Proceedings of the 2024 Geneva Science and Diplomacy Anticipation Summit

9-11 October 2024

CERN Science Gateway,
Geneva, Switzerland

gesda

Table of contents

Acknowledgments

The Geneva Science and Diplomacy Anticipator (GESDA) was founded by the Swiss Government and the State Council of the Republic and Canton of Geneva in collaboration with the City of Geneva in 2019 and operates as an independent Swiss foundation. A global public-private partnership in the field of science anticipation and action, GESDA benefits from public funding by the Swiss Confederation as well as the Canton and City of Geneva.

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The 2024 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 members of the GESDA Board of Directors and of the GESDA Committee, with collaboration from the GESDA Executive Team.

For more information on GESDA, please see www.gesda.global

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Alternity Limited

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Executive summary

THE SUMMIT IN A NUTSHELL

The fourth annual Geneva Science and Diplomacy Anticipation Summit took place on 9-11 October 2024 in Geneva, Switzerland, at the European Organization for Nuclear Research, known by its French acronym CERN. Returning to CERN for the second year running, the 2024 Summit convened over 1,000 scientists, diplomats, policymakers, innovators, executives and citizens in-person and online, under the theme of "The Great Scientific Acceleration".

With 32 sessions and workshops spread across three days, the Summit provided insights and guidance on using the acceleration of science and its applications to help solve some of humanities biggest global challenges.

Three major Announcements	• Launch of **GESDA's Anticipation Gateway initiative** which seeks to democratize access to knowledge and uses of emerging science for current authorities, future leaders, as well as citizens around the world via its three component parts: 1. The **Global Curriculum on Science Diplomacy (GCAL)**, supported by Wellcome, will prepare leaders globally for transformations driven by science and technology. The GCAL will offer five regional leadership programs with local host institutions in Istanbul (Sabancı University), Madrid (IE University), Pretoria (Science Diplomacy Capital for Africa), San José (INCAE Business School) and Singapore (National University of Singapore). 2. The **Geneva Public Portal to Anticipation**, an interactive installation to democratize access to emerging science and technology. It invites citizens to project themselves into the future through an immersion into art, science, and diplomacy. The Portal will debut as a key attraction in the Swiss Pavilion at the World Expo 2025 in Osaka, Japan in April 2025. 3. The **Anticipation Observatory**, which aggregates validated data to track emerging scientific trends and assess their potential impacts on diplomacy, business, and society. It filters scientific advancements through the lens of prosperity and development, peace and security, and human rights, countering misinformation and fake news.
Political engagement	• Geneva Political Talks on Science and Diplomacy hosted by the Swiss Minister of Foreign Affairs, Federal Councillor Ignazio Cassis, with Ministers and delegates from El Salvador, India, Latvia, Poland, and the United Arab Emirates; the heads of four International Organizations; and high level representation from the city and canton of Geneva. • Ministerial Working Dinner at the Residence of the Swiss Permanent Representative to the UN Office at Geneva.
Star speakers	• 77 speakers from Europe, Asia, the Americas, and Africa, with equal representation of male and female speakers. • Representation from OpenAI, Microsoft, United Nations, CERN, international governments, leading universities around the world, the European Space Agency, and many more. See speakers p6-10.

Scientific insights	• Launch of GESDA 2024 Science Breakthrough Radar® with contributions from over 1,500 scientists. • Seven anticipatory briefings on topics from the 2024 radar including quantum computing, synthetic biology and the future of archaeology. • Launch of the Intelligence Report on Quantum Diplomacy for the SDGs.
Community engagement	• 14 invitation-only workshops and community gatherings to advance GESDA workstreams. • Exclusive breakfast for the diplomatic community on space diplomacy with key international stakeholders. • Four community dinners including one affiliate dinner hosted by Quantonation
Media and digital engagement	• 122 articles with a reach of 287 million people. • Sponsored coverage in Financial Times, NZZ, and Le Temps. • 66,000 LinkedIn views; 24,000 YouTube views. • 10 Leman Bleu video interviews with Summit speakers.
Innovative Programming	• 11 panels, seven anticipatory briefings, 14 workshops and four community dinners. • Interactive demonstrations of the Geneva Public Portal to Anticipation in CERN's iconic Globe. • Dynamic sessions covering topics from the future of space diplomacy to the restoration of coral reefs and innovative solutions to food security.

Key messages

Closing the summit, **Peter Brabeck-Letmathe**, Chairman of the Board of Directors of GESDA, said that inclusiveness was a key issue for the organisation. "Inclusiveness means that we have to help to overcome the gap which is increasingly opening in our societies, whether it's a gap between countries or the gap inside countries," he said. "Inclusiveness in international science and technology research is paramount for fostering innovation, addressing global challenges and ensuring equitable access to knowledge."

Christina Kitsos, Mayor of Geneva, said: "Geneva is proud to be an active supporter of GESDA's activities. GESDA's great strength lies, of course, in its ability to bring together panels of experts and their respective fields, to encourage exchanges, enrich the cross-fertilisation of views and bring together scientists, diplomats and decision-makers. [GESDA's] work is part of a long tradition that has made our city a privileged place where the debate of ideas and exercises is encouraged, allowing visionary minds to answer complex questions and move the world forward."

Ignazio Cassis, Federal Councillor and Minister of Foreign Affairs at the Federal Department of Foreign Affairs, Switzerland, addressed the press conference after the close of the summit. He said: "The vast benefits of new technologies could spark future conflicts. Shared solutions are needed to democratise access to scientific advancement and prevent future conflicts. This is exactly what Switzerland is pursuing with GESDA."

Speakers

Graham Alabaster
Chief Geneva Office of UN-Habitat

Christine Allan de Lavenne
Intellectual Property Attorney and Human Rights and Innovation Expert, SIDE Law Office

Anousheh Ansari
CEO of XPRIZE

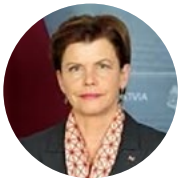
Mourad Beji
Chief Software Officer, Pasqal

Seth Berkley
Senior Advisor to the Pandemic Center, Brown University in Providence, Rhode Island

Tamaki Bieri
Chief Operating Officer, Coral Gardeners

Thomas Biersteker
Honorary Professor of International Relations/ Political Science, Geneva Graduate Institute

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



Baiba Braže
Minister of Foreign Affairs at the Ministry of Foreign Affairs of the Republic of Latvia

Lidia Brito
Assistant Director-General for Natural Sciences, UNESCO

Emma Camp
Team Leader of the Future Reefs Program, University of Technology Sydney

Ignazio Cassis
Federal Councillor and Minister of Foreign Affairs at the Federal Department of Foreign Affairs, Switzerland

Nam-Hai Chua
Senior Investigator (Emeritus), Temasek Life Science Laboratory

Jennifer Cohn
Director, Global Access, Global Antibiotic R&D Partnership

Junbiao Dai
Professor, Agricultural Genomes Institute at Shenzhen Chinese Academy of Agricultural Sciences

Arnaud de la Tour
CEO,
Hello Tomorrow

James Donovan
Head of Science Policy, OpenAI

Fanny Douvere
Head of the World Heritage Centre's Marine Programme, UNESCO

Alexandre Edelmann
Head of Presence Switzerland
Federal Department of Foreign Affairs, Switzerland

William Egbe
Managing Partner
Vibranium Capital Group

Lindy Elkins-Tanton
Principal Investigator for NASA Psyche mission, Arizona State University

Fernando Espinosa
Deputy Permanent Representative
Mexican Permanent Mission

Sylvian Fachard
Professor of Classical Archaeology, University of Lausanne

Alexandre Fasel
State Secretary,
Federal Department of Foreign Affairs, Switzerland

Luciano Floridi
Founding Director,
Digital Ethics Center,
Yale University

Anna Fontcuberta i Morral
Incoming President of EPFL, the Swiss Federal Institute of Technology

Henrietta Fore
Member, Board of Directors, GESDA

Jennifer French
Executive Director,
Neurotech Network

Ariel Garten
Founder and Chief Evangelist Officer, Muse

Urs Gasser
Professor for Public Policy, Governance and Innovative Technology, Technical University of Munich

Meret Gaugler
Healthcare Investor

Ioannis Ghikas
Ambassador and Permanent Representative, Permanent Mission of Greece to the UN in Geneva

Fabiola Gianotti
Director-General,
CERN

Sandro Giuliani
CEO,
GESDA

Patricia Gruber
Science and Technology Advisor to the Secretary of State at the Department of State, US

Rebeca Grynspan
Secretary-General
UN Trade and Development (UNCTAD)

Aisha Hadejia
Partner,
Sahel Consulting

Lynn Hanessian
Chief Strategist,
Edelman

Laurent Haug
Founder,
200ideas

Michael Hengartner
President,
ETH Board

Matthias Honegger
Climate Interventions Program Director,
ICFG — International Center for Future Generations

Friedhelm Hummel
MD, Director of the Defitech Chair of Clinical Neuroengineering at the Neuro-X Institute at EPFL, the Swiss Federal Institute of Technology

Camelia Ilie
Dean, Strategy and International Affairs
INCAE

Alok Jha
Science and Technology Editor, *The Economist*

Sarah Kenderdine
Head, Laboratory for Experimental Museology at EPFL, the Swiss Federal Institute of Technology in Lausanne

Christina Kitsos
Mayor of Geneva

Amy Kruse
General Partner and Chief Investment Officer,
Satori Neuro

P. Kumaran
Special Secretary,
Ministry of External Affairs,
India

Hilal Lashuel

Research, Development and Innovation Advisor to the Chairperson, and Executive Director, Qatar Foundation

Yusuf Leblebici

President Sabancı University

Enrico Letta

Member of the Board of Directors GESDA

Chris Luebkeman

Head of Strategic Foresight, ETH Zurich

Sabrina Maniscalco

Professor of Quantum Information, Computing, and Logic at the University of Helsinki, Finland; CEO and Co-Founder, Algorithmiq

Benedetto Marelli

Associate Professor, Massachusetts Institute of Technology

Kristen Marhaver

Project Director and Associate Scientist, The Marhaver Lab of the CARMABI Foundation

Rose A. Marks

Assistant Professor, Department of Plant Biology at the University of Illinois

Tanja Masson-Zwaan

Assistant Professor, Leiden University

Katherine Mathieson

Director, Royal Institution

Anders Meibom

Professor, Laboratory for Biological Geochemistry at EPFL, the Swiss Federal Institute of Technology in Lausanne

Adriana Mira

Vice Minister at the Ministry of Foreign Affairs, El Salvador

Suerie Moon

Co-Director of the Global Health Centre at the Geneva Graduate Institute

Carole Mundell

Director of Science, European Space Agency

Ken Natsume

Assistant Director General, World Intellectual Property Organization

Andrin Oswald

Director and Co-Founder, Swiss Vaccines Initiative

Enrica Porcari

Head of Information Technology Department, CERN

Jennifer Schenker

Founder and Editor-in-Chief, *The Innovator*

Debbie Senesky

Associate Professor of Aeronautics and Astronautics at Stanford University, California

Omran Sharaf

Assistant Foreign Minister of Advanced Science and Technology at the Ministry of Foreign Affairs, United Arab Emirates

Barbara Sherwood Lollar

Professor, Department of Earth Sciences at the University of Toronto

Muriel Siki

Journalist

Subra Suresh

Former Director of the US National Science Foundation; Professor at Large at Brown University

Ayaka Suzuki

Director of the Strategic Planning and Monitoring Unit in the Executive Office of the Secretary-General, United Nations

Andrzej Szeptycki

Under-Secretary of State at the Ministry of Science and Higher Education, Poland

Anthony Taubman

Former Director of the IP Division, World Trade Organization

Stephen J. Toope

President and CEO, Canadian Institute for Advanced Research

Matthias Troyer

Technical Fellow; Corporate Vice President Microsoft Quantum

Tatiana Valovaya

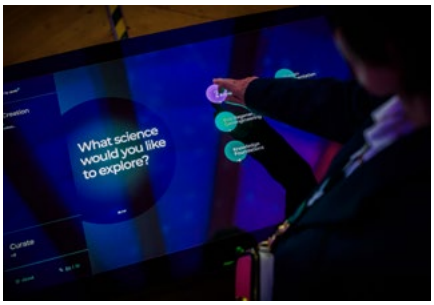
Director-General of the United Nations Office at Geneva

Geneva Public Portal to Anticipation

Live Demos at the 2024 GESDA Summit

The 2024 GESDA Summit showcased the Geneva Public Portal to Anticipation, an interactive exhibition blending arts, science, and diplomacy to help participants anticipate and shape the future using the GESDA Science Breakthrough Radar. The Portal is part of GESDA's Anticipation Gateway Initiative, which aims to democratize access to emerging science. It will debut globally at the 2025 World Expo in Osaka as part of the Swiss Pavilion.

At the Summit, the Portal was installed in CERN's iconic Globe, enabling participants to co-create fictional futures with generative AI based on scientific trends projected 5, 10, and 25 years ahead. This immersive experience bridged imagination and interdisciplinary collaboration, encouraging participants to explore opportunities for future generations while addressing global challenges. By integrating science anticipation into decision-making frameworks, GESDA aims to empower policymakers and citizens alike.



Towards a Global Dialogue: World Expo 2025 and Beyond

The Portal will feature prominently at the World Expo in Osaka, offering over 1.5 million visitors the chance to create personalized Science Anticipation Maps and Avatars. Feedback gathered will inform GESDA's initiatives, turning scientific breakthroughs into practical applications. A full-scale Geneva-based exhibition, complemented by global Anticipation Satellites and an open online platform, is planned for 2026-2027.

In partnership with EPFL's Experimental Museology Laboratory, the Portal also serves as a research project led by Professor Sarah Kenderdine, exploring innovative ways to visualize complex knowledge.

Long-Term Vision: Accessible Science for All

GESDA envisions engaging citizens with emerging science to address humanity's greatest challenges. Through creative AI-driven data visualization, the Portal inspires reflection, fosters debate, and builds trust in science. This transformative initiative aligns with global efforts like the UN's *Pact for the Future*, emphasizing collective action to shape a prosperous and innovative society.

9 October 2024 · 13:00-13:15 CET

Plenary Session

Welcome Remarks

SPEAKERS

Peter Brabeck-Letmathe Chairman of the Board of Directors at GESDA

Alexandre Fasel State Secretary at the Federal Department of Foreign Affairs, Switzerland

Tatiana Valovaya Director-General of the United Nations at Geneva

KEY MESSAGES

- GESDA is not only a think tank: it is also a "do tank", whose initiatives will make a practical difference to the world
- Switzerland promotes the concept of anticipatory science diplomacy internationally
- The UN Global Digital Compact, adopted in September 2024, is an example of the multilateral cooperation we need if we are to harness science and technology to solve urgent challenges

SESSION RECORDING →

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SUMMARY

GESDA is not only a think tank, said **Peter Brabeck-Letmathe**: it is also a "do tank". It not only monitors emerging science and technology, but also anticipates their future evolution and uses. To this end it develops and funds international trials "to make sure that opportunities, benefit and access are shared as soon as possible by as many people as possible".

The first big demonstration of this approach has been the Open Quantum Institute, part of a GESDA initiative to accelerate and democratise the uses of quantum computing. GESDA incubated it, with the support of UBS, and in March 2024 handed it over to CERN, the European laboratory for particle physics, which will test the institute over three years.

Google and XPRIZE have joined GESDA in another quantum-computing initiative: the Quantum for Real-World Impact competition. XPRIZE will announce the winner in 2027.

Five years ago, the Swiss Confederation and the canton and city of Geneva founded GESDA to respond to the pace of scientific and technological innovation. Since then, such innovation has overtaken all sectors of society. Competition for scientific supremacy has become part of geopolitics. At the same time, "not everybody, by far, benefits quickly enough from those advances", said Brabeck-Letmathe. The key to spreading such benefits more widely is anticipation — GESDA's founding purpose.

This year's summit focuses on how the acceleration of science and technology is augmenting fields including data, neuroscience and ecology. It will discuss the work of the 2100 scientists from 87 countries who work with GESDA and aims to find out how we can "transform those augmentations into shared knowledge and an increased ability to use it diplomatically, economically and individually as citizens".

Peter Brabeck-Letmathe

Alexandre Fasel

As part of this summit agenda, GESDA will launch its second big project, the Anticipation Gateway Initiative. It has three parts: the Global Curriculum for Anticipatory Leadership; the Geneva Public Portal to Anticipation, which will be part of the Swiss pavilion at the World Expo in Osaka, Japan, next year; and the Anticipation Observatory.

These initiatives are GESDA's first worldwide activities. Support for the Anticipation Gateway Initiative comes from the Rupert family and the Compagnie Financière Richemont. Thanks also go to Fondation Hippomène for sponsoring press advertisements, and the Swiss government bodies that founded GESDA. Public bodies contribute 27% of its sponsorship, with 73% coming from the private sector.

Alexandre Fasel recalled that GESDA began in a conversation between the Swiss federal government and the Geneva authorities about the future of international governance and international Geneva. They saw that the international community was failing to consider the acceleration of science and technology fully, and probably lacked an instrument to do so. What came next was GESDA.

Switzerland has used its membership of the UN Security Council to promote the concept of anticipatory science diplomacy internationally. The country holds the presidency of the council in October 2024, and its flagship event in New York on 21 October will consider the impact of breaking science on international affairs. The GESDA Summit's High-Level Political Segment will be a stepping-stone to this event.

Tatiana Valovaya said that we need multilateral cooperation if we are to harness science and technology to solve urgent challenges. We must work together to strengthen existing digital cooperation, to support collaboration across regions and industries, and to facilitate new governance arrangements where they are needed.

Tatiana Valovaya

World leaders took a big step in this direction in September 2024 when they adopted the UN Global Digital Compact, the first universal agreement on the international governance of artificial intelligence. It also calls for universal digital connectivity by 2030 and the protection of human rights in the digital sphere.

Geneva, with its rich ecosystem of international agencies, is uniquely positioned to lead in realising this vision. For instance, the Open Quantum Institute has brought stakeholders together to work on issues ranging from carbon emissions to food production. Meanwhile, the Beyond Lab at the UN Office at Geneva has helped GESDA to put the Sustainable Development Goals at the centre of the Open Quantum Institute's work.

9 October 2024 · 13:15-13:30 CET

Plenary Session

Launch of the 2024 GESDA Science Breakthrough Radar®

SPEAKER

Michael Hengartner President of the ETH Zurich board and Chair of GESDA's Academic Forum

KEY MESSAGES

- The GESDA Science Breakthrough Radar® contains briefings on the present state of 40 emerging areas of research, science and technology. It foresees potential developments over the next 5, 10 and 25 years. It is available free of charge
- The Radar is the collective work of over 2100 scientists from 83 countries around the globe
- It refrains from considering what is desirable or preferable

SESSION RECORDING →

SUMMARY

Science and technology have been transforming human life for centuries, but the pace of their development has accelerated over the past few decades. One reason for this is the increase in the numbers of scientists and engineers. Another is the increased power and sophistication of their tools. For instance, machine learning and artificial intelligence allow them to make discoveries and breakthroughs far more rapidly than before.

The award of the Nobel prize for physics to machine-learning experts on 8 October was clear evidence of this. Machine learning allows physicists to generate new materials and to analyse the vast amounts of data that we collect through our telescopes, satellites and particle accelerators — in particular, of course, the one at CERN, the European laboratory for particle physics.

Yet there are still many fundamental questions we cannot answer. Our responses to these questions will reshape who we are as humans, how our societies work and our relation to our planet. This is why it has never been more important than today that we anticipate possible futures to make decisions today — to gain agency over our future.

Michael Hengartner

The 2024 edition of the GESDA Science Breakthrough Radar contains briefings about the present state of 40 emerging areas of research, science and technology. It foresees potential developments over the next 5, 10 and 25 years.

The Radar has a solid methodology with two basic principles. First: we stick to science. We strive to understand what is possible and probable in science, but we refrain — as much as we can — from considering what is desirable or preferable. We avoid such questions in the Radar because they are too important to be left to scientists: all of us need to address them.

Second: we apply the scientific method to science anticipation. For example, we use deep expertise, academic rigour and peer review.

We want the Radar to be an open and free resource that the broadest possible audience can access and use. However, its depth, density and richness may deter some. For this reason we have this year launched RadarAI, an AI tool which provides an easy way to find out about the complexity of future science and its relation to the problems of humanity.

The 2024 edition also gives a list of scientific trends that have a particularly high Anticipation Potential. This metric summarises a trend's potential for transformative breakthroughs in the future as well as its opportunities for effective action in the present.

For example, eco-augmentation was the topic of our 2024 High-Level Anticipation Workshop in Villars, Switzerland. This field is a great example of how advances in many fields of science are converging to give us powerful new tools in the future. For instance, findings in AI, synthetic biology, complex system science and space observation will come together in the future to allow us to not only read but also write entire ecosystems. Some researchers are working on bringing extinct species back to life, while others aim to make existing ecosystems more resilient. And new knowledge about life in the deep seas, at the poles or in other extreme environments inspires new solutions for today's problems, from resilient food production to antimicrobial resistance.

The Radar is the collective work of over 2100 scientists from 83 countries around the globe. They have contributed through dedicated workshops, symposia and surveys.

9 October 2024 · 13:30-14:30 CET

Plenary Session

Opening Plenary: Building Preparedness in the Age of Acceleration

SPEAKERS

Moderator: **Alok Jha** Science and Technology Editor at *The Economist*

Patricia Gruber Science and Technology Advisor to the Secretary of State at the Department of State, US

Subra Suresh former Director of the US National Science Foundation; Professor at Large at Brown University

Arnaud de la Tour CEO of Hello Tomorrow, a global organisation that uses emerging technologies to help solve world challenges by connecting start-ups, investors and corporates, and providing consulting services

Tatiana Valovaya Director-General of the United Nations Office at Geneva

KEY MESSAGES

- Industry spends more than three times as much on basic research and development as governments do
- Policy-makers and scientists need to build mutual trust over time
- The global network of entrepreneurs forms an ecosystem that anticipates the future and provides the best technology for it
- If we do not anticipate applications of technology, it becomes harder to develop the international laws and agreements that we need to govern them

SESSION RECORDING →

SUMMARY

Subra Suresh noted three "megatrends" related to science and society. First: 10 or 12 years ago the US federal government spent as much on basic research and development as industry did. Today industry spends more than three times as much as the government, with enormous implications for the openness and applications of science.

Second: artificial intelligence (AI) poses questions about the meaning and existence of humans that make science and institutions such as GESDA critically important.

Third: increasing international competition in science and technology has put up walls in science diplomacy.


Subra Suresh

Patricia Gruber said that speed of adoption of AI took the state department by surprise. "The bottom line here is that technology is always going to lead policy," she said. To prepare policy-makers, therefore, we must use science diplomacy to foster an international science and technology ecosystem that is open, transparent and collaborative "before we get caught by that ChatGPT moment".

In addition, it is important to implant science and technology expertise into policy organisations. "You don't want the first time a policy-maker and a scientist talk to be when there's when there's a technology policy issue," she said. "They have to learn to communicate with each other, and they need to build trust over time."

Arnaud de la Tour said that individual entrepreneurs are no better at science anticipation than anyone else. But they form a global "ecosystem that is able to anticipate the future", he said. "Then through natural selection only the projects


Arnaud de la Tour


Patricia Gruber

that make sense will be financed". This is how Hello Tomorrow works. The ecosystem creates a challenge for science anticipation, he said, because "information about the future is really fragmented".

Tatiana Valovaya discussed the difficulty of developing the new international laws and agreements that we need to govern new technology. For instance, an international treaty regulating the exploitation of the Moon has existed since the late 1960s, modelled on the Antarctic Treaty – but none of the major spacefaring nations has signed it, even as the start of such exploitation draws nearer.

There are similar problems with established technology. There is a pressing need for an international treaty about the use of cloud-seeding, given its potential for changing rainfall patterns across borders. But because this technology has been in use since the 1970s without regulation, reaching agreement now will be hard. Early anticipation is essential to avoiding such problems.

The Global Digital Compact, signed in September as part of the UN Pact for the Future, is the first universal agreement for the governance of AI. To implement it we need an independent, international scientific panel to advise member states.

Subra Suresh used the example of GPS to show how technology can find unanticipated uses. Huge resources were devoted to its realisation, but no one anticipated that it would end up in mobile devices in the pockets of ordinary people.

The ever-faster pace of development means that the time frame for anticipating applications is getting ever shorter. Meanwhile fundamental research and innovation from government agencies, industry and academia are merging and crossing disciplines. This will accelerate change even further and in ways which we cannot yet anticipate.

Arnaud de la Tour pointed out that start-ups are temporary organisations in a search of match between a problem and a solution. Big organisations by their nature cannot work in this way. He sees a new value chain of innovation that mostly goes via start-ups to wider industry.

This will happen because the cost of science is decreasing. The initial capital required to bring a first version of a product to potential customers is very small. In almost any domain it's now possible to create a prototype with just €1 million, the amount that an investor would give to a company which has just come out of a university. A few decades ago, that would not have been possible.

Patricia Gruber said that a valuable use of science diplomacy is that enables countries which "don't see eye to eye geopolitically" to communicate.

She outlined how science diplomacy operates at different levels. At a high level, collaboration with organisations such as the UN, G7, G20 and OECD can make a difference to many lives. For instance, in 2023 the state department partnered with the African Union and the UN Food and Agriculture Organization to work on research to introduce climate-resistant and diverse crops and soils into developing countries to improve yield and nutrition.

There is also what she calls "bottom-up science diplomacy". This is about creating opportunities for researcher-to-researcher collaboration. One example is the Fulbright US Scholar Program. USAID also funds fundamental research: its Partnerships for Enhanced Engagement in Research (PEER) have funded more than 400 researchers in healthcare across more than 30 countries. These collaborations tend to be long-term and self-sustaining.

Gruber also noted the importance of the private sector in science diplomacy. For instance, just a couple of weeks before, at the UN General

Assembly, President Joe Biden had announced a partnership with nine large US AI companies to spend $100 million to provide more access to AI to developing countries.

Tatiana Valovaya said that civil society also has an important role: together with the private sector and young people, it had a lot of input into the Declaration on Future Generations that is part of the UN Pact for the Future.

It is important to have intergenerational dialogue about science because “where all the scientists see a risk, young people see a possibility”. Without it, there will be a divide between a risk-averse stagnation of good new technology and risk-blind development.

In response to audience questions, **Gruber** noted that science advisors must be able to “translate” why policy-makers should care about science in terms of economic prosperity, security or human rights.

Suresh warned science policy-makers and funders against following fashionable or spectacular developments. For instance, the first patent to put wheels on a suitcase was filed a year after the first human walked on the Moon. Wheels on a suitcase, Suresh argued, are much more useful in day-to-day life than walking on the Moon. He argued that we should not ignore individual ideas while we chase major dreams and trends.

De la Tour said that it is not possible to control the decentralised innovation ecosystem that he had described from the top down. However, entrepreneurs need support to understand the ethical consequences of their actions.

Tatiana Valovaya

Valovaya also reflected on ethics and human rights in technology. For example, as a child she read Isaac Asimov’s novels and so grew up knowing his first law of robotics, which states that a robot may not injure a human. As an adult she was disappointed to learn that no international treaty prohibits artificial intelligence or autonomous systems from killing a person. This shows that we have to try to have at least some basic principles governing research, discovery and development.

9 October 2024 · 14:45-16:15 CET

Panel Session

Unlocking Next-Generation Neurotechnology Applications

Human Augmentation Highlight I

SPEAKERS

Moderator: **Lynn Hanessian** Chief Strategist at Edelman, a global public relations consultancy

Presentation: **Friedhelm Hummel** MD, Director of the Defitech Chair of Clinical Neuroengineering at the Neuro-X Institute at EPFL, the Swiss Federal Institute of Technology in Lausanne

Presentation: **Ariel Garten** Founder and Chief Evangelist Officer at Muse, a start-up aimed at revolutionising brain health through technology

Jennifer French Executive Director at Neurotech Network, a non-profit organisation that focuses on education and advocacy of neurotechnologies

Ioannis Ghikas Ambassador and Permanent Representative at the Permanent Mission of Greece to the UN in Geneva

Amy Kruse General Partner and Chief Investment Officer at Satori Neuro, a venture fund focused on mental health, neurotechnology and human flourishing

Hilal Lashuel Research, Development and Innovation Advisor to the Chairperson, and Executive Director, RDI, at Qatar Foundation, a not-for-profit organisation focused on education, research, innovation and community development

KEY MESSAGES

- Neurotechnology can enable personalised treatments for brain disorders without surgery
- The biomarker and health data that wearable tech can gather will allow us to treat diseases such as Parkinson's and Alzheimer's at their earliest stages
- We must build in equity and inclusion early in the development of a new neurotechnology
- We need an international regime to protect citizens from the misuse of neurotechnology

SESSION RECORDING →

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Friedhelm Hummel called brain disorders such as stroke, depression, dementia, addiction and brain injury "the epidemic of the 21st century". They need personalised treatments: variations in response to treatment and in side effects are too great for one-size-fits-all approaches.

Neurotechnology can help with diagnosis and prognosis and allows personalised treatment. For instance, two recently developed technologies allow us to alleviate Parkinson's symptoms by targeting deep brain structures without invasive and expensive surgery. One is transcranial focused ultrasound for neuromodulation, and the second is transcranial temporal interference electrical stimulation.

These non-invasive techniques can also help to rehabilitate people who have suffered brain damage. While a patient is relearning a task, we can stimulate deep brain structures involved in learning and so significantly enhance the training.

Techniques like these open the way to new treatments that patients could use at home. To make this a reality quickly, however, all stakeholders — researchers, clinicians, patients, funders and insurers — need to collaborate. If, instead, we wait to complete basic research before developing clinical translations of that research, regulation and so on, it will be a long time before patients are able to benefit.

Hummel's team has also used transcranial stimulation for the cognitive enhancement of healthy people, enhancing their navigation of a virtual maze.

Friedhelm Hummel

Ariel Garten

Ariel Garten describes her company's brain-sensing headband Muse as "a clinical-grade EEG" designed for the average person to use at home. Before it went on sale to the general public in 2014, only trained staff in labs or clinics could use EEGs. By contrast, Muse is easy to put on, achieves a good signal in three minutes and displays its data on the user's phone. The aim is to use measurements of brain activity to improve both cognition and mental health. Early applications were in improving meditation and sleep.

Other companies have found further uses for Muse. These include Myndlift's cognitive training games and neurofeedback applications, brain-based musical selection apps, art experiences that morph with your brainwaves, EEGEdu's education tools and Healium's VR applications.

Over 200 published scientific papers feature Muse data, with thousands of scientists using the device to track brain activity in real-world settings. Researchers are studying thousands of individuals at once. Studies can continue for years, and what the researchers lose in sensor numbers or imperfect conditions they make up for in volumes of data. This allows the creation of large brain models like the large language models that AI uses. The scientific insights that such approaches can permit are staggering.

Hilal Lashuel noted that advances in brain sensors and neurofeedback have improved the responsiveness and personalisation of deep brain stimulation, an existing therapy for Parkinson's. Focused ultrasound, meanwhile, is one of the most effective treatments for tremors, and ultrasound can also open the blood–brain barrier to admit drugs. Looking further ahead, we are developing neurotechnology that may be able to discover what people with Alzheimer's are thinking and imagining, which could improve communication with them.

Technology's greatest potential, however, lies in the biomarker and health data that wearable tech can gather. This information will allow us to treat diseases such as Parkinson's and Alzheimer's at their very earliest stages, when we have the ability to prevent further deterioration.

Amy Kruse remarked that we have training and technology that allows people to enhance their psychological performance, but few have leapt the "chasm" that stops them from using and exploiting these things. A "breakout" form of neurotechnology, equivalent to the iPhone, has not yet emerged. She believes that a combination of education, personalisation — giving individuals the ability to use their brain data in the way they want — and effective data protection will help the neurotechnology field achieve its potential.

Jennifer French described the "dual valleys of death" where new technologies can fail to reach their potential. The first valley that a technology must cross separates the lab or a small group of users from the marketplace. This is the "chasm" that Kruse mentioned. The second valley of death lies on the path to widespread adoption, whether in clinics or the marketplace.

She also considered neurotechnologies for people with disabilities, such as neuroprosthetics and cognitive aids. She argued that technology developers too often leave user-centred design

until the end of the development process, when are creating user interfaces. Instead, they should collaborate with the community of potential users from the start. This will build trust in the technology.

In addition, we must think about building equity and inclusion early on: how will we deploy these technologies medically, what type of technical support will there be, and how will they be affordable? There is economic benefit as well as cost, however, because these technologies can help reduce the economic burden of neurological conditions.

Abandonment is another important issue. What happens to people who have used a technology as part of a trial when the trial ends? Post-market access is a related problem: what happens to someone with an implant when the company that made it goes bust? We need to develop systems that will avoid such problems.

Collaborative communities can help resolve these issues. They are continuing forums that bring together public and private sectors: researchers, scientists, clinicians, funders, regulators, advocacy organisations and people with lived experience collaborate to solve unanswered questions for the development and adoption of technologies.

Lynn Hanessian said that this approach aligns with trends in public trust in technology: while people may not trust institutions, they trust doctors, friends, family and others with whom they identify. Collaborative communities therefore lends credibility to the scientific process.

Ioannis Ghikas recalled a 2022 UN resolution stating that we must identify the dangers to human rights from neurotechnologies. He said we need an international regime to protect citizens worldwide from their misuse or trafficking.

He thought it unlikely that the whole world will benefit from these technologies. For instance, in the past 20 years productivity and GDP in the US has grown 30% more than in the EU. This is because the US system is friendlier to venture capital and innovation – and the tech gap will be much worse for many other countries. Furthermore, we must slow the brain drain from lower-income countries in order to level the playing field and ensure that different societies have technology that meets their peculiar needs.

Regarding equity and inclusivity, **Lashuel** argued that we need to make sure that our data is diverse and reflects the diversity of humanity. Otherwise, we are developing tools and drugs that will merely perpetuate inequality. In addition, no one is better at coming up with creative solutions than the people who need them. We should be thinking in terms of equal partnership with people in low-income countries, not providing a service to them. In addition, such people are sensitive to the perception that technology developers come to their part of the world only to test things for richer markets. That is why, beyond questions of finance, engagement with communities early in development is important. It gives them a true sense of partnership and of ownership.

Kruse argued that it would be better if small neurotechnology companies did not sell up to tech giants but instead grow as part of a specialist sector. Independence will allow them to build trust and effective privacy systems better than more broadly focused companies. This will make consumers more likely to adopt their technologies.

9 October 2024 · 15:30-16:00 CET

Anticipatory Briefing

Origins of Life

SPEAKERS

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Barbara Sherwood Lollar Professor in the Department of Earth Sciences at the University of Toronto, Canada

KEY MESSAGES

- Recent discoveries about microbes that live far underground could help us make vaccines that do not need a cold chain for transportation
- Such microbes also have a big potential in bioremediation: the use of biological processes to clean up pollutants
- Human activity far underground will increase within 5-year and 25-year horizons

SESSION RECORDING →

SUMMARY

About four decades ago researchers discovered "an entirely new type of microbial ecosystem" that does not rely on sunlight for energy. Such microbes live around hydrothermal vents in the deep, dark ocean floor and in continental rocks up to 3 kilometres deep. They are known as chemolithotrophs, which simply means "rock- and chemistry-eating" organisms, because they feed off reactions between water and rock. This process is called chemosynthesis, a previously unknown alternative to photosynthesis — the familiar mechanism that fuels life forms which get energy from light.

These discoveries mean that life on Earth may not have begun "in some warm little pond", as Charles Darwin suggested, but instead, said Sherwood Lollar, "in a warm little fracture" in rock deep underground, "isolated from what was a really hostile environment on our planet 4 billion years ago, when life first arose".

However, it is not yet clear when life first emerged in different environments, so it is still not possible to identify a most recent common ancestor — the evolutionary origin of all the species we know of. There is also no evidence that life began separately on the surface and below it: the subsurface microbes have the same basic DNA as surface life. Nevertheless, studies of deep, dark environments are yielding important insights into evolution. In 2010 teams diving in the Arctic Ocean found organisms at a hydrothermal vent that are a genetic missing link between single-celled and multicellular life forms.

Another major finding is that groundwater exists up to 4 kilometres underground, far deeper than we had thought. About 40 per cent of Earth's water is down there — and stays there. Some has not been at the surface for tens of thousands or millions of years, and in some places, even a billion years. This deep, "old" water is now known as the hidden hydrogeosphere. We have much to learn about what lives in it.

Barbara Sherwood Lollar

This new knowledge has practical uses. For instance, many deep, dark microbes are extremophiles — organisms living at extremes of temperature, pressure and salinity. Many vaccines, by contrast, must be kept within a narrow range of cold temperatures, which is a big challenge for the health services that store and distribute them. It could prove very useful, therefore, to understand how the proteins of extremophiles tolerate high temperatures.

Subsurface microbes also have a big potential in bioremediation, which is the use of biological processes to clean up pollutants. On the negative side, microbes cause corrosion or biofouling that hinders activities such as subsurface storage, including carbon capture and storage.

Sherwood Lollar described the main developments in the field of subsurface life that she expects within the next 5, 10 and 25 years.

5-year horizon: Human activity rapidly affects subsurface life. Some of this activity is extraction: taking out water, minerals and energy, for instance. Some is accidental injection, such as groundwater contamination. There is also intentional waste disposal, carbon capture and storage, and hydrogen storage for energy.

10-year horizon: Wider understanding of subsurface life on Earth widens the search strategy for life elsewhere: when studying exoplanet atmospheres for signs of life, astronomers no longer look only for oxygen, a tracer of photosynthesis. They also look for biosignatures of chemosynthetic processes like those found deep below Earth's surface. Long-standing international agreements for planetary protection — preventing the accidental contamination of extraterrestrial environments with life forms from Earth, and vice versa — prove inadequate as the private sector is ever more active in outer space and as exploitation of extraterrestrial resources rises up spacefarers' agendas.

25-year horizon: Climate change drives more extraction of minerals for making electric vehicles and of water. It also drives more injections for shale gas fracking and carbon storage.

9 October 2024 · 16:45-17:15 CET

Anticipatory Briefing

The Promises of Synthetic Biology

SPEAKERS

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Junbiao Dai Professor at the Agricultural Genomes Institute at Shenzhen Chinese Academy of Agricultural Sciences

KEY MESSAGES

- We are able to decipher genetic code far more rapidly and cheaply than was possible only 20 years ago
- Mass sequencing will reveal the genes that cause genetic disease. We can then use the CRISPR gene-editing technique to fix the genes and so cure the disease
- We will be create crops that yield more or more nutritious food, or microbes that grow faster, resist viruses or produce things that we want

SESSION RECORDING →

SUMMARY

We are able to decipher genetic code far more rapidly and cheaply than was possible only 20 years ago. The latest gene-sequencing machines can transcribe 6 terabytes of DNA sequences a day, equivalent to about 10,000 human genomes a year. By contrast, the Human Genome Project spent the years 1990 to 2003 sequencing a single human genome. It cost about $3 billion; now you can sequence your own genome for less than $1000.

As capacity has risen, so has demand. It is going up about 15% each year. In 2020 the global sequencing market was worth about $10 billion; in 2032 it will reach $40 billion.

In the future, it is possible that everyone in the world will get sequenced. Mass sequencing will reveal the genes that cause genetic disease. We can then use the CRISPR gene-editing technique to fix the genes and so cure the disease.

We can go further and write new genomes to provide operating systems for new organisms. This would allow us to repurpose or reprogram anything that is biological. For instance, we could make microbes grow faster or produce things that we want. We can make crop plants yield more food and more nutritious food. This approach could also solve problems that can occur when we transplant an organ from a pig to repair a human body. Without treatment the human immune system will recognise the pig organ as foreign and reject it, and pig viruses may infect the human recipient. We could avoid such problems by rewriting a pig genome to eliminate viruses and make the pig's immune system more like a human's.

Junbiao Dai

An example of success comes from the lab of Jason Chin at the Medical Research Council Laboratory of Molecular Biology in the UK. Viruses rely on a cell's own protein-making machinery to replicate, so Chin's team altered the genome of a synthetic bacterium to remove a redundant part that many viruses use. This gave the synthetic bacterium a "firewall" against viral infection.

Dai himself is part of the international Synthetic Yeast Genome (Sc2.0) Project. The yeast genome is larger than any that has been redesigned before, so the project aims to develop new tools and platforms for genome assembly. Applications of customised yeast genomes could include brewing, other products of fermentation and pharmaceuticals.

His team is also studying a desert moss that spends most of its life dried out but, once watered, resumes photosynthesis within seconds. They want to understand the genetic basis of its drought resistance, with the intention of transferring it to crops.

Ethics are important in such work. Dai's team always involves social scientists in planning their projects. They practise biocontainment to prevent synthetic organisms from escaping into the wild. Luckily, natural organisms have so far outcompeted every organism they have made in the lab.

Dai described the main developments in synthetic biology that he expects within the next 5, 10 and 25 years.

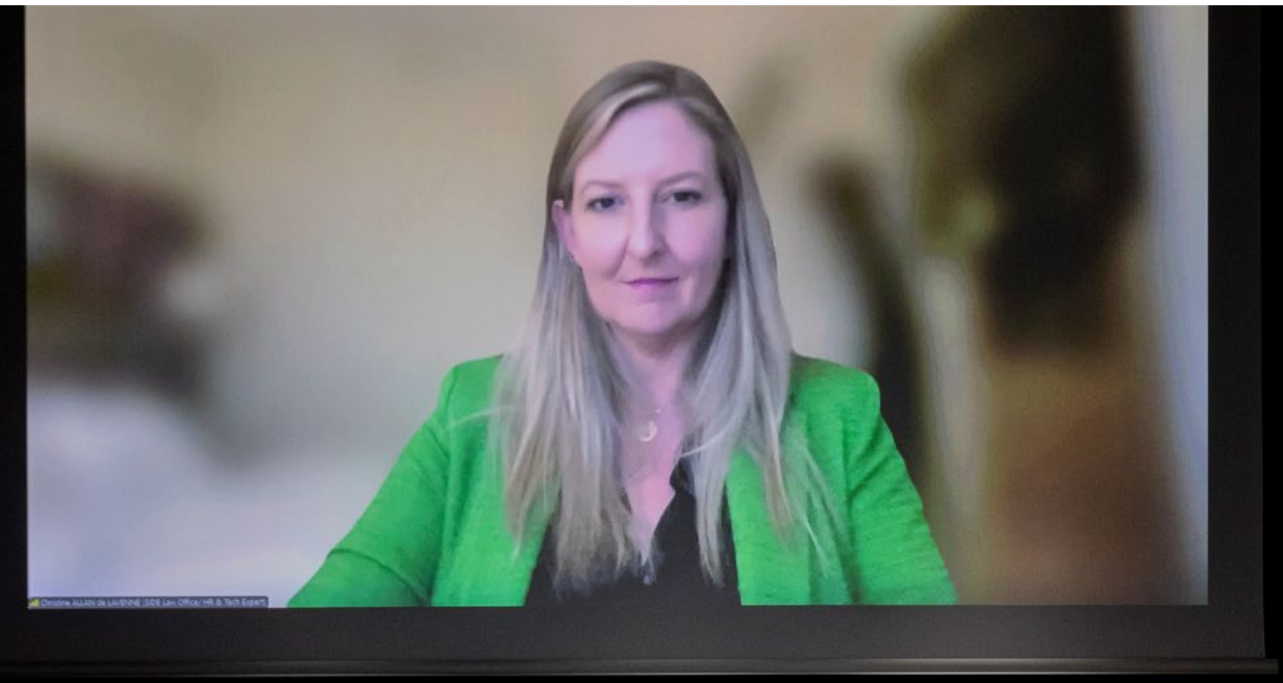
5-year horizon: High-throughput DNA synthesis technologies – chip-based synthesis and enzymatic synthesis, for example — mature. Large-genome synthesis projects become feasible as many companies provide cheaper DNA synthesis, with a 10,000-fold decrease in the price. The cost of resynthesising a human genome falls to about $300,000.

10-year horizon: Artificial intelligence can define the ancestral genome of an organism, allowing researchers to better understand the structures of the genome and to better control how it works. Many synthetic organisms are created: for example, crops that can survive drought, flood and extreme temperatures, and resist parasites and pests. Synthetic microbes help drug production and environmental remediation.

25-year horizon: Improved sequencing technology permits the de-extinction of recently extinct species such as the Yangtze river dolphin, using tissue samples.

9 October 2024 • 16:45-17:30 CET

Rethinking Intellectual Property Rights in the Age of Rapid Scientific Progress



SPEAKER

Moderator: **Jennifer Schenker** Founder and Editor-in-Chief of *The Innovator*, a global subscription-based publication about digital transformation and sustainability

Christine Allan de Lavenne Intellectual Property Attorney and Human Rights and Innovation Expert at SIDE Law Office

James Donovan Head of Science Policy at OpenAI

Ken Natsume Assistant Director General at the World Intellectual Property Organization

Anthony Taubman Former Director of the IP Division at the World Trade Organization

KEY MESSAGES

- It is not clear who is the author of what an AI produces, legally speaking
- We always have to balance the protection of a creator's IP — their incentive to create — with ensuring that people at large benefit from the technology they invent
- We should diversify IP systems to match the diversity of funding that we need for scientific progress

SESSION RECORDING →

SUMMARY

Christine Allan de Lavenne confirmed that the "right to science" is an agreed human right. Article 27 of the Universal Declaration of Human Rights defines it as the "right freely… to share in scientific advancement and its benefits"; article 15 of the International Covenant on Economic, Social and Cultural Rights asserts the same right. In addition, however, both articles protect "the moral and material interests resulting from any scientific, literary or artistic production of which he is the author".

Scientific progress and innovation would not happen if intellectual property (IP) did not exist, said Allan de Lavenne. The right to science would then be meaningless. The goal, therefore, is a balance between IP rights and the right to science, a balance that we can adjust to meet new realities. Sadly, many people — including some within the UN and other international institutions — have for decades seen IP as a mortal enemy of the right to science.

Anthony Taubman argued that we should not see the IP system in terms of human rights but instead as a tool. We must recalibrate this tool when a new wave of transformative technology hits us.

Artificial intelligence (AI) is one such wave, for which Taubman drew an analogy with the invention of photography. In the 19th century some argued that a photographer was not the creator of a photograph

Anthony Taubman

because they did nothing more than point and operate a machine — the camera. Some make the same argument about the authorship of the products of AI.

The lessons are, first, that we must study the impact of the new technology as it evolves. Second, we must debate the correct balance between protecting a creator's IP and ensuring that people at large benefit from the technology. No IP right is absolute.

Because we have not resolved fundamental questions about the nature of invention and originality, the issue is "bouncing at the moment between legislatures who don't want to touch it and courts that are forced to touch it". He noted the Thaler case, in which the UK Supreme Court ruled that an AI cannot be an inventor for the purposes of a patent. The case turned on the principle that an inventor must be a human. This principle will become harder to maintain if AIs start to outstrip human inventiveness.

Ken Natsume explained that the World Intellectual Property Organization hosts the public and academics to identify common ground and areas of disagreement in such issues. A meeting in November would discuss generative AI: can there be copyright for music or images that an AI creates? At present, different jurisdictions have different answers to this question. Some argue that there is human creativity in the prompts that the AI follows to make the end product. Others say that because the AI is a "black box", and no one can say how it makes the product, there is no human creativity involved.

James Donovan would like to see a diversity of IP systems to match the diversity of funding that we need for scientific progress. This can range from government grants to focused research organisations like the Arc Institute. We can attach different, more granular notions of IP to different problems and disciplines in order to incentivise the right people.

He argued that IP systems for AI need to permit licensing agreements that meet the needs of all stakeholders, both AI companies and users of their technology. AI is not exceptional in this regard, however. Although the 2024 Nobel prizes show that AI can be essential to some scientific breakthroughs, the same is true of other items of scientific infrastructure such as microscopes and particle accelerators.

As AI automates the process of science, said Donovan, the risk-reward balance starts to change. If the risk to individual scientists, companies or research institutions falls, the reward should change too.

Allan de Lavenne identifies the IP tools or "dials" we need as the "three Xs": exclusion, exception and expiration. Exclusions determine what and who IP does and does not protect. Exceptions allow for IP-protection barriers to be taken down in a health crisis, for instance. Expiration defines how long IP protection lasts. This is the backbone of IP: the temporary character of patent is the reason why this legal monopoly has survived.

In the exclusion field, the guiding principle has always been that IP protects what humans create,


Jennifer Schenker


Ken Natsume

not what they discover or reveal. This is why no one can appropriate laws of nature. Allan de Lavenne argues that the principle remains valid for AI: all the work that humans do to create AI tools should be patentable. All the work that humans do with the outputs of AI could also be protected. But the outputs of AI themselves would be outside the realm of IP.

When it comes to exceptions, Allan de Lavenne believes that compulsory licences must respond to globalisation by breaking national boundaries. In addition, they must reach beyond patents to such things as trade secrets and copyrights if they are to address the reality of what an innovation is today.

In terms of expiration, the acceleration of innovation means that we must revisit the average 20-year period. We should also address "bad practices" such as "improvement patents", which, in essence, allow a patent holder to renew it forever.

Taubman responded with another IP "dial": that of recognition, moral rights or attribution, which is part of the human rights framework. Still another "dial" is the application or management of technology. We need to look at strengthening incentives or creating more open licensing structures.

As an example of how not to do this, Taubman referred to 1980s debates about the appropriate IP protection for computer programs. Instead of innovating, the industry pretended that a computer program was the same as a novel. As a result, programs have the same way IP rights as literary works, with protection for the life of the author plus


James Donovan

70 years. We lost an opportunity to think outside the box, or at least to really push the "dials" to the limit. We should not allow that to happen with the next wave of technological disruption.

Looking up to 25 years ahead, **Donovan** would like to see a much clearer distinction between basic research – which must be done in the public domain — and applied research. He called for a proactive version of the GESDA Radar that covers IP incentivisation.

Taubman believes that IP can and facilitate technology partnerships. It is a way of getting financing and resources into not only scientific progress but also the development, application and diffusion of that knowledge and progress.

9 October 2024 · 17:30-18:15 CET

Progressing Pandemic Preparedness

Human Augmentation Highlight II

SPEAKER

Moderator: **Suerie Moon** Co-Director of the Global Health Centre at the Geneva Graduate Institute

Seth Berkley Senior Advisor to the Pandemic Center at Brown University in Providence, Rhode Island

Jennifer Cohn Director, Global Access, at the Global Antibiotic R&D Partnership in Geneva

Meret Gaugler Healthcare Investor

Andrin Oswald Director and Co-Founder of the Swiss Vaccines Initiative

KEY MESSAGES

- Mostly because of misinformation, one-third of people in the US did not receive any COVID-19 vaccine, and two-thirds got no booster. Growing nationalism is one of the biggest dangers to pandemic preparedness
- We are living through a renaissance in vaccine development
- At present antimicrobial resistance is leading to more deaths than HIV and malaria combined
- The US market does not reward the research and development of new antibiotics
- Chronic poor health made populations vulnerable to COVID-19

SESSION RECORDING →

SUMMARY

Seth Berkley noted that COVID-19 probably killed around 25 million people, who were about 1.5 per cent of everyone the virus infected. There is a 25 per cent probability that within 10 years another disease outbreak will cause a similar number of deaths. The probability of such an outbreak within 25 years is nearly 50 per cent. Moreover, many agents of disease have a much higher mortality rate than COVID-19.

We are not well enough prepared for another such pandemic. We are not investing enough money in preparation, nor are we making the changes we need in biological research, surveillance, diagnostic tests and interventions.

One big problem is that vaccination has become politicised. Mostly because of misinformation, one-third of people in the US did not receive a vaccine at all, and two-thirds got no booster. “Everybody’s entitled to their own opinion,” said Berkley, “but not their own facts.”

On the positive side, he said we are living through “a renaissance in vaccine development”.

Seth Berkley

Jennifer Cohn pointed out that antibiotics underpin much of modern medicine. Safe surgery and childbirth, and cancer treatment, require these medicines. A recent paper said that improving access to antibiotics could save 50 million lives over the next 25 years.

As bacteria evolve and develop resistance to existing antibiotics, however, we have more and more need of novel drugs. At present antimicrobial resistance (AMR) is leading to more deaths than HIV and malaria combined. By 2050 this death toll could have risen by 70 per cent. AMR has its biggest impact in


Jennifer Cohn


Andrin Oswald

low- and middle-income countries, where doctors can no longer treat “very basic infections” because they cannot prescribe the latest antibiotics.

The pharmaceutical industry is struggling to make new antibiotics available, said Cohn, and this will be a challenge for the next 25 years. At present, major pharmaceutical companies are abandoning research and development: often it is small and medium-sized companies that develop new antibiotics. These companies normally launch new antibiotics in the US market first, but often find that the drug is not commercially viable there. There are also shortages of manufacturing capacity.

Cohn argued that current remedies for these industrial ailments are misguided. They use either “push” funding such as grants and “pull” incentives such as “milestone” prizes. She believes that we need an entirely new access and R&D ecosystem.

This would include four main elements. First would be public-private partnerships that support small and medium-sized enterprises, including efficient systems for chemistry, manufacturing and controls. Many such enterprises do not have these.

Second is early licensing. This would decrease the risk of manufacturing bottlenecks. It would also permit joint launches in the US and in low- and middle-income countries. These latter countries form the largest market and have the highest burden of disease.

Third is market efficiency. We need to harmonise and consolidate priorities and pool procurement. These are things we’ve learned with HIV and tuberculosis vaccines.

Finally, this needs to be a priority at both national and regional levels.

Andrin Oswald outlined the plans of the Swiss Vaccine Initiative to widen access to vaccines in a pandemic. In such a situation we cannot rely on technology transfer to do this: there is not enough time. Even though the development of vaccines for COVID-19 was impressively fast, a year would be too long for a hypothetical virus with 5 per cent mortality in under-5s. As it was, we made 11 billion doses of COVID-19 vaccine in 2021 but just 1 per cent went to low-income countries.

The Swiss Vaccine Initiative aims to make bilateral agreements with other countries to immediately share knowledge and genetic code for nucleic-acid vaccines. We can make such vaccines in far smaller facilities than earlier technologies required: such a facility costs probably only a 10th of what it did five years ago. This means that smaller countries can each have their own facility, linked to their own universities. Indeed, by 2050 we could have such a facility in every city.

Long-term contracts with governments, and the falling cost of the technology involved, will make this approach economically viable.

Berkley noted that access to manufacturing is already widening. In 2000 there were five vaccine manufacturers, most of them in high-income countries; now there are 24, mostly in developing countries, and the largest manufacturing facility in the world is in India.

“Facilities alone won’t solve the problem,” he added. Only a few people have the skills needed to transfer technology, both on the giving and receiving sides.

Meret Gaugler


Suerie Moon

This is one concern of the CEPI 100 Days Mission, which aims to ensure that we can make a safe and effective vaccine against any viral pandemic threat within 100 days.

Meret Gaugler focused on population health. In the COVID-19 pandemic we learned how chronic poor health made populations vulnerable to the virus. Another lesson was the cost of vulnerabilities in healthcare systems. Private capital investors have seen how expensive these vulnerabilities are — expensive both in normal times and during a crisis. "People today focus a lot more on prevention" in both population health and healthcare systems, said Gaugler, "because they realise that the payback time on these doesn't need to be so lengthy. Innovation should mean you taking out cost."

Regulation needs to change. As an investor Gaugler recognises that technology already exists to both improve population health and combat AMR. The problem is that incentives are misaligned. Regulators can help by creating a framework for the periods within which investors can expect a return.

In the case of AMR, regulators should "set the bar for everyone to… make economically viable models for better means of detection", said Gaugler. With regard to the health of people at large, regulators should ensure that populations have access to fresh, healthy food and that we tackle immune diseases and excess body fat.

To cope with AMR we need longer-term incentives for slow-moving, iterative work. Overall we need a sliding scale of incentives, going from rapid-response investors who want a payback within five years through more patient, longer-term investors to philanthropic institutions and public money.

From his experience at Gavi, The Vaccine Alliance, and COVAX, **Berkley** saw the effectiveness of "zero-day" rapid funding for vaccine R&D and access.

An audience member suggested that, given the limited attention of policy-makers, we should not attempt to prevent every crisis and should accept that sometimes we will have to just react. Berkley argued that prevention is very important. He drew an analogy with armed forces: they must always think long-term and invest, plan and practise for future events.

We must also think globally, Berkley added, as we cannot tell where diseases will break out. Bilateral agreements are therefore insufficient. This requires a change of mindset: everyone must accept that "Nobody's safe unless everybody is safe." **Cohn** likewise said: "One of the biggest dangers to pandemic preparedness, and AMR included in that, is growing nationalism. We are going to succeed together or we're going to fail together."

9 October 2024 · 17:45-18:15 CET

Anticipatory Briefing

The Future of Archaeology

SPEAKER

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Sylvian Fachard Professor of Classical Archaeology at the University of Lausanne

KEY MESSAGES

- War, deforestation, urban expansion and global warming are threatening world heritage and archaeological evidence as never before
- Rapid and accurate virtual 3D modelling of artefacts, buildings and landscapes allows us to record monuments that are under threat of destruction
- The study of ancient DNA, proteins and climates will allow us to write chronicles of ancient populations, migrations, diets, food webs and climate going back thousands and millions of years

SESSION RECORDING →

SUMMARY

Breakthroughs in science and technology are revolutionising archaeology. They help us formulate new questions and insights regarding the societies that preceded us and the natural challenges they faced. These in turn reshape urgent problems we face now: long-term human resilience, climate change, disease, migration and the preservation of world heritage.

Archaeological research is itself urgent: war, deforestation, urban expansion and global warming are threatening world heritage and archaeological evidence as never before.

Recently, ancient DNA has led to major breakthroughs in this discipline. Genetic material from ancient human bones has yielded near-complete genetic sequences. In 2010 an entire Neanderthal genome was mapped for the first time, leading to the groundbreaking discovery that we modern humans share DNA with this extinct human species. In the past decade, researchers have sequenced the genomes of more than 10,000 ancient individuals and so revealed family relationships, kinship patterns and migrations.

Palaeoproteomics, the study of ancient proteins, now enables us to extract data from fragmentary remains, shedding new light on past diseases and diets.

Sylvian Fachard

Another breakthrough field is palaeoclimatology, the study of ancient climates. We can chart the deep history of rainfall and temperature from a range of proxy evidence: ancient pollen in lake sediments, minerals that groundwater has deposited in caves, ice cores from glaciers and polar regions, marine sediments and coral.

A third breakthrough is 3D laser scanning. This allows us to expose and record world heritage with unprecedented clarity, providing new insights into the history of architecture, technology and other forms of cultural achievement. It also saves a huge amount of time in field work. The technique now has a precision of under 1 centimetre for ancient buildings and is getting cheaper and quicker every year.

We're now using remote sensing with lidar — light detection and ranging using lasers – across the world. It allows us to locate ancient sites and monuments from the air and can also reveal illegal excavations and looting.

Fachard described the main developments in archaeology that he expects within the next 5, 10 and 25 years.

5-year horizon: We chart ancient lifestyles, family trees and population trends more comprehensively. New and improved proxies for ancient climates enable us to sample a wider range of them. Cheaper and more accessible sampling techniques allow palaeoclimate studies to cover previously neglected regions such as Central Asia and South America. Rapid and accurate virtual 3D modelling of artefacts, buildings and landscapes allows the wider sharing of knowledge. We use these techniques to record monuments that are under threat of destruction.

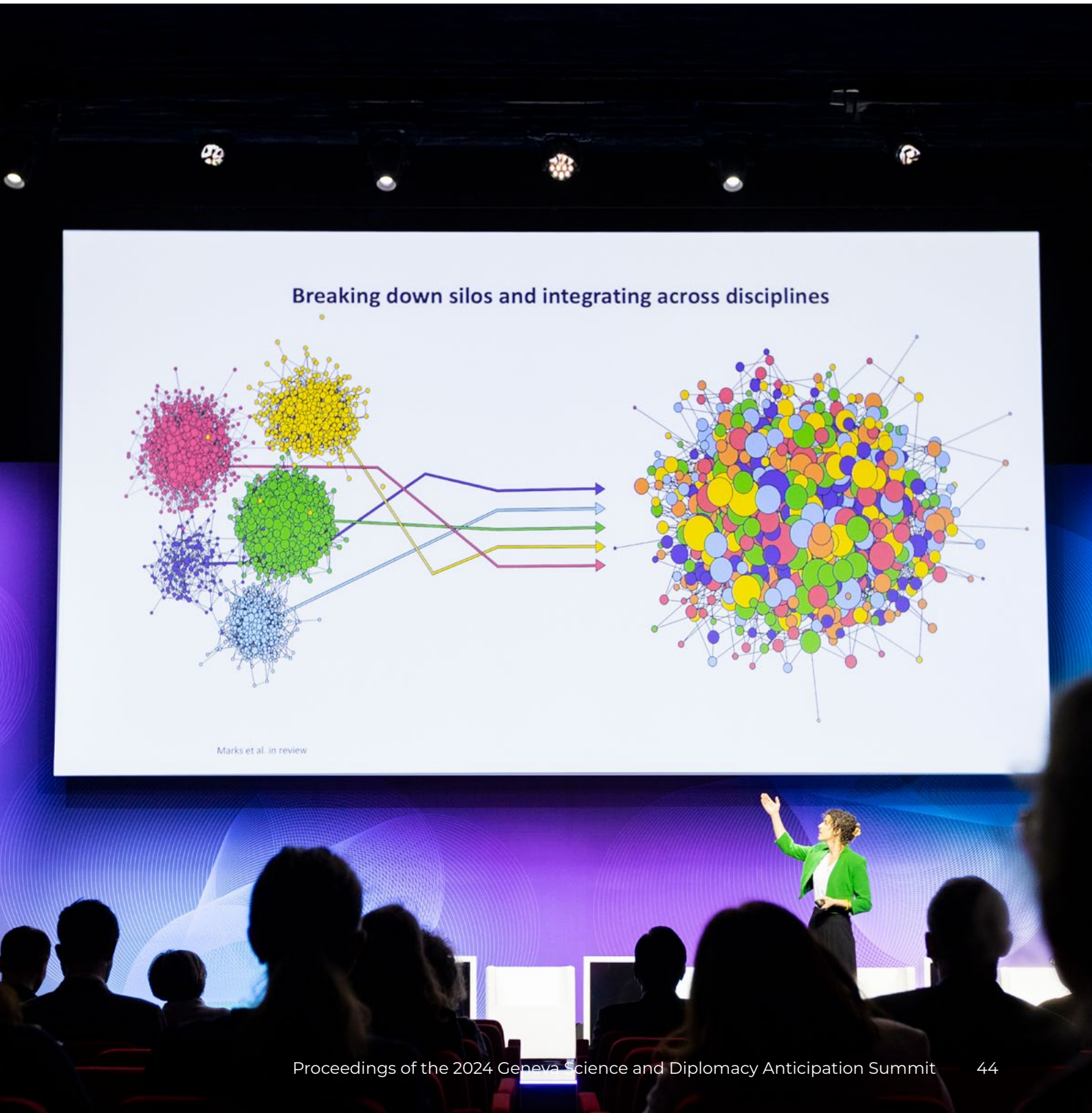
10-year horizon: DNA data improves estimates of ancient population sizes, interpersonal interactions and migrations. The number of ancient genomes decoded reaches 100,000. Global data banks make this information available widely. New knowledge of past diseases and diets, and how they affected our ancestors, helps us to prepare for future pandemics. Researchers routinely deduce past ecosystems and food webs from evidence including ancient DNA, palaeoproteomics and tooth wear. They standardise methods for assessing proxies for past climates, enabling reliable and systematic climatic reconstructions. Lidar with a resolution of 1 centimetre improves the study of ancient buildings in hard-to-reach areas. Photogrammetry allows us to construct virtual 3D models of such buildings, helping us to protect them, or even rebuild them after destruction. Artificial-intelligence systems trained in ancient languages can translate texts and complete those that are fragmentary.

25-year horizon: Researchers chronicle a global history of human disease. Ancient DNA analysis allows researchers to discover patterns of social change and write a history of global migration spanning thousands of years. The details of past ecosystems become clear. We have detailed records of global climate for the entire span of human evolution — from probably 7 million years ago to the present — allowing us to determine the many ways in which climate change has affected our species. 3D scans extend beyond the visible spectrum, revealing the composition of pigments and materials in soil. We are able to monitor from afar cultural heritage that is at risk of destruction. We establish a world bank of architectural models of important sites.

10 October 2024 • 9:15-10:30 CET

Climate Resilience and Food Security

Eco-Augmentation Highlight I



SPEAKER

Moderator: **Chris Luebkeman** Head of Strategic Foresight at ETH Zurich

Presentation: Rose A. Marks Assistant Professor in the Department of Plant Biology at the University of Illinois

Nam-Hai Chua Senior Investigator (Emeritus) at Temasek Life Science Laboratory, Singapore

Aisha Hadejia Partner at Sahel Consulting, Nigeria

Matthias Honegger Climate Interventions Program Director at ICFG – International Center for Future Generations

KEY MESSAGES

- Lead researchers from the Global North often do not involve local people in their work in the Global South, and as a result local people do not adopt products of the research
- We need to diversify our food sources. Humanity relies on just four crops — corn, wheat, rice and soybeans — for about 80 per cent of our food energy. All are under threat from "abiotic" stresses such as extreme weather
- Micronutrient deficiency is a big problem in the Global South
- European mistrust of genetically modified crops is denying us the benefits they can bring

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Rose A. Marks studies "resurrection plants", which become dormant to survive hot, dry, barren environments but spring back to life when rain comes. This work is of practical value as droughts are becoming more frequent and severe, ecosystems are collapsing, crops are failing, and species are disappearing.

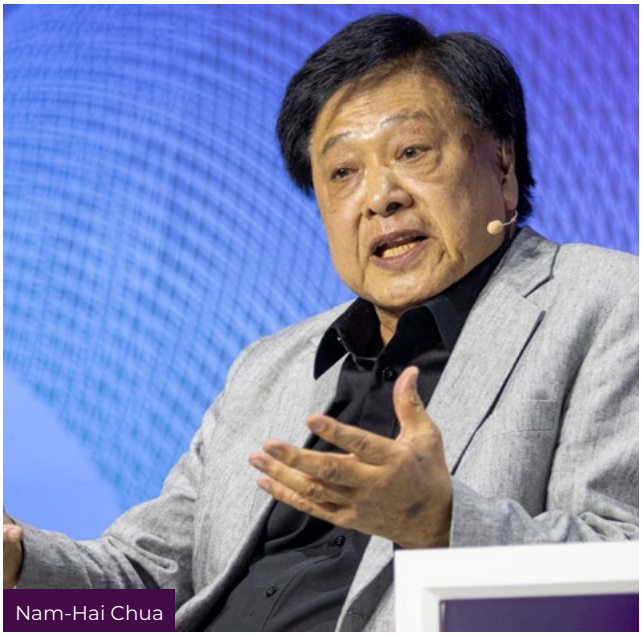
For example, we could have better techniques for "zero preservation" — the dry storage of biological materials. We are already using this with biological macromolecules such as RNA vaccines, eliminating the need for refrigeration and costly cold-chain logistics. If we can scale this up to whole cells and complex tissues, we can preserve embryos and perishable seeds. We could safeguard the genetic resources of endangered species and crops for future generations, revolutionising the conservation of biodiversity.

Rose A. Marks

If we could apply these techniques to whole organisms, we could achieve biostasis – the long-term preservation and suspension of life. This would have profound implications for medicine, agriculture and even interplanetary travel.

To counter drought, we need crops that can withstand unpredicted extreme weather. Marks and her colleagues are working to identify the key genetic features that enable desiccation tolerance in resurrection plants. However, there is a bottleneck that is significantly slowing the exploitation of this work: a lack of centres that specialise in transforming plants via genetic modification. Marks estimates it will be 10 to 20 years before farmers are growing crops containing the dessication-tolerance genes she is finding.


Aisha Hadejia


Nam-Hai Chua

The microbiome of resurrection plants is another promising area of research. Biostimulants and inoculants derived from these plants' microbes could improve drought tolerance in agriculture without the need for genetic modification. Marks thinks that products could come to market within five years.

To achieve these goals, we need more integration and exchange between the sub-disciplines that are working on dessication tolerance. An even greater challenge is that lead researchers often come from the Global North even though much of the world's biodiversity is the Global South. They often do not involve local people in the work, and as a result local people do not adopt products of the research. WALII, the Water and Life Interface Institute, aims to remedy these problems by building a global network of scientists in this field. We need funding opportunities that extend beyond science and beyond national boundaries.

Aisha Hadejia likewise called for research and production to be close to their end users. This allows for more ideas on appropriate design. She gave the example of a West African region where insurgents had been attacking communities for about a decade. Farmers there traditionally grew sorghum but stopped doing so because insurgents were using it to hide in: it grows well over five feet tall. Knowing this, researchers came up with a dwarf variety engineered to withstand the harsh local conditions. Not only does it offer no hiding place, it uses less fertiliser and water than traditional varieties. As a result, sorghum is gradually coming back into the area.

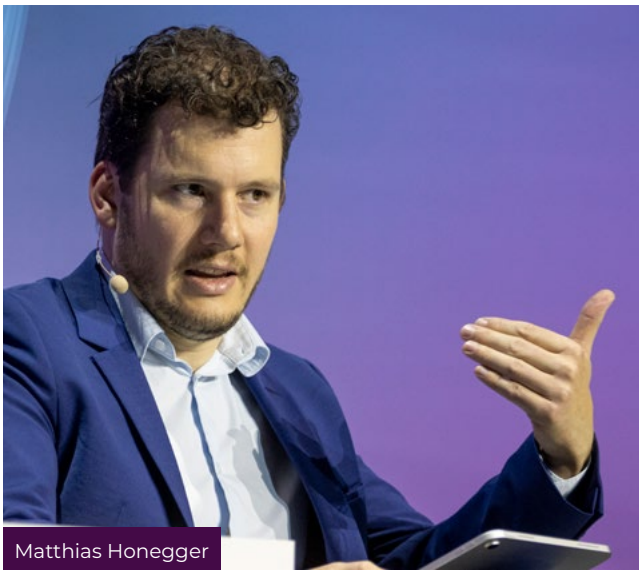
Hadejia also discussed her work in gender-responsive agricultural systems. She works to get more women's voices into the policy sector. This allows us to understand nuances in women's roles in agriculture from region to region and even within communities. Failure to take the social dynamics of food access and distribution into account weakens food security.

Looking globally, **Nam-Hai Chua** said that climate change is clearly affecting plant life, altering growing seasons and geographical ranges and causing huge price increases for some foodstuffs. Worse, humanity relies on just four crops — corn, wheat, rice and soybeans — for about 80 per cent of our food energy. All are under threat from "abiotic" stresses — problems other than pests and diseases, such as the extreme weather that climate change causes. We therefore need to diversify our food sources.

On that topic, **Marks** discussed "underutilised" or "orphan" crops: edible plants that farmers now cultivate only in small amounts in particular regions. Large-scale farming tends towards "monocropping", the cultivation of single, widespread crop varieties in enormous quantities. Many underutilised crops tolerate abiotic stresses better than mainstream crops, and also provide nutrients that many diets lack. Investment in breeding and farming underutilised crops could therefore improve food security and quality.

Ecological restoration is itself another important issue for food security, said Marks. Monocropping creates impoverished agricultural ecosystems. Marks argued that we need diverse agriculture that mimics natural ecology. This would make it resilient and sustainable.

Chua said that food security is not simply a matter of providing enough calories — although, **Hadejia**



Matthias Honegger

noted, this will always be the priority in a crisis. Alongside the “macronutrients” that give us energy — carbohydrates, protein and fats — we need small amounts of “micronutrients”, which are vitamins and minerals. Micronutrient deficiency is a big problem in the Global South.

For instance, about 150 million people there suffer from anaemia — iron deficiency. This has a transgenerational effect, because if a fetus and then baby does not receive enough iron in the first thousand days after conception, its brain will not develop properly. Meat is a good source of iron but cannot solve the problem alone. Another source is fermented food that contains fungus which accumulates minerals.

Another problem is vitamin A deficiency, which kills about a million people a year and leaves half a million children blind or near blind. To address this, biologists have modified rice genes to make “golden rice”, which contains a precursor of vitamin A. European regulators have not approved it, however, because of concerns about genetically modified organisms (GMOs).

Hadejia argued that trust is the key to persuading people in the Global North to accept GMOs. We need better policies to safeguard the use of these organisms, so that people can rest assured that they are not going to get out of hand.

Hadejia also highlighted the potential of synthetic biology for improving soil health. We need soil microbes that can adapt quickly to suppress pathogens, fix nitrogen and sequester carbon as both climate and soil itself change. This could allow farmers to use biopesticides in place of chemical pesticides, thereby promoting more balanced ecosystems. **Chua** mentioned researchers working in Granada, Spain, who have isolated bacteria that produce plant stress hormones, helping olive trees tolerate drought.

Matthias Honegger said that we lack clear and specific predictions and estimates of the local and regional effects of climate change, and that this makes it hard to develop policy.

10 October 2024 • 11:00-11:30 CET

Anticipatory Briefing

Food Systems

SPEAKERS

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Benedetto Marelli Associate Professor at the Massachusetts Institute of Technology

KEY MESSAGES

- Bionanotechnology will allow us to engineer crops and livestock, design better ecosystems and create new types of foods
- Nanosensors will help us to better understand how ecosystems work and how we can preserve them
- Biopesticides and biofertiliser will replace synthetic pesticides and fertiliser

SESSION RECORDING →

SUMMARY

Benedetto Marelli showed the audience a strawberry coated in silk. Not a silk textile, but a continuous skin that formed after he sprayed a suspension of silk in water — "liquid silk" — onto the fruit. A bioplastic membrane formed when the water evaporated. It has no holes and is tasteless, odorless, transparent and colourless. It protects food in three ways: it keeps oxygen out, preventing browning; it keeps water in, maintaining weight and therefore value, and extending shelf life; and it slows the growth of microbes that cause food to decay.

Coating food in liquid silk will allow hauliers to pack more of it on trucks and so decarbonise its transportation. It can also reduce the rejection of food that doesn't look good. Twelve nations with more than 1.1 billion inhabitants have approved silk coatings on food; the next step is to commercialise the technology.

This is an example of the bionanotechnology that will be very important in feeding the future world population of 10 billion — 2 billion more than our present number. The idea of bionanotechnology in the context of food is likely to alarm people, however. We therefore need new policies to regulate bioengineering, and we need to foster public acceptance of it across the world.

Bionanotechnology will have three main applications in agri-food systems. It will allow us to engineer crops and livestock. It will allow us to design better ecosystems, in which agriculture is a part of the ecosystem, not an antagonist to it. And it will allow us to create new types of foods.

Particular products of bionanotechnology will include nanosensors that will help us to better

Benedetto Marelli

understand how ecosystems work and how we can preserve them. Others will be biomaterials like liquid silk that can replace current plastics. Bionanotechnology will also make fermentation possible at scale, using microbes to produce synthetic food.

We will engineer organisms and communities of organisms to increase food production. For instance, biofertiliser microbes are already commercially available. They work well in marginal land where crops do not have enough phosphate and nitrogen. Such engineering does not necessarily involve genetically modified organisms.

Marelli described the main developments in food systems that he expects within the next 5, 10 and 25 years.

5-year horizon: Biofertilisers in the form of microbes become more prominent in the market and more effective. Researchers start to improve photosynthesis. Nanosensors monitor soil and pollinator health everywhere, producing vast amounts of data on how ecosystems work. Nanosensors made from biopolymers cause less harm to the environment. We begin to develop genome-editing tools that help different ecosystem components to work together. Vertical farming — growing crops in stacked structures — increases. Biomass fermentation — using microorganisms to produce nutritional elements like carbohydrates, fats and proteins — reaches the market. We make progress in developing "sentinel plants": plants grown on farms that are not for eating but rather are packed with nanosensors that report on threats and stresses to neighbouring crop plants.

10-year horizon: We enhance photosynthesis in plants. Biopesticides such as RNA vaccines replace synthetic pesticides. Cimate change allows pests and diseases to spread into new regions. We engineer livestock and their feedstock to reduce the carbon intensity of meat production. Cropless agriculture uses carbon dioxide to form carbohydrates that we feed to bacteria to make food for humans. Global rules protect pollinators. We increase our engineering of soil microbes to help ecosystems and biodiversity, and to boost agriculture. Synthetic meat and fish taste like the real thing. AI gene-editing tools help to reduce greenhouse gas emissions from food production.

25-year horizon: We have new cereal strains, including perennials. Many people eat synthetic meat. We monitor ecosystems closely using nanosensors. We integrate agriculture into ecosystems, using microbes that we have designed. Nanocarriers deploy precisely any synthetic pesticides and fertilisers still in use. We use fermented proteins as medicine in personalised synthetic diets.

10 October 2024 • 9:15-10:30 CET

Governing Space's Next Frontier to Benefit All

SPEAKER

Moderator: Alok Jha Science and Technology Editor at *The Economist*

Lindy Elkins-Tanton Principal Investigator for NASA Psyche mission at Arizona State University

Tanja Masson-Zwaan Assistant Professor at Leiden University in The Netherlands

Carole Mundell Director of Science at the European Space Agency

KEY MESSAGES

- Space debris and congestion is the most immediate challenge for governance
- Private, non-state actors have become far more significant: one company, SpaceX, owns half of all functioning satellites
- We must respect the investments of commercial space pioneers while ensuring that we don't see a "gold rush" that drives inequality
- Space provides a narrative of inspiration

SESSION RECORDING →

SUMMARY

Lindy Elkins-Tanton highlighted some of the developments in outer space that we can expect. There will be new and improved space stations. We are likely to see settlements on the Moon: this is where some of the sharpest national competition is happening. A lot of companies are planning to extract minerals from near-Earth asteroids, and we may see progress in this soon. However, we are not close to settling on Mars. If humans ever do this, it will be a long way in the future.

Extractive industries in space would face inevitable challenges. Earth's gravity well, for instance, is a big obstacle. As a result, it very expensive to bring things from space to Earth. If we extract resources in space, we will probably use them in space too.

We must also bear in mind that extraterrestrial geology is not the same as Earth's. Most metal ores on Earth exist because of processes involving water. No such processes have happened on the Moon: the water there is just frozen in craters.

Tanja Masson-Zwaan explained the law of outer space. Nation states treat space as a global commons beyond national jurisdiction, like Antarctica or the high seas. Five international agreements govern it, and most states have signed them. These agreements rely on individual states to

Lindy Elkins-Tanton

enforce them: when someone launches something into space, a state must authorise and supervise what they are doing. They decree that no one can own outer space: if someone establishes a mine on the Moon they cannot claim to own that part of the Moon's surface or interior. **Carole Mundell** noted that there is no way to enforce laws or agreements in space.

All the panellists believed that the public does not appreciate how much we interact with space in our everyday lives — satellite navigation systems being the ubiquitous example. Satellites also help us to observe everything from armed conflicts to climate change, agriculture and natural disasters. **Masson-Zwaan** pointed that we will not reach most of the Sustainable Development Goals without using space technology. And many people do not realise that humans have been present in space continuously for 20 years.

Elkins-Tanton argued that space debris and congestion is the most immediate challenge for governance. There is a risk that we could become "entombed" on Earth within "a cloud of space debris", as **Mundell** put it. We need ways to move redundant space hardware out of orbits where it can do damage, said **Elkins-Tanton**. Work is afoot to develop such technology, but we also need rules for space traffic management. And if a collision occurs, it will be unclear who is liable for any damage.


Tanja Masson-Zwaan

Elkins-Tanton believes that anti-satellite weapons tests have been the worst example of the failure of space ethics and law. **Mundell** also emphasised the threat of space war and argued against developing the technology that would enable it.

Masson-Zwaan said that the membership of the UN's Committee on the Peaceful Uses of Outer Space shows how widespread access to space has become. The committee formed shortly after the first satellite launch in 1957, with members from 18 states; now the states number 102. Only a handful are able to launch satellites into orbit, but many more are able to establish a presence in space as the cost of those launches has plummeted — largely thanks to reusable rockets — and as satellites themselves have become smaller. **Elkins-Tanton** pointed out that five nations have now landed spacecraft on the Moon. Private, non-state actors have also become far more significant, said **Masson-Zwaan**. Indeed one company, SpaceX, owns half of all functioning satellites.

Elkins-Tanton said that the resources of outer space could fuel an unprecedented creation of wealth. The extreme inequality that we see now will be nothing compared with what could happen. We must all, therefore, make sure that everyone is included in the exploration of space. **Masson-Zwaan** believes it is essential that we hear the voices of civil society and Indigenous people.

Elkins-Tanton pointed out that an additional advantage of extracting minerals in space and moving other dirty industries off-world too is that it would spare the fragile environment of Earth from further damage.

Mundell said that international consensus across all entities involved is the solution to the governance of space. To this end **Masson-Zwaan** co-founded The Hague International Space Resources Governance Working Group. It brought together government representatives, engineers, scientists, ethicists and lawyers and came up with "building blocks" for the governance of space resources, which it submitted to the UN in 2020. The UN has in turn created a Working Group on Legal Aspects of Space Resource Activities.

The UN's recent Pact for the Future acknowledges that we must listen to non-state stakeholders in space exploration — something that many multilateral organisations are reluctant to do, safeguarding their traditional role as a body of states.

Masson-Zwaan believes that regulating the extraction of space resources will be contentious. The challenge is to respect the investments of pioneers while ensuring that we don't see a "gold rush". The UN is talking about this issue and some countries have established relevant national laws, which can be a stepping-stone to international agreements.

Mundell explained how the European Space Agency (ESA) works. It is the only space agency that brings together multiple nations, with 23 member states. It also collaborates with private companies of all sizes to grow the space industry across Europe. ESA supports small enterprises across "the valley of death" to reach commercial viability and win contracts with other agencies such as NASA.

ESA focuses on sustainability and life-cycle analysis of its spacecraft. It has a zero-debris charter that drives technological choices all along its supply chain. **Masson-Zwaan** agreed that industry is concerned about sustainability, recognising that orbiting junk could shut us out from space completely.

Elkins-Tanton believes that "one of the things that space does for us is it gives us a narrative of inspiration and hope when we're surrounded by narratives of fear and narratives of guilt". **Mundell**, too, sees "this huge inspiration of deep space, of how we have to push our knowledge and our capabilities to operate in these incredibly extreme environments [and] come back and benefit how we do things on Earth". **Masson-Zwaan** also finds hope in space exploration, pointing out that it is by nature collaborative: most spacecraft contain instruments from several countries, and space is the only place where countries that are at war can still cooperate.

Masson-Zwaan highlighted the importance of telling the story of how space can help us solve problems on Earth. **Mundell** is optimistic because of what she learned from working with ambassadors in very difficult environments. Sometimes when progress seems impossible, a human-to-human connection makes it possible. She encouraged the audience to make such connections to further the interests of everyone rather than individual advantage.

Carole Mundell

10 October 2024 • 11:00-11:30 CET

Anticipatory Briefing

Preparing for Quantum Computing

SPEAKERS

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Sabrina Maniscalco Professor of Quantum Information, Computing, and Logic at the University of Helsinki, Finland; CEO and Co-Founder of Algorithmiq

KEY MESSAGES

- The marriage of quantum computing and AI will bring big changes, for instance, in simulating new drug molecules
- We already have "post-quantum" cryptography, which should be immune to quantum-computing attacks. Nation states are now adopting this
- Applications of quantum computing that have industrial relevance will appear within 10 years

SESSION RECORDING →

SUMMARY

All computers, whether quantum or "classical", work by processing and manipulating information through algorithms. The difference with quantum computers is that they work with a logic that exploits the quirks of quantum physics.

In classical computing, the fundamental unit of information is the bit, which is binary: its value in computer code is either 0 or 1. In terms of electric current, the corresponding states are "off" or "on". The quantum version of the bit, the qubit, can be 0 and 1 at the same time, thanks to a counterintuitive quantum phenomenon called superposition. Another quantum phenomenon that quantum computers exploit is entanglement, a strange correlation between different atoms or subatomic particles.

Quantum computers already exist — you can use them via the cloud — although they are not yet commercially useful. One important current development is the integration of quantum computers with classical supercomputers, also called high-performance computers. These are two different kinds of computing but each does not exclude the other.


Sabrina Maniscalco

The marriage of quantum computing and AI, meanwhile, will bring big changes. In chemistry, for instance, AI has great potential for simulating new drug molecules. However, machine learning needs to have datasets for its training, and very often its output is only as good as the training data. If we want to simulate molecules that are very different from the biological molecules that exist today, using machine learning alone can cause problems. Another difficulty is that AIs function as "black boxes", which means that it can be hard to explain

their results. Furthermore, machine learning can use a lot of energy, making sustainability a problem too.

Quantum computers, on the other hand, are naturally able to simulate molecules. Molecules are quantum objects, and so quantum computers can simulate them from first principles, without training datasets. This makes quantum computing a good partner for AI in simulating new molecules. The technology is at an early stage and so is prone to errors at present. But the complexity of simulations is expanding gradually towards commercial and industrial value.

Perhaps the most famous possible use of quantum computers is codebreaking. In theory, quantum computing could crack the most common forms of digital cryptography, threatening national security and much else. However, we still do not know if quantum computers will fulfil their theoretical codebreaking prowess in practice. Even if they do, we already have "post-quantum" cryptography, which should be immune to quantum-computing attacks. Nation states are now adopting this.

Another answer to this issue is to level the playing field by ensuring that all countries have access to quantum computing. The Open Quantum Institute is working to that end, as is the International Centre for Theoretical Physics, a UNESCO institute that supports scientists from the Global South and gives them access to the latest technology.

Maniscalco described the main developments in quantum computing that she expects within the next 5, 10 and 25 years.

5-year horizon: Integration between quantum computers and high-performance conventional computers continues in both hardware and software. Hardware providers work with end users and software developers to co-design algorithms. First prototypes of error-corrected, fault-tolerant quantum computers appear. Error-mitigation algorithms enable more complex simulations for niche uses. Applications develop in chemistry and material science. Simulations of molecules from first principles provide datasets for training AI. One or a few hardware and software providers gain massive pricing power.

10-year horizon: Quantum computers have many hundreds of thousands of qubits. Complexity of quantum algorithms grows, enabling applications that have industrial relevance. The quantum-computing market exceeds $50 billion. Chemistry algorithms transform materials science. Quantum algorithms that can simulate subatomic particles lead to breakthroughs in high-energy physics. AI and quantum computing come together in drug discovery, drastically reducing the cost and time we need to bring drugs to market. We find applications for error-corrected quantum computers.

25-year horizon: Very powerful error-corrected quantum computers with millions of logical qubits are routinely available via the cloud. Many financial institutions are using quantum computers. The market is worth $1 trillion to $2 trillion or more. Medicine and pharmaceuticals remain important applications, resulting in better health, wellbeing and longevity worldwide.

10 October 2024 • 13:45-14:45 CET

Bridging Science and Diplomacy for the Future of Corals

Eco-Augmentation Highlight II

SPEAKER

Moderator: **Muriel Siki** Journalist

Introduction: Alexandre Fasel State Secretary at the Federal Department of Foreign Affairs, Switzerland

Tamaki Bieri Chief Operating Officer at Coral Gardeners in Moorea, French Polynesia

Emma Camp Team Leader of the Future Reefs Program at the University of Technology Sydney, Australia

Fanny Douvere Head of the World Heritage Centre's Marine Programme at UNESCO

Kristen Marhaver Project Director and Associate Scientist at The Marhaver Lab of the CARMABI Foundation, Curaçao

Anders Meibom Professor at the Laboratory for Biological Geochemistry at EPFL, the Swiss Federal Institute of Technology in Lausanne

KEY MESSAGES

- The best way to protect coral for the future is to establish marine and land reserves
- We need easy-to-use technology for monitoring and conserving coral
- The groups working to protect coral are scattered and disconnected: we need an overarching organisation that brings together scientists and local people

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Anders Meibom said that the world's coral has halved in the past 40 years. Global warming is the main culprit: as temperatures rise, corals die. **Kristen Marhaver** said people studying significant reef-building corals in the Caribbean have seen no juveniles in decades. Corals also suffer from pollution and fishing. **Meibom** said that industrial fishing can cause immediate devastation, but artisanal fishing can also cause substantial damage, "a death by a thousand cuts".

The loss of coral reefs and their ecosystems will have harmful side effects on land. Hundreds of millions of people rely on seafood that will be scarce in 25 years. Reefs reduce the impact of big waves on coastlines: we will miss that protection as climate change fuels worse and more frequent storms. In many places, a tourism economy will lose the marine life that is a star attraction. **Emma Camp** argued that the loss of corals is also a loss of human rights, as these include the right to a healthy and sustainable environment.

Anders Meibom

Alexandre Fasel summarised the achievements of the Transnational Red Sea Center, which Switzerland has supported throughout the five years it has existed. **Meibom** said that the institution has two jobs: research and new technology to help to monitor and protect the coral; and diplomacy to facilitate the collaboration between states that is essential for this protection.

Camp argued that the protection and restoration of corals needs a variety of approaches. These can span from geoengineering — such as brightening clouds to reduce the light stress on corals — to growing and planting corals at key sites. To that end, **Marhaver**'s

team is trying to work out how to get corals to reproduce in the lab. Other techniques, **Camp** said, include assisted evolution, in which we influence natural evolution to breed corals that can tolerate higher temperatures.

The goal of all these interventions, **Camp** said, is to buy time for the reefs to recover between stress events. Ultimately, however, we must tackle climate change itself. We cannot market the interventions as if they alone will save reefs.

Marhaver said that the best way to protect the future of corals is to set aside big stretches of land and marine reserves and ban their development in perpetuity. The purpose is to buy us time to create biobanks from which we can breed corals in future. With more money, she said, she would want boats and guns to keep people away.

Fanny Douvere called for no-take zones and seasonal closures in the places that are critical for the integrity of an ecosystem. She said that the UNESCO World Heritage List includes 29 coral reefs — around 15 per cent of the global total. This means that each reef is not the responsibility of its home country alone. For instance, UNESCO has been working with the government of Australia for 15 years to protect the Great Barrier Reef, the world's largest and most diverse coral ecosystem. It has no mandate to address the threat of climate change, but it can bring interests such as fishing, shipping and tourism together with NGOs, donors, government and local communities, not to mention international companies at work around the reef. It also helps the government to prioritise its actions, legislation and policies to defend the resilience of the reef.

UNESCO's work has concrete outcomes. In Australia, the 2022 climate act effectively stopped almost a decade of climate wars. The government has also invested over $500 million to improve water quality.

Douvere introduced the idea of the "debt-for-nature swap". This is becoming a big movement in younger countries such as Belize and Ecuador. A debt-for-nature swap restructures national debt while reserving money for nature conservation. In Belize UNESCO worked with the government to draw up a clear, prioritised plan for protecting and strengthening the Belize Barrier Reef, the second-largest reef system in the world. The plan was adopted as part of a debt-for-nature swap that is now bringing tens of millions of dollars a year into the conservation of the reef.

Fanny Douvere

Tamaki Bieri

Tamaki Bieri explained how local people can lead the restoration of coral reefs, basing their work on science. Her organisation, Coral Gardeners, uses social media to reach younger global audiences "to make coral reef restoration sexy". It also bridges the gap between the cutting-edge research work that big institutions do and what local communities need. **Meibom** agreed that "we need to get [technology] out of our labs". Coral Gardeners takes well-proven techniques and makes simple tools that anybody with a little training can use, said **Bieri**. For instance, it has a simple iPhone app that people can use underwater to record the state of a reef.

Coral Gardeners also talks to local fishing communities to recruit their knowledge and involve them in conservation work. **Meibom** acknowledged that people rely on artisanal fishing for their food and livelihoods, and that fishing can also be an important part of cultural identity.

Meibom agreed that the groups working to protect coral are scattered and disconnected. He proposed "a CERN for coral reef protection". **Camp**, too, said that we need an overarching organisation to bring together scientists and local communities around the world to share knowledge.

Bieri said that one problem for local initiatives is that many big funders such as the Global Fund for Coral Reefs or CORDAP are most comfortable working with scientific institutions. Furthermore, big funders often assume that a scientific institution will devise a project and then look for a local partner to implement it. There is little incentive for the scientists to ask local communities what they need.

Camp's team took a different approach when they set their research questions, basing them on conversations with local communities. This requires trust between scientists and local people. Camp called for coordinated funding that communities and academics can collaboratively access. She added that her team has to be sure that the money it accepts is ethical and not "greenwashing". Otherwise, it puts at risk the community engagement they have worked hard to build.

Marhaver recounted how a bank invited her to help choose recipients of their conservation financing. She told the bank she was uncomfortable about how much money it was making from coastal construction. It did not reply. "They ghosted me because they were too uncomfortable with that disconnect," she said.

Marhaver said that "even us in the ivory tower" find it difficult to work with donors. For instance, a donor may abruptly stop funding work on corals. Donors also load recipients with excessively onerous requirements for project specifications and accounting.

Local organisations need revenue-generating business models, said **Bieri**. Coral Gardeners also works in ecotourism, for instance, so that it does not rely on philanthropy and public funds alone. **Douvere** said that it is often a visit to a reef that leads a donor to invest in conservation.

10 October 2024 • 15:00-15:30 CET

Anticipatory Briefing

Made in Space

SPEAKERS

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Debbie Senesky Associate Professor of Aeronautics and Astronautics at Stanford University, California

KEY MESSAGES

- We can make bigger and better semiconductor crystals with fewer defects in orbit than we can on Earth
- Non-silicon semiconductors, optical fibre, biomaterials, biomedicines and complex metal alloys are also promising candidates for in-orbit manufacturing
- The cost of delivering a payload to orbit will fall to around $10 per kilogram in 25 years

SESSION RECORDING →

SUMMARY

From the Copper Age to our present "silicon age", our ability to control basic physical phenomena has changed what we can make and therefore what our civilisation can do. Such phenomena have included temperature, oxidation and vacuum. Our ability to go into orbit and so to control gravity may be what defines the next "age", that of AI and quantum computing.

Satellites in orbit, and everything inside them, experience microgravity. If an astronaut releases water in orbit, it spontaneously forms a floating sphere. It holds together as an object without a container, which means that a liquid in microgravity need not touch any other material. Furthermore, in microgravity there is neither buoyancy nor sedimentation. Nothing will float on top of a liquid nor will anything sink to its bottom because there is no top or bottom. For the same reason, there are no convection currents within a liquid in microgravity: warmer liquid does not rise nor colder liquid sink. Instead, heat spreads through the liquid by diffusion alone. Microgravity, therefore, suppresses a lot of the phenomena that cause problems when we are making materials on Earth.

Debbie Senesky

Experiments have shown that we can make bigger and better semiconductor crystals with fewer defects in orbit than we can on Earth. This is useful in itself but could also help us surpass a limit that is inevitable with our current silicon chips. As we make smaller and smaller transistors with silicon, power density creates overheating. This limits the potential computation speed of silicon chips. Other materials, such as diamond, silicon carbide and gallium nitride, could perform better. It is hard to make these on Earth because defects arise and we cannot grow them in very large formats. But we may build the AI supercomputers of the future from advanced non-silicon materials like these, made in space.

In-orbit manufacturing could also shorten supply chains for computer chips. At present, a silicon wafer may travel thousands of miles across the world, from wafer growth to printing and patterning. We could shorten that chain by moving some of those processes up to low Earth orbit, which is only 250 miles up.

Glass fibre is another material that we may be able to make better in orbit, with more efficient optical semiconductors as a result. Biomaterials, biomedicines and complex metal alloys are also promising candidates for in-orbit manufacturing.

Senesky described the main developments in the exploitation of outer space that she expects within the next 5, 10 and 25 years.

5-year horizon: The cost of delivering a payload to orbit falls below $1000 per kilogram. The International Space Station is decommissioned. Private companies such as Blue Origin may deploy space stations. Tourism may be one of their applications. These space stations may have modules dedicated to manufacturing. Commercial supply chains may have a link in orbit.

10-year horizon: An in-space manufacturing economy requires reliable launchers to bring materials and people up to low Earth orbit. Satellite stations must be able to raise or lower their orbits reliably. Assembly of products may take place in orbit. We may mine asteroids, extracting important and valuable minerals that we would use on Earth. We require a lot of work and investment in re-entry technology to bring materials and products back to Earth. Such products may include non-silicon semiconductors for use in AI and quantum computing.

25-year horizon: The cost of delivering a payload to orbit falls to around $10 per kilogram. Cost is no longer an issue for growing materials in space. The in-space economy may extend from low Earth orbit to the Moon, Mars and beyond. This requires reliable communication. We also need autonomy, which means innovation in spacecraft and robotics. We need to find out how to sustain human life in unfamiliar environments, such as those on Mars. We need policy to control access to outer-space resources.

10 October 2024 • 15:15-16:15 CET

Harnessing Quantum for All

Data Augmentation Highlight

SPEAKERS

Moderator: **Enrica Porcari** Head of Information Technology Department at CERN

Opening remarks: Sandro Giuliani CEO of GESDA

Graham Alabaster Chief Geneva Office of UN-Habitat

Anousheh Ansari CEO of XPRIZE

Mourad Beji Chief Software Officer of the quantum-computing company Pasqal

Lidia Brito Assistant Director-General for Natural Sciences at UNESCO

Anna Fontcuberta i Morral Incoming President of EPFL, the Swiss Federal Institute of Technology in Lausanne

Closing remarks: Fabiola Gianotti Director-General of CERN

KEY MESSAGES

- Quantum computing can help access to basic services in the Global South
- Private companies benefit from collaborating to solve societal problems
- Bridging skills and knowledge gaps in quantum computing across the world is a priority

SESSION RECORDING →

SESSION RECORDING →

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SUMMARY

Sandro Giuliani noted that GESDA had launched the Open Quantum Institute (OQI) a year earlier. On 4 March, CERN took over operational responsibility for the institute and started a three-year pilot implementation phase. Since then the institute has worked on two of its four objectives: to develop use cases and to develop educational tools. The other two objectives are open access to quantum technology through partnership with industry and facilitating the development of multilateral governance.

The OQI is part of GESDA's Quantum for All initiative. GESDA is also interested in bridging the perspectives of commerce and of society in this field.

An **OQI video** outlined a use case that the institute is prioritising: the improvement of access to fresh water. Climate change and ageing water infrastructure threatens to cause global water shortages. Leaks, old infrastructure and illegal use halve the water supply in many cities. If we could put leak detectors in the right places, we could stop leaks more effectively. To do this, we can model a city's water pipe network in a computer, but the more complex the water system, the harder this task becomes for classical computers. Quantum computing could tackle this problem. A team from UN-Habitat and the computing companies QClavis.io, Reply and Pasqal is exploring this use case.

Graham Alabaster said that some cities lose up to 70 per cent of their water supply. Shortages push the price of water up, so that people in slum districts may pay as much as 10 per cent of their income just

Sandro Giuliani


Graham Alabaster


Anousheh Ansari

to get enough to drink. Where water is intermittent people will store it in their homes, creating a breeding ground for mosquitoes and so spreading diseases like dengue and malaria.

The answer is to put meters into the system to monitor water flow, but they are expensive. We need quantum computers to help us decide where best to install these meters. Not only are the pipe networks complex, often there are no records of exactly where facilities are. Even in many developed economies, very large amounts of water go unaccounted for.

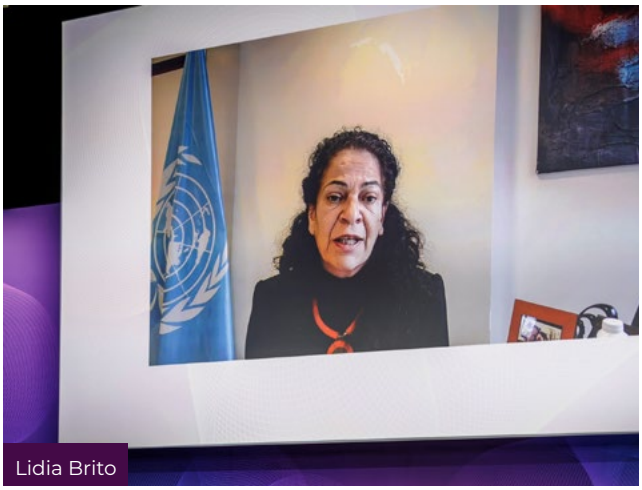
Mourad Beji explained why a private company like his is interested in solving societal problems. One reason is that in tackling these problems, the teams at OQI will open new paths, build new algorithms and find the experts in specific fields. This will show Pasqal new ways of using its technology. For example, algorithms for optimising water distribution networks could then help it optimise electrical grid networks.

Another reason is that Pasqal's employees want to work on things that have a positive effect. These projects are a great way to attract talent and are also part of a culture the company wants to foster. It is committed to capacity-building and training the next generation of quantum developers. For instance, the highlighted use case of detecting water leaks emerged in a hackathon that Pasqal launched last year.

Anousheh Ansari said that XPRIZE had noticed that commercial applications were dominating quantum-computing research. In response, it collaborated with Google and GESDA to run the Quantum Applications competition. This offers $5 million to the entrants that present the best workable plans, involving quantum computing, for meeting a UN Sustainable Development Goal or solving a similar societal problem. Since its launch in March, 240 teams from 43 countries have registered. Forty-four per cent of those teams are from the US and Canada, 24 per cent from Europe and Central Asia. No team from sub-Saharan Africa has registered: XPRIZE would love to see more participation from around the world.

Lidia Brito explained why the UN has designated 2025 as the International Year of Quantum Science and Technology. There is a strong, global recognition of the immense potential of quantum technology for sustainable development. The hope is that we can bridge knowledge gaps, increase scientific and technological collaboration, and build capacity in quantum science and technology around the world. OQI is on the steering committee for the year's activities.

Anna Fontcuberta i Morral described the work of the Center for Quantum Science and Engineering (QSE Center) at EPFL, the Swiss


Lidia Brito

Anna Fontcuberta i Morral


Mourad Beji

Federal Institute of Technology in Lausanne. As well as a master's degree and PhDs, it offers apprenticeships that build basic technical skills. It also intends to provide continuing education through workplace training.

EPFL also collaborates and shares knowledge with the Global South through projects such as its Essential Tech Centre and the Excellence in Africa initiative. Fontcuberta i Morral encouraged people in the Global South to get in touch with EPFL and other universities to accelerate their development of education in quantum technology.

Enrica Porcari said that OQI had just launched its Hackathon in a Box, a set of resources for those who want to organise events to explore quantum technologies. OQI means this to benefit regions that at present have little access to quantum technology and knowledge.

An audience member noted that countries are putting export controls on quantum technology, at odds with the spirit of Quantum for All. **Ansari** said that OQI mostly focuses on applications that are not sensitive for governments. The team hopes, therefore, that export controls will not be a problem. Working with suppliers from a range of countries will help to mitigate any problems that do arise. IP may also restrict openness, however. It may be that not every resource will be open to every country.

She added that policy is important in this respect, "because a lot of time policies are made out of fear". OQI's current pilot phase allows for conversations and collaboration about policy to happen early on.

Fontcuberta i Morral argued that private companies working with quantum technology are realising that it is in their interests to share knowledge with universities, "because that's where the talent is".

Ansari said that a key decision in the early days of OQI was to focus on advancing applications for quantum computing, not hardware. This was because the hardware requires enormous investment and infrastructure, which not every country or entity can afford. What is more, the technology is not mature, so it is wiser to invest in access to platforms rather than in hardware. Cloud computing can make quantum-computing resources available to everyone. It is also more sustainable environmentally than replicating computing infrastructure.

Fabiola Gianotti said that the OQI is exploring 12 use cases. One is the water-leak work already described; others include work on optimisation of food production, carbon capture and other environmental issues, and health. The goal is to reach a pipeline of around 20 use cases in 2025. OQI has signed three agreements with private providers of quantum-computing resources; Pasqal is one. GESDA has held several diplomatic briefings and a diplomatic summit on quantum technology, and Gianotti sees the OQI as a template for other science-diplomacy initiatives.

10 October 2024 • 16:45-18:00 CET

Nourishing Science Culture

Knowledge Augmentation Highlight I

SPEAKERS

Moderator: **Katherine Mathieson** Director of the Royal Institution, UK

Opening remarks: Luciano Floridi Founding Director of the Digital Ethics Center at Yale University

Urs Gasser Professor for Public Policy, Governance and Innovative Technology at the Technical University of Munich, Germany

Ayaka Suzuki Director of the Strategic Planning and Monitoring Unit in the Executive Office of the Secretary-General, United Nations

Stephen J. Toope President and CEO of the Canadian Institute for Advanced Research

KEY MESSAGES

- Science cannot offer certainty, and truth is not fixed for all time. This is hard for both the public and scientists themselves to accept
- Science offers a model of how to make decisions despite uncertainty and different points of view
- Trust in science is weakening. It now demands social equity and environmental sustainability as well as functional reliability. Scientists must listen more to what the public wants
- Manipulation of information is a big challenge

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Luciano Floridi described information as the sum of a question and an answer. If someone has a question without an answer, they are uncertain; if they have neither a question nor an answer, they are ignorant.

Evidence is something that supports or refutes information. It does so by asking a meta-question: given that the information comes from a question plus an answer, is the answer the best possible one for the question?

The digital revolution is changing the nature of both questions, answers and evidence, and also our conception of causation and correlation.

The biggest challenge facing science and technology policy, said **Urs Gasser**, is the need to make decisions in complex and uncertain situations. Despite the wealth of evidence available, we are often flying in the dark, because the questions of tomorrow may look different to those of yesterday.

“In the old paradigm”, said Gasser, we intended laws and policies to remain in place for a long time in order to provide certainty. Now we need to be able to revisit our decisions and revise our policies and laws as we learn more. “We need to reprogram policies, guardrails and institutions to ready them for rapid social learning and experimentation,” he said.

Gasser believes that we must “double down on an old value, on a virtue, and that is self-constraint and humility. Both personally as well as institutionally, including at the political level, we need more overreach protectors. We need to limit the power

Luciano Floridi

we may have and be much more modest and be aware that whatever we decide, we actually may be wrong, and that others and other viewpoints may be ultimately right."

We have had a paradigm shift in the nature of public trust in science, said Gasser. In the past, trust was a matter of believing that science and technology would work reliably: that a plane would stay in the sky, for instance. Now people want to know that technology will serve people and the planet fairly. This is a move from a functional to a fiduciary conception of trust.

Ayaka Suzuki cited a statement called "Trust in science" that the UN Secretary-General's Scientific Advisory Board published in September 2024. It recommends "local forums for community leaders, businesses, laypeople, and scientists". However, she noted that trust is not an end in itself. The aim is to support evidence-based decision-making.

Katherine Mathieson cited the philosopher Onora O'Neill, who said that "scientists can never ask to be trusted. All you can do is seek to be trustworthy and see what happens."

Stephen J. Toope cited survey results showing that in the US only 29 per cent of people say they have significant trust in science. The figure was 39 per cent just a year or two ago. Trust levels elsewhere are probably higher, but falling all the same.

One reason for this is the insights people gained into the process of science during the COVID pandemic. People saw that "there are issues that scientists who are equally adept don't agree on", said Toope, "and I think a lot of people found that unsettling".

He also argued that we should not overpromise the benefits that science may bring. For instance, for 25 years he has been hearing claims that precision medicines will deliver extraordinary advances in human health, but a lot of people have experienced their healthcare systems getting worse in that same period. He believes that the same could happen with quantum computing.

He also believes that science must be responsive. "Are we actually addressing the questions that the public wants to see addressed? All of us in the academic world have to be better at listening. Education is a mutual activity."

Gasser argued for greater promotion of the process of science because it offers a protocol for how to deal with disagreement. In support of this, **Toope** referred to US pragmatic philosophy of the early 20th century which proposed "that truth is the best knowledge that we have, given the data in front of us at any given moment". He believed this notion "might help people understand that we can't create absolute certainty, but we do have frames that allow us to operate with enough certainty to make decisions".

This means that truth is mutable, he said. That is a profound shift in values for many societies. It calls into question the interrelationship of societies and how they understand truth.


Ayaka Suzuki


Stephen J. Toope

Gasser suggested three ways in which scientists can engage in societal and political debates, beyond their role of describing and analysing issues. They can interact with their students in ways that will instil democratic values in them. They can reach out to journalists and other "multipliers" to communicate as far as possible the best knowledge available, as well as our areas of uncertainty. And universities could team up globally to create a response system, a network when media manipulation or disinformation on a given topic takes over. An example of such disinformation is "news" that recent hurricanes were geoengineered by the US government.

Suzuki argued that the Intergovernmental Panel on Climate Change is a good model for science-based policy-making, despite its disappointing results. She cited the UN's Global Digital Compact, which includes a commitment to "establish, within the United Nations, a multidisciplinary Independent International Scientific Panel on AI with balanced geographic representation". However, she recognised that with over 190 countries negotiating a final text, no policy will ever be purely science-based. **Mathieson** agreed that it is politicians who must take final policy decisions.

Suzuki also raised the importance of developing the scientific and technological capacity of the Global South. Some scientists from the Global South have said we should work together to stop "parachute science". Some talk about decolonising science. These issues are important in levelling the playing field and making sure that all voices are heard.

We do not always need new treaties to regulate technological advances, said Suzuki. For instance, her team has looked at how new neurotechnology may affect human rights and concluded that we just need to implement existing treaties, perhaps with some clarifications. Our failure to implement treaties is a frequent problem.

That said, some existing agreements have gaps. For instance, the Outer Space Treaty of 1967 cannot regulate the current proliferation of private actors in space. In addition, there are ways to govern emerging technologies that are "softer" than treaties.

Toope warned that international collaboration is becoming more difficult because restrictions such as export controls and research security protocols are multiplying. He thinks this could limit scientific success. **Gasser** agreed, saying that university leaders should push back against national policies and national security interests to keep international communication channels open.

In terms of values, **Toope** argued that "we have to let go of purely game-theoretic understandings of human interaction. It's not just about competing interests. All of the evolution in constructivist international relations theory, in behavioral economics: I think these are really important developments that cause us to go back to more complicated understandings."

Urs Gasser

10 October 2024 • 17:30-18:00 CET

Anticipatory Briefing

The Future of International Relations

SPEAKERS

Moderator: **Laurent Haug** Founder of 200ideas, a Swiss company that seeks to build a community of decision-makers, intellectuals and curious minds to explore the challenges and opportunities of the 21st century

Thomas Biersteker Honorary Professor of International Relations/Political Science at the Geneva Graduate Institute

KEY MESSAGES

- There are multiple world orders: different conceptions of how the world is and should be governed
- Traditional formal systems of global governance are competing with newer, informal systems that feature a wider range of actors. Both are useful
- We need a multiperspectival approach: we need to use empathy to understand how the other feels about the world and why they feel this way

SESSION RECORDING →

SUMMARY

There are enormous and complex challenges and uncertainties in contemporary world affairs: wars in Ukraine, Gaza, Lebanon, Sudan and elsewhere; growing debt; nationalist efforts to minimise imports and maximise exports; and climate change causing storms, floods and droughts. These form a "polycrisis", in which crises interact and make each other worse.

The Russian invasion of Ukraine violated fundamental principles of the UN Charter, a deep wound "to what we thought were fairly well-established norms". Growing national economic protectionism is threatening another norm, "the so-called liberal international rules-based order with regard to international trade". Violations of human rights in Afghanistan also reveal the fragility of norms.

The polycrisis shows that there is no single world order. Indeed, the "liberal international rules-based order" that arose after the Second World War was never universal. We live in a world of contested, interpenetrating conceptions of global governance. These include the "illiberal democracies" of Viktor Orbán, Vladimir Putin and Donald Trump, and the radical Islamist transnationalism that is happening in many regions.

The existence of multiple world orders means that we need to think in terms of "global international relations". This is a shift in attitude that is based on the acceptance of many points of view — multiperspectivism. We need to make a serious effort to use empathy to understand how the other feels about the world and why they feel this way.

Thomas Biersteker

In the Russia-Ukraine war, for instance, we need to listen to Russia's arguments. That does not mean that they are legitimate. But we must try to understand what motivated Russia. Similarly, we need to understand empathetically the motivations of Hamas and Israel.

After the Second World War there was a steady growth in the number of formal intergovernmental organisations such as the UN, the World Trade Organization, the World Bank and the International Monetary Fund. This growth ended in the 1990s. From the 1970s onwards, meanwhile, there has been an exponential growth in transnational governance initiatives. These are forms of multistakeholder governance that bring together governments, the private sector and NGOs. Examples include the Kimberley Process, the Extractive Industries Transparency Initiative and the International Code of Conduct Association. Over the same period there has been a steady rise in the number of informal intergovernmental organisations — groups of like-minded states such as the G7, G20, BRICS and expanded BRICS group.

This is a fundamental competition for authority between the traditional, formal systems of global governance and newer, informal systems that feature a wider range of actors.

Informal governance in world politics takes three forms. One is the informality in institutional form mentioned above. The second is reliance on informal practices within organisations: everything from who appoints the director-general to the institution's cultural practices. And third is the informal policy networks that operate around institutions, which may include people from governments, international organisations, the private sector, NGOs and academia.

We do not have to choose between formal and informal, however. Often informality allows us to do things that we cannot do through formal channels. They can be complementary. But we need to make the effort, often through informal channels, to engage others in a way that helps us to understand where they're coming from — literally.

Biersteker argued that we should not accept determinism in international relations. He believes that war is not inevitable: "It's a world of our making," he said. "What we do, what we say, and what we don't do and don't say, are part of the world that we live in."

Biersteker described the main developments in international relations that he expects within the next 5, 10 and 25 years.

5-year horizon: Informal intergovernmental organisations and transnational governance organisations continue to displace formal intergovernmental organisations.

10-year horizon: The multipolar world continues to displace the Eurocentric world. Non-Western countries and regions seek to reform institutional structures. International relations experts recognise a contestation between different ideas of how the world is and should be governed.

25-year horizon: International relations theorists go beyond a "Newtonian" approach to cause and effect and use "open-ended, non-deterministic, dialectical approaches" that parallel quantum theory.

11 October 2024 • 8:45-10:15 CET

GESDA Anticipation Gateway

SPEAKER

Alexandre Fasel State Secretary at the Federal Department of Foreign Affairs, Switzerland

Sandro Giuliani CEO of GESDA

KEY MESSAGES

- The Anticipation Gateway comprises three interconnected projects to democratise the understanding of emerging science and its uses
- The Global Curriculum for Anticipatory Leadership covers science, diplomacy and policy, business, economics, global societal trends, science anticipation, science diplomacy and leadership skills, and has educational institutions across the world as partners
- The Geneva Public Portal to Anticipation is an interactive installation that will allow citizens from diverse backgrounds to anticipate and co-create images and stories of the world to come
- The Anticipation Observatory will give decision-makers — be they diplomats, entrepreneurs or artists — information and analysis about current and anticipated developments in science and technology

SESSION RECORDING →

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INTRODUCTION

Sandro Giuliani announced the launch of the Anticipation Gateway. This comprises three interconnected projects to democratise the understanding of emerging science and its uses. One, the Geneva Public Portal to Anticipation, is for citizens. Another, the Global Curriculum for Anticipatory Leadership, is for future leaders. The third, the Anticipation Observatory, provides intelligence to current leaders and decision-makers.

With these three projects, GESDA is scaling up. Its intention is to “go global” and offer many partners around the world opportunities to collaborate.

Sandro Giuliani

Alexandre Fasel agreed that GESDA needs to scale up. Through GESDA, the Swiss government and the Geneva authorities aim to provide the international community with a way to think scientific advances through and then to act on the resulting insights. It is a multistakeholder approach, bringing together scientists and technologists, states, international organizations, the private sector, philanthropy and citizens at large.

Alexandre Fasel

11 October 2024 · 8:45-10:15 CET

Panel I: Global Curriculum for Anticipatory Leadership

SPEAKERS

Remarks: **Enrico Letta** Member of the Board of Directors of the GESDA Foundation

Rebeca Grynspan Secretary-General of UN Trade and Development (UNCTAD)

William Egbe Managing Partner of Vibranium Capital Group, Washington DC and Johannesburg, South Africa

Camelia Ilie Dean of Strategy and International Affairs at INCAE Business School, Costa Rica

Yusuf Leblebici President of Sabancı University, Istanbul, Türkiye

SESSION RECORDING →

Enrico Letta

SUMMARY

Enrico Letta defined three aspects of anticipatory leadership. First is the ability to detect emerging science and technology breakthroughs. Second is understanding their implications. Third is driving decisions and action together with citizens, scientists, politicians, diplomats and business leaders — people who do not usually talk to each other.

He mentioned two important principles. First, science must be at the centre of all discussions and the foundation of all decisions. Second, failure to anticipate scientific and technological change has a cost that we cannot bear — a cost in human life as well as an economic cost.

GESDA has created an initial framework for training anticipatory leaders. It is modular and so can adapt to regional and sectoral needs. It covers science, diplomacy and policy, business, economics, global societal trends, science anticipation, science diplomacy and leadership skills. In 2025 there will be five Anticipatory Leadership Weeks in five educational institutions around the world, under the brand "25-5-5".

Sandro Giuliani noted that two of the panellists are from the "demand" side of education, the others from the "offer" side. The latter two are from educational institutions that are part of the Global Curriculum for Anticipatory Leadership coalition.

Rebeca Grynspan said that she had just hired the first person in her organisation who knows something about AI. UNCTAD has to make an enormous effort just to get up to date with technology. But we cannot think about the global standards or rules of the future if we do not understand what we are regulating. She would therefore like her entire management team, including herself, to participate in the Global Curriculum for Anticipatory Leadership.

William Egbe explained how anticipatory leadership creates value for the private sector. First of all, it allows companies to anticipate opportunities for


Rebeca Grynspan


William Egbe

growth. And on the other hand, it can mitigate the disruption that new technologies may cause. This is a particular problem for larger, older companies, which are less ready than smaller, nimbler companies to take risks. Another advantage is that anticipatory leadership makes companies more resilient: if they can see what is coming, they can flex and adjust their plans.

A different sort of advantage comes in the field of "building belonging". Anticipatory leadership can help companies respect the many stakeholders that they have beyond owners and shareholders. It "helps them reinforce and renew their social licence".

Yusuf Leblebici argued that universities must educate the general public and future leaders about the implications of the technologies that they develop. One important principle of this work is interdisciplinarity: departmental boundaries can make this difficult. Another is an international approach. This allows us to exploit the relative advantages of different cultural viewpoints in addressing the issues that technological progress brings. A third principle is close links with the world outside academia, including business, industry and the public sphere. This will make universities more effective in addressing and educating the public.

Camelia Ilie agreed that public institutions, private organisations, academia and civil society need to work together better and more inclusively. She said that leaders need to integrate scientific advances, technology and data analysis to make decisions. Leadership development programmes should therefore foster curiosity and instil a learner mindset, not an expert mindset. They also need to accelerate the collaboration between humans and AI to design better solutions quicker. To do this, governance must also look more towards prediction and foresight, instead of the past-based analysis that is common now. Purpose and shared values should drive leadership styles: this is the only way to reach a more sustainable world and to help live not only longer, but also more meaningful lives.

Letta called for an ambition to establish in the next three years a "Geneva process" for education that could change the world and mindsets, creating a possibility of a better world through the accelerating change that we are seeing.


Yusuf Leblebici


Camelia Ilie

11 October 2024 · 8:45-10:15 CET

Panel II: Geneva Public Portal to Anticipation

SPEAKERS

Remarks: **Henrietta Fore** Member of the Board of Directors of the GESDA Foundation

Alexandre Edelmann Ambassador and Head of Presence Switzerland at the Federal Department of Foreign Affairs, Switzerland

Sarah Kenderdine Head of the Laboratory for Experimental Museology at EPFL, the Swiss Federal Institute of Technology in Lausanne

SESSION RECORDING →

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Henrietta Fore introduced the Geneva Public Portal to Anticipation, an interactive installation at the intersection of arts, science and diplomacy. It will allow citizens from diverse professional and cultural backgrounds to anticipate and co-create images and stories of the world to come.

GESDA plans a full-scale implementation of the portal in 2026 and 2027. There will be a physical exhibition in Geneva, mobile satellites around the world and an open online platform. These will allow people everywhere to create personalised intelligence, fostering a greater sense of agency and connection. Feedback from visitors will support other GESDA initiatives.

Alexandre Edelmann described the Switzerland Pavilion at Expo 2025 in Osaka, Japan. He expects 1.5 million people will visit the pavilion, which showcases the country's architecture and breakthroughs in membrane technology. It has enclosures with different themes, one of which is "anticipation". This area will highlight Swiss innovation, and it is here that GESDA will contribute.

Henrietta Fore

Alexandre Edelmann

Sarah Kenderdine

An important purpose of the pavilion is to emphasise the role of Switzerland in global diplomacy. Switzerland is experienced in bringing people together for discussion: even if the result is that they agree to disagree, they have also agreed that they need to talk.

Sarah Kenderdine gave examples of how art and expos in the 19th and 20th century anticipated scientific and technological progress.

The Geneva Public Portal to Anticipation will be a key installation in the Swiss pavilion at Expo 2025. It combines ChatGPT 4.0 and the text-to-image generator Ideogram with the content of the GESDA Science Breakthrough Radar. Users can co-create and see possible futures from their own perspectives. To begin with, the portal asks each user which of the Radar's 116 "sub-fields" they want to explore. It asks five further questions and presents a list of possible responses to each. In this way the user sets parameters which the portal's AI uses to generate a personalised narrative and an image of a possible future they are interested to see.

Because existing visions of the future are often dystopian, in early testing with the Radar the AI system generated a lot of dystopian scenarios. "Successive generations of generative AI tools tend towards increasing normality or true-to-the-real-world aesthetics and narratives rather than a speculative future," said Kenderdine. The portal team has engineered prompts for the AI "to redirect the story and the imagery to be more creative". They have also instructed the generative AI engine to remove offensive cultural biases, shocking images and other undesirable outputs.

11 October 2024 · 8:45-10:15 CET

Panel III: Anticipation Observatory

SPEAKERS

Remarks: **Sandro Giuliani** CEO of GESDA

Fernando Espinosa Olivera Deputy Permanent Representative of the Mexican Permanent Mission to the UN Office in Geneva

Matthias Troyer Technical Fellow and Corporate Vice President of Quantum at Microsoft

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

A **GESDA video** explained that the Anticipation Observatory would give decision-makers — be they diplomats, entrepreneurs or artists — information about current and anticipated developments in science and technology. It would use AI to interrogate the Science Breakthrough Radar, with its contributions from 2000 leading scientific minds, plus extra input from academia, diplomats, business and citizens.

GESDA was building a pilot app for key information about neurotechnology. The app would draw on the Science Breakthrough Radar, multilateral initiatives, legislation from different countries, market overviews, news articles and public discussions in social media to curate intelligence to answer a user's questions. It would also help them understand the science and how it may be applied in 5, 10 and 25 years.

A user could also find out how neurotechnology may affect prosperity, security or human rights, using these three UN perspectives to gain deeper insights into their area of interest.

The Anticipation Observatory would soon include all 40 emerging topics featured in the Science Breakthrough Radar.

Sandro Giuliani described the observatory as "a GESDA Science Breakthrough Radar on steroids". GESDA would launch the full version of the Anticipation Observatory app for neurotechnology at the end of 2024. He demonstrated how a user could ask the app about the implications of neurotechnology for peace and security in humanitarian terms. The results would include information and its sources, specific recommendations and graphics. He also showed the results of queries about human rights, governance and markets, with the results giving information appropriate to each area.

What is more, the app would reveal correlations and discrepancies between different perspectives. For instance, it would show the relationship

between regulation of and investment in neurotechnology for different parts of the world.

Fernando Espinosa Olivera said that science and technology have overwhelmed politics, diplomacy and society. We are a step behind most of the time. He said that the Anticipation Observatory would be a game-changer in providing information that could lead to better decisions. He said that we now have a virtual galaxy of information, news, fake news, science and pseudoscience. The observatory will give us lenses that can reveal specific insights into precise, curated information. This is what he needs in, for instance, pandemic treaty negotiations at the World Health Organization. The use of artificial intelligence also allows us to see into the corresponding galaxies of other languages, allowing a democratic view.

Matthias Troyer raised the danger of multiplying AI hype. AI is useful as an interface to data: it lets us ask questions in natural language. It also lets us summarise data, find connections between data and show its sources. What we need is a way to bridge AI with trusted scientific fact.

The base of the Anticipation Observatory is GESDA's role as a trusted broker of information. But the Anticipation Observatory will go beyond search. It can help to find links and relations between seemingly unrelated data and give new insights.


Matthias Troyer


Fernando Espinosa Olivera

11 October 2024 • 10:45-12:00 CET

Democratizing Science Literacy: High-Level Political Segment

Geneva Political Talks on Science and Diplomacy

SPEAKERS

Moderator: **Alexandre Fasel** State Secretary at the Federal Department of Foreign Affairs, Switzerland

Opening remarks: **Ignazio Cassis** Federal Councillor and Minister of Foreign Affairs at the Federal Department of Foreign Affairs, Switzerland

Baiba Braže Minister of Foreign Affairs at the Ministry of Foreign Affairs of the Republic of Latvia

P. Kumaran Special Secretary at the Ministry of External Affairs, India

Adriana Mira Vice Minister at the Ministry of Foreign Affairs, El Salvador

Omran Sharaf Assistant Foreign Minister of Advanced Science and Technology at the Ministry of Foreign Affairs, United Arab Emirates

Andrzej Szeptycki Under-Secretary of State at the Ministry of Science and Higher Education, Poland

KEY MESSAGES

- Politicians, private enterprises, scientists, civil society, communities and individual citizens live in separate bubbles. We must facilitate trustworthy communication and collaboration between them
- Science and technology must bring practical benefits to the lives of ordinary people
- Governments must prioritise their country's science and technology sector

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Ignazio Cassis highlighted two rapidly advancing fields with the potential for both good and harm. First, synthetic biology, which could lead to the rapid development of vaccines and other treatments but could also create biological weapons. Second, neurotechnology, which could help paraplegic people walk again but could also enhance soldiers' abilities. These potential uses raise ethical issues that we must address.

Given Switzerland's history of innovation and mediation, Cassis believes it is crucial to focus on preventing and managing the conflicts that may arise from emerging technologies. This is why Switzerland and the state and city of Geneva created GESDA. As president of the UN Security Council in October, Switzerland would highlight the importance of monitoring scientific advances and their effects on global peace and security.

Asked why world leaders should pay attention to the acceleration of progress in science and technology, Cassis answered that it's important to prepare for the future rather than run after it. By contrast, we did not anticipate consequences when CERN invented the world wide web, or when drone technology emerged.

Ignazio Cassis


Baiba Braže


Andrzej Szeptycki

Baiba Braže considered how science can help us reach global goals such as those defined in the recent UN Summit of the Future. She said that we need to bring together people who normally live in separate bubbles, such as politicians, scientists and tech companies, and different local, national and regional communities. She also said that scientific and technological breakthroughs are not enough on their own: they must benefit communities. For instance, she said, "vaccines don't save lives. Vaccination does."

To improve scientific literacy, **Andrzej Szeptycki** said we need to make science accessible, attractive, understandable and trustworthy. Scientists need to learn how to talk to and write for the general public. Science museums are also popular, and life-long learning programmes should nourish personal interests as well as career advancement.

We must also counter the threat of misinformation and disinformation, Szeptycki said. We need to know who is using AI for political influence, we need AI to be trustworthy and we need to have sovereign control over it. We also need a legal framework to fight disinformation. Szeptycki also suggested limiting young people's access to social media.

Adriana Mira explained El Salvador's success in public-private partnerships for science and innovation. Five years ago, the government appointed its first Secretary of Innovation. A few weeks ago, it created the post of Secretary of Cybersecurity. About a year ago, a new law made it easier for companies to invest in innovation and technology. As a result, Google made a big investment in the country.

She believes that it is also important to collaborate with civil society and academia to create opportunities for young people. If people cannot find work, she fears a return to the violence for which her country was once notorious.

P. Kumaran outlined how India has become a leader in scientific and technological development for all. One reason for India's success is the wide availability of open-source educational materials and cheap textbooks, including those in Hindi and regional languages. India has a national digital library, and educational technology platforms are more and more popular. The government runs science fairs, exhibitions and outreach via television and radio. It also focuses on helping women in science, technology, engineering and maths education.

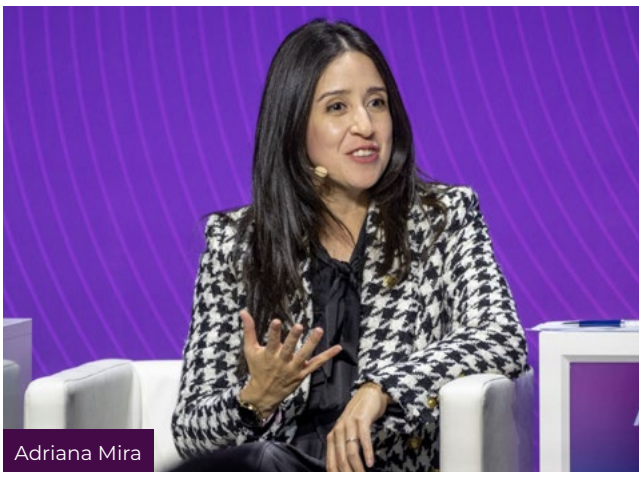
India started establishing scientific institutions and building a technological base soon after independence: it set up the Indian Institutes of Technology and Management, the Council of Scientific & Industrial Research, the Indian Council of Agricultural Research and others. The Indian Space Research Organisation began work in 1969 and has launched many satellites and two lunar missions.

The government now aims to increase spending on education and R&D. It is also enabling more collaboration with foreign education institutions. India focuses on frugal innovation: cost-effective, resource-efficient and sustainable solutions to social and economic problems.

In terms of science and technology diplomacy, the Ministry of External Affairs now has a New Emerging and Strategic Technologies — NEST — division.

Omran Sharaf said that the government of the United Arab Emirates (UAE) realised early on that it had to establish a strong science and technology sector, and that it could not do this alone. Instead of starting from scratch, Emiratis worked with and learned from others. They integrated their scientists and engineers with those of other countries and built programmes together.

For instance, the UAE space programme is only 17 years old and has already reached Mars. Of the


Adriana Mira


Omran Sharaf

450 people who worked on that mission, 200 were Emiratis, 150 were Knowledge Transfer Partners from US universities and 100 were subcontractors from around the world. The mission was delivered in six years — other countries take 10 to 12 years for a comparable enterprise — and for just $200 million.

Sharaf argued that during the Cold War, international discussions and diplomacy focused on politics. Afterwards, economics joined politics at the top of the agenda. Now science and technology are there too: emerging technology will play a vital role in defining the relationships between the countries and regions.

The polarisation that is happening globally will be difficult for countries like the UAE, which is a hub that works with both East and West. But Sharaf believes that opportunities will emerge from this. If other countries could create their own version of the UAE model, different views can come closer together. This is because the more scientific and technological capability countries have, the more language they will share with others. It will then be easier for us to address emerging technologies together in terms of standards, guidelines, norms and ethics. So, to avoid our standards reflecting wider polarisation, it's critical that we build capacity in other countries.

P. Kumaran

Alexandre Fasel asked all the panellists to answer one question: how do we give leaders the tools to anticipate technological and scientific breakthroughs to make policy decisions fruitful?

Szeptycki said that we can align science programmes with other government priorities to make the most of limited budgets.

Sharaf argued for building trust and promoting responsible behaviour in international discussions and collaborations in venues like the Security Council, as Switzerland has.

Mira said we need to ask the biggest countries not to use science and technology as weapons. Rather, science diplomacy should lead to specific actions that make science and technology available to developing countries.

Kumaran said that we should turn science and technology more towards solving the practical problems of ordinary people, such as health, agriculture and employment. He would want to open-source as many technologies as possible.

Braže thinks that scientists should develop storytelling skills to tell the public about their successes. In Latvia, more than half of the scientific workforce is women, and communicating that fact has led the public to believe that science is for everyone. In addition, she argued that investing in future technology such as a 6G communication network enables other technological developments, which in turn repay the investment.

Cassis said that scientific language is evidence-based but political language is opinion-based. GESDA creates projects that allow a cross-pollination between these two bubbles.

11 October 2024 • 12:00-12:15 CET

Closing of the Summit

SPEAKERS

Peter Brabeck-Letmathe Chairman of the Board of Directors at GESDA

Christina Kitsos Mayor of Geneva

KEY MESSAGES

- Inclusiveness was a key theme of the summit
- Quantum computing can help solve concrete issues facing underprivileged people
- Multilateral diplomacy is essential for informed debate on technological advances and for establishing a proper legal framework for them
- Human beings, their rights and their dignity must be at the centre of our concerns

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Peter Brabeck-Letmathe noted that speakers had mentioned inclusiveness several times during the summit. Inclusiveness means that we have to help to narrow the gaps that are increasingly opening between and inside countries. It is an absolute must for GESDA. Otherwise, scientists, diplomats, politicians and society at large will not recognise the organisation as an honest broker. For this reason GESDA has decided to create a civil society forum under the leadership of its Board Member Henrietta Fore, a former Executive Director of UNICEF.

Brabeck-Letmathe recapitulated the recent and new GESDA initiatives that the summit had covered: the Open Quantum Institute and the three-part Anticipation Gateway. The first two use cases from the Open Quantum Institute show how GESDA is a "do tank" as well as a think tank. To even Brabeck-Letmathe's surprise, they were not about abstract applications such as encryption but rather very concrete things: the first use case is about improving the water situation in Mexico, and the second is about strengthening food security in Indonesia. The Open Quantum Institute has showed that quantum computing can be essential for very simple things that will improve the lives of people all over the world.

Next year GESDA will become still more global. It will be active not only in Geneva and Switzerland, but also in Japan, Costa Rica, South Africa, Turkey, Spain, Singapore and at the UN in New York and Kenya.

Peter Brabeck-Letmathe

Brabeck-Letmathe thanked GESDA's founders, private sponsors and partners, and the thousands of scientists who are working as volunteers — none receives payment. He also thanked the GESDA Board, the panel moderators, GESDA's management team and the audience.

Christina Kitsos outlined the current political, economic and social crisis. She mentioned widespread resentment, nationalism and polarisation of politics and of society. She said that these forces are eroding fundamental freedoms, democratic principles and the rule of law. Attacks on the press and widespread disinformation are further concerns. In this context, she is convinced that multilateralism is needed more than ever, and that Geneva must retain and cultivate its place at the heart of world diplomacy. Without international cooperation, we will face failure, not to mention the sacrifice of our collective values of solidarity and dignity.

Kitsos mentioned the frightening possibility that technological advances could work against us. This becomes more likely if innovators make such advances outside an appropriate legal framework or without informed debate on the real issues at stake, particularly in terms of democracy. Meetings such as those that GESDA convenes are essential in avoiding such dangers. This is because GESDA brings together people who not only have highly specialised knowledge but who are also able to establish links, break down barriers and compare points of view.

This is why Geneva is proud to support GESDA's activities, said Kitsos. GESDA is part of a long tradition that has made the city a privileged place that encourages debate, allowing visionary minds to answer complex questions and move the world forward.


Christina Kitsos

Kitsos quoted Amartya Sen's view that seeking economic growth alone will lead to failure. This is because education, health and nutrition are not only essential to a decent human life but are also important ingredients of human productivity, as Adam Smith had earlier pointed out. She called for the rehabilitation of the common good and a regulated economy where the benefits of growth profit society as a whole. She said that only by placing human beings, their rights and their dignity at the centre of our concerns, and by putting scientific innovation at the service of the greatest number of people, can we hope to emerge from the current crisis and build the future for everyone.

11 October 2024 • 12:15-13:00 CET

Press Conference

SPEAKERS

Peter Brabeck-Letmathe Chairman of the Board of Directors at GESDA

Baiba Braže Minister of Foreign Affairs at the Ministry of Foreign Affairs of the Republic of Latvia

Ignazio Cassis Federal Councillor and Minister of Foreign Affairs at the Federal Department of Foreign Affairs, Switzerland

Henrietta Fore Member of the Board of Directors of the GESDA Foundation

Sandro Giuliani CEO of GESDA

Enrico Letta Member of the Board of Directors of the GESDA Foundation

KEY MESSAGES

- Latvia and Switzerland have a strong relationship, with Switzerland giving significant support to Latvia
- GESDA's new initiatives are tools that will lead to action
- Trust, transparency and inclusiveness are central to GESDA's work

SESSION RECORDING →

SESSION RECORDING →

SUMMARY

Following a bilateral meeting earlier in the day, the foreign ministers of Latvia and Switzerland made statements. **Ignazio Cassis** said that Switzerland was supporting projects in Latvia in the fields of vocational training, research, environmental remediation and health. It was spending over €40 million on them as part of the second Swiss contribution to selected EU member states.

He said that the ministers had discussed Swiss negotiations with the EU. There had been over 120 rounds of them in Brussels since March, with the ninth main meeting taking place on that day.

He thanked Latvia for its participation in the peace summit on Ukraine at Bürgenstock, Switzerland. Switzerland had already contributed about half a billion euros to support those affected by the war. It would further allocate €1.5 billion for help, development and recovery in the next four years, 2025-28, with €5 billion being pledged by 2036.

Ignazio Cassis

Baiba Braže said that Latvia highly appreciated what Switzerland had done through its diplomatic engagement with Russia's war in Ukraine.

She said that the ministers had also discussed further joint work. Latvia was a candidate for the UN Security Council election the following summer and so would be happy to take on Swiss experience in that forum.

The two countries engaged widely and deeply across all sectors from economy to science. Latvia was looking forward to becoming a full member of CERN in a couple of years.

Baiba Braže

Enrico Letta

A journalist from the Swiss news agency said that Lithuania had withdrawn from the Convention on Cluster Munitions and asked whether Latvia would consider doing the same. **Braže** questioned the accuracy of the statement about Lithuania and said that Latvia was not changing its membership of any convention or organisation.

Cassis mentioned some of the extraordinary technological developments we can expect in the next 5, 10 and 25 years. He said that these innovations must benefit everyone, not just a few. Conflict prevention is crucial, with science diplomacy playing a key role. This is what Switzerland is pursuing with GESDA and why the GESDA summit is crucial. It is also why Switzerland, as president of the UN Security Council that month, intended to commit the council to monitor scientific advances and their impact on international peace and security.

Enrico Letta outlined the Global Curriculum for Anticipatory Leadership, discussed more fully in the earlier session on the GESDA Anticipation Gateway.

Peter Brabeck-Letmathe said that GESDA's founders, the Swiss government and the Geneva authorities, gave it the task five years ago of developing an instrument of anticipation and action for renewed multilateralism. The foundation for this is a forum of thousands of scientists.

This forum needs three things to function. First is the scientists' trust in GESDA as an honest broker. The second requirement is transparency, which is why everything GESDA does is available to all online. The third is inclusiveness: GESDA must engage consciously with underrepresented communities in research, because they can yield insights that we very often overlook when concentrating on the world's big research centres.

To fulfil its mission, GESDA has to create tools for science anticipation and diplomacy. One of these is the GESDA Science Breakthrough Radar. Another is the Quantum for All initiative, with the Open Quantum Institute as its centre. In a session earlier that day GESDA had announced its latest initiative, the Anticipation Gateway, which comprises three concrete projects: the Global Curriculum for Anticipatory Leadership, the Geneva Public Portal to Anticipation and the GESDA Anticipation Observatory.

In this way GESDA is moving quickly from anticipation to action, and from neuro-augmentation and eco augmentation, which were the cornerstones of this summit, to knowledge augmentation and diplomacy augmentation.

Henrietta Fore said that the aim of GESDA's citizens' forum, which she chairs, is for as many people as possible, in all areas and of all ages, to take part in what GESDA does. She asked for help in working out how to gather ordinary people's thoughts about emerging technologies. This will bring data that GESDA can use.

Sandro Giuliani gave a further explanation of the GESDA Anticipation Observatory, which had been launched in the Anticipation Gateway session earlier that day.

A journalist from the Swiss news agency asked how Cassis could convince leaders to take a long-term view and think about anticipation of scientific breakthroughs.

Cassis said that it would take a long time: it is change management on a generational timescale. Every day, however, he is struck by the influence of misinformation, which makes an evidence-based approach important, even though politics must also remain somewhat emotional.

He wants a revolution like the one in epidemiology that began when he graduated as a doctor in the late 1980s. It will be much more difficult to introduce evidence-based politics, however.

The journalist asked Cassis what time horizon he had selected when he tried the Geneva Public Portal to Anticipation that morning. **Cassis** said he had chosen 25 years, as he looks 5 and 10 years ahead in his daily work. He acknowledged that politicians have to reconsider long-term targets as situations change. But he thinks a politician who does not aim for targets, but merely reacts to day-to-day events, is playing with fire.


Henrietta Fore

An independent journalist who works mostly for Tamedia asked whether Cassis could use GESDA in diplomacy for ending conflicts. He suggested that scientists could write to governments encouraging them to engage in dialogue. He also asked whether GESDA might partner with the World Economic Forum (WEF).

Cassis said "our approach is not a moral one or a paternalistic one, writing letters and telling people what they need to do. Absolutely not. It would be ridiculous to do that." He mentioned some of the Swiss government's initiatives in science diplomacy: its focus on science during its presidency of the UN Security Council that month; a Security Council debate on trust through science diplomacy that he had chaired in March 2023; a Security Council meeting at GESDA in Geneva in August 2024; and expert briefings on anticipating the uses of new technology in warfare.

In response to the second question, he pointed out that the Chairman of the Board of Directors of GESDA is Vice-Chairman of the Board of Trustees of the WEF, and the Swiss government has close ties with the WEF. However, the two organisations have different aims and he would not want GESDA to be a chapter of the WEF.

For the final question, a journalist proposed that GESDA is important for Switzerland's image as a country involved in humanitarian aid and is a new part of the catalogue of such Swiss enterprises. **Cassis** said that was exactly right. He drew parallels with the foundation of the International Red Cross in the 19th century and the UN Human Rights Council in the 20th. If Geneva is to deserve the place and name it has in the world, it must respond to the 21st century. That is why the Federal Council had decided to invent something that could help to define instruments to better face future challenges.

Peter Brabeck-Letmathe


Sandro Giuliani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