Science for Sustainability and Wellbeing in the Anthropocene: Opportunities, Challenges, and AI

It has become ever more evident that humankind deeply impacts Earth systems. The Anthropocene, understood as the growing and lasting human influence on the global environment, was identified by our esteemed PAS Academicians Paul Crutzen (1933-2021) and Mario Molina (1943-2020). PAS has addressed Anthropocene issues at various workshops before.[1] As the Anthropocene is showing its increasingly dramatic consequences for nature and for people especially through climate crisis and loss in biodiversity, the PAS has chosen to focus on this theme in its Plenary 2024.

The Anthropocene represents the cumulative effect of human activities on nature and its life forms. The Anthropocene is the age we live in, characterized by heavy imprints of human activities on nature by, for instance, industrial revolution based on fossil fuels, nuclear arms and nuclear energy, urbanization, consumption, and communication technologies. Sciences are not independent from the forces that created the Anthropocene. Actually, we must note that past science and the innovations facilitated by science, were among key drivers of the Anthropocene. Examples are energy systems based on fossil fuels, transport systems, construction, consumer goods, and agriculture and land use related innovations, causing greenhouse gas emissions, pollution, and land and water systems degradation.

At the same time, science and innovations are progressing and serving human betterment providing also opportunities to mitigate and manage the Anthropocene. The sciences, including the life sciences and medical sciences, have made child survival, longevity and coping with

diseases possible and led to the growth of the human population, yet combined with expanded consumption and lifestyles with big environmental foot print. Science-based innovations of the past, often with time lags, are part of the root causes of the Anthropocene.

Current and future science is now challenged to mitigate and help to adapt humanity to the Anthropocene. It is not new, that science-based innovations are posing ethical challenges for scientists and society at large. This is nowadays particular so with Artificial Intelligence (AI) impacting on society and many aspects of the sciences and innovation processes. We are challenged to explore AI developments and applications, as well as other innovations, as accelerators in the making of the Anthropocene, but we shall also ask if artificial intelligence may help human intelligence in achieving a sustainable Anthropocene.

Furthermore, the emerging sciences in chemistry, physics, biology and life sciences, and medicine are already aided in new ways by AI. Quantum physics and computing may be another field that offers innovations to turn the Anthropocene onto sustainable pathways. The Pontifical Academy of Sciences has addressed related themes with its consultations, publications, and public statements before,[2] and is committed to address the protracted challenge for sciences as both, causes and cures of the adverse elements of the Anthropocene. Since the Plenary Conference in 2022, the Pontifical Academy of Sciences has held workshops addressing important aspects of this broad agenda. For instance, the massive health and societal problems caused by the COVID pandemic and by the chronic disease of cancer, the climate crisis and resilience challenges, the health of oceans, stem cell science, neurotechnology, quantum physics and computing, the growing humanitarian and food crises. We identified specific science opportunities in each of these areas and issued related statements urging policy and societies to act. The Plenary Conference 2024 partly draws on the insights from these workshops and puts them into the broader context of science and science diplomacy opportunities.

We emphasize that basic sciences remain ever more important for understanding and addressing the complex Anthropocene processes. Curiosity-driven science has big payoffs that often come about in unpredictable ways, mostly in the longterm, but increasingly even in the short term.

The Pontifical Academy of Sciences continues to address issues of science skepticism in society and media. It is necessary to further consider at the Plenary 2024 the determinants of these trends, the role that religion may play in openness to science, and the opportunities of science education to make a difference. The 2024 Plenary Session includes discussions with leaders from various global academy and science policy networks. This shall continue our Academy's strong track record to identify scientific solutions and engage with political and societal actors, including faith-based communities, and the Church in particular, to implement innovative actions for overcoming the most serious problems facing humanity. This is especially important when crises, wars, and growing risks trouble people and planet, as is currently the case. Purposeful sciences must have peace as a goal, as peace is a precondition for sustainable development.

1. [Resilience of People and Ecosystems under Climate Stress](#) Workshop | 13-14 July 2022
• [Science and Survival. A Focus on SARS-CoV-2 and Connections Between Large-Scale Risks for Life on This Planet and Opportunities of Science to Address Them](#) Plenary Session | 7-9 October 2020
• [Science and Sustainability. Impacts of Scientific Knowledge and Technology on Human Society and its Environment Plenary Session](#) | 25-29 November 2016
• [Climate Change, Health of the Planet and Future of Humanity Workshop](#) | 15 November 2018
• [Biological Extinction: How to Save the Natural World on Which We Depend Workshop](#) | 27 February - 1 March 2017

2. [Robotics, AI, and Humanity: Science, Ethics, and Policy](#). Conference Workshop 16-17 May 2019 and Publication.
• [Big Data and Science: Relevance of Computational Sciences for Data Collection, Data Storage and Data Management in Basic and Applied Scientific Investigations](#). Proceedings of the Working Group 17-18 November 2015
• [Power and Limitations of Artificial Intelligence](#). Workshop 30 November - 1 December 2016.