maury Zeff that explores the convergence of art and AI in the near future. It is set in 2030, and wunderkind computer programmer Dashiell has set for himself the difficult task of producing technology with human instincts. When he meets rising painter Annelise, he hits upon the idea to create software that can render artistic masterpieces. This play wrestles with questions of how far to allow technology to creep into human endeavours and whether you can still call something art if human beings cede its creation to machines.

The Frozen Sea has been previously workshopped or received readings in the Berkeley Rep Theater Lab, the San Francisco State University's theatre department, the San Francisco Playhouse, and elsewhere. The reading will be immediately followed by a panel discussion about how we can use theatre and other creative mediums to bring non-technical people into important conversations about the science and technologies that will shape our future. This session is offered jointly with the Fête du Théâtre.

About the Playwright

Maury Zeff is a San Francisco playwright and fiction writer whose work has been performed and published throughout the United States. He formerly worked in the tech industry in Silicon Valley and Asia, most recently as the managing director of Yahoo! Southeast Asia. His previous career left him deeply fascinated by digital technology, which he frequently explores in his plays and fiction.

Presented and reported by:

Samira Kiani, CEO and Founder, GenexGen; Director, Tomorrow.Life Initiative; Associate Professor, Liver Research Center, Department of Pathology, School of Medicine, University of Pittsburgh, US; Member GESDA Academic Forum, US

Report

In the theatrical work *The Frozen Sea*, Maury Zeff explores the intersection of art and AI and what constitutes the authenticity of art and intelligence. In a provocative twist, the experimental stage-reading was performed not by professional actors, but by Tomorrow.Life staff and invitees with highly technical backgrounds.

The cast included Cody Sheehy, a documentary filmmaker whose education and training is in conservation sciences, Marcia Fiamengo, the programme director for Tomorrow.Life, a nuclear engineer by training with a career in hard science communication related to NASA and space exploration, and graduate student Joseph Maggiore, who is pursuing an MD/PhD in medical bioengineering with a focus on integrative systems biology. Samira Kiani, the director, provided stage direction interjections.

Working closely with Maury Zeff to maintain his theatrical vision and context, the cast presented a future where AI is used to create art, and exceeded the bounds and intentions of both the developers and artist's intentions over the course of an hour. By introducing the story through the voices of technical developers inexperienced in performance art, a transformative occurrence was achieved.

The round table discussion at the conclusion included the general public, and a rousing debate was held not only about the capability of AI to perform art, but the cathartic nature of scientists and technologists performing theatre in a space designed to elicit changes in approach and thinking on development topics. The cast reflected on the personal impact of being involved in the production and noting affinities and personal connections with the characters they portrayed.

The consensus amongst discussion artists and scientists alike was that this methodology, akin to conflict resolution theatre for veterans and those victims of war crimes, was likely to create spaces in bridging cultural gaps between scientists, artists, and the communities they represent and impact. A call to action was heard to include interactive performances of a similar nature in future GESDA summits and for Tomorrow.Life to incorporate this novel methodology in dialogues to be held in the future.

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