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Perspective

The 2020s:
A critical decade for sustainability

Stephen A. Matlin

With the turn of the year and the decade just passed, many people have been referring to the 2020s as a 'critical decade' for sustainable development. This notion that we have entered a particularly sensitive time period has at least two separate strands of concern and two different time horizons, which intertwine to give a unique urgency to our thoughts and actions for the coming years.

The first strand is related to the UN Sustainable Development Goals (SDGs).[1] This ambitious set of 17 goals and 169 targets, agreed by all members states of the UN in 2015, has a delivery date of 2030. Reviews of progress at the 5-year point in 2020 are underway and no-one has any illusions that all is on track for smooth completion by 2030.

The SDGs and their deadline were agreed by negotiations among countries and institutions after much debate and quibbling over precise details. There is real urgency in delivering on the promises made – because if there is slippage in the rates at which some people are brought out of poverty and to equitable levels of access to good health, quality education, clean water and sanitation, freedom from hunger and discrimination, etc, these people will suffer: some will die and others will have their life circumstances permanently impaired.

The second strand concerns an even bigger and more threatening set of circumstances and also carries with it an even graver set of long-term consequences for everyone. This involves the timescale on which human response is required to an accelerating combination of environmental threats.

The 1972 book *The Limits to Growth* published by the Club of Rome[2] warned about the growing impact of uncontrolled consumption. Such concerns[3,4] about the limits of resources and the Earth's carrying capacity for its population and for the increasing levels of anthropogenic pollutants were forerunners of the concept of 'planetary boundaries' presented by Rockström and colleagues[5] in 2009. They proposed nine Earth system processes of critical importance for sustainable development. Boundaries were identified that define a 'safe operating space for humanity' and updated quantitative estimates for several of the boundaries were published in 2015.[6] Most of these boundaries have direct chemistry correlates, as expressed in the quantitative chemical measure of the chosen control variables, including the very large biogeochemical flows of carbon, nitrogen and phosphorus that represent largely uncontrolled ejection of waste into land, sea and air as a result of human activity.[6]

Since the mid-20th Century, there have been steep and correlated increases in the rate of change of many socio-economic indicators and features of the Earth System (defined[7] as Earth´s interacting physical, chemical, and biological processes), illustrated schematically in Figure 1.[8,9,10,11] This phenomenon, described as the 'Great Acceleration' has resulted in a heightened level of concern about the sustainability of the planetary environment that is reflected in the use of terms such as 'crisis' and 'emergency' and in efforts to have the current period officially designated as the Anthropocene Epoch in recognition of the fact that human beings are now the most powerful force determining the conditions prevailing at the planet's crust.[12,13,14,15]

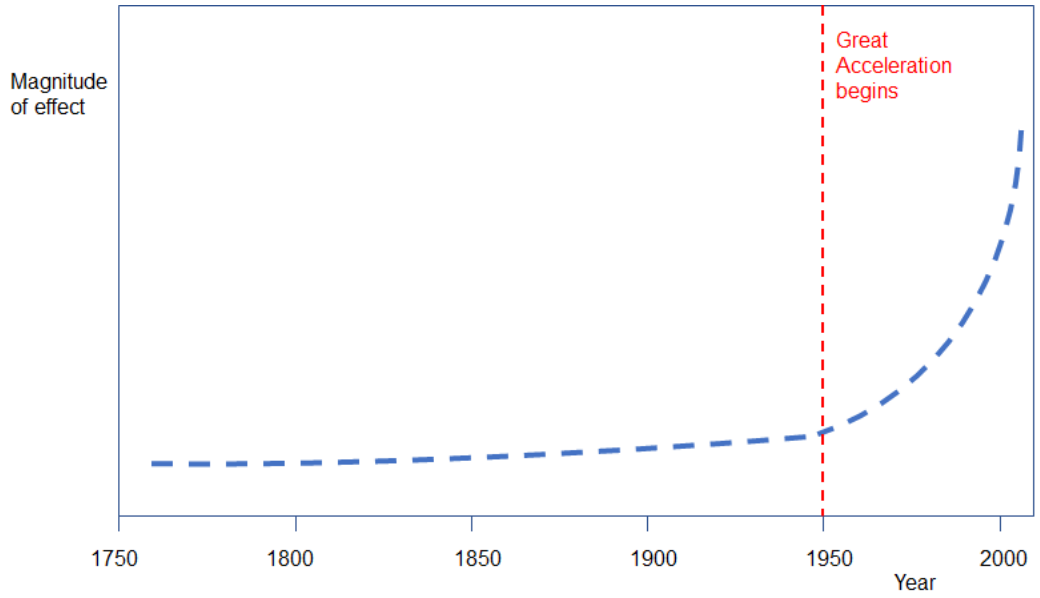

Figure 1 Schematic representation of trends from 1750 to 2010
----- illustrates trends for: **(a) Socio-economic indicators:** population, real GDP, forest direct investment, urban population, fertilizer consumption, large dams, water use, paper production transportation, telecommunications. **(b) Earth System environmental indicators:** carbon dioxide, nitrous oxide, methane, stratospheric ozone, surface temperature, ocean acidification, marine fish capture, shrimp aquaculture, flux of nitrogen into the coastal margin, tropical forest loss, domesticated land, terrestrial biosphere degradation.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reported in May 2019 that the health of ecosystems on which human beings and all other species depend is deteriorating more rapidly than ever. In what is emerging as the 6th mass extinction of species in the planet's history, species are being lost 1,000 times faster than the natural rate of extinction.[16]

In the face of the acknowledged environmental crisis[17] and planetary climate emergency[18,19,20] and the need to achieve climate security,[21] in 2019 the UN urged the international community to take effective action on climate change.[22] The UN Secretary General and General Assembly President warned that "we are the last generation that can prevent irreparable damage to our planet" and that inspiration must be drawn from the thousands of students worldwide demanding tangible action.[23, 24,25]

Adding to the urgency of making radical changes to the prevailing patterns of human activity, new analyses are focusing on the concept of tipping points – sudden and irreversible environmental changes.[26,27,28,29,30] Rockström[31] has cautioned that *"In 50 years we tipped from the Holocene of the last 10,000 years to the Anthropocene. What we do in the next 50 years will determine the next 10,000 years."* An emergency response of rapid action to reduce emissions has been called for is to stop the 'tipping cascade' that is now threatened.[32]

So, the 2020s will indeed be a critical decade, during which decisions taken and actions executed by governments, organizations, industries and people everywhere will have profound effects on the lives of individuals and the conditions in the planetary environment, both in the immediate term and for a very long time ahead. Science has immense capacities to help meet these challenges – and to do so it needs to make its best efforts to deliver evidence, advice and products, but also to engage effectively with society and policy makers to ensure that sound pathways are chosen towards sustainable development and the sustainability of the planetary environment.

The IOCD action group, *Chemists for Sustainability*[33] (C4S) focuses on the role that chemistry must play in contributing to a more sustainable future,[34] The group has emphasised[35] the need for chemistry to adopt systems thinking[36] and cross-disciplinary[37] working to optimise its capacity to fulfil its role.

Stephen Matlin *is a visiting Professor in the Institute of Global Health Innovation, Imperial College London and Secretary of the International Organization for Chemical Sciences in Development, Namur, Belgium.*

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