the Pontifical Academy of Sciences

Summary of the Joint PAS/PASS Workshop on Sustainable Humanity, Sustainable Nature: Our Responsibility

In May 2014 the Pontifical Academy of Sciences and the Pontifical Academy of Social Sciences held, at the Casina Pio IV, a Joint Workshop devoted to sustainable development. In the four days of the workshop, thirty-eight talks were presented by members of the two Academies and by invited experts, and half of the available time was spent on discussions. This report is on the main topics dealt with, on the identified roles of past, present and future development, and on proposed measures to be taken in order to ensure the long-term sustainability of forthcoming development in the context of the ongoing cultural evolution of mankind.

The Roots and History of Mankind

Referring to another workshop held in May 2013 at the Casina Pio IV on “Via Humanitatis”, the participants were reminded that the species *Homo* has its roots about 7 million years ago. We can date the start of mankind’s cultural evolution with the start of agriculture, i.e. the domestication of some plants and of some animals. This contributed about 10,000 years ago to ensuring the nutrition of humans. At this early time, members of the species *Homo Sapiens*, driven by their intellectual capacity and curiosity, might have reflected on the possible roots of themselves and of their environment. The chapter of Genesis is a remarkable testimony to the world view of several thousand years ago, containing the results of early scientific observations complemented with religious beliefs. In the past centuries, scientific investigation has become considerably more powerful. But it is only in the last about 200 years that scientific knowledge has become enriched to a degree to allow mankind to develop applications of this knowledge to facilitate its life in its encountered environment. Today, we realise that some of these biomedical and technological applications can also have specific risks. This aspect has to be considered to ensure the sustainability of future development.

Based on available astrophysical knowledge, we can assume that the cosmic evolution of our solar system together with planet Earth will persist for a few thousand million years. We can also assume that biological evolution can continue on our planet for a very long time. The sustainability of cultural developments should take this aspect into account. However, in view of the difficulties in predicting future natural developments, it is proposed that our reflections should be made with a time horizon of 10 million years, or more feasibly of 10,000 years, and not only for a few human generations.

The Science-Based Impact on the Health and Facilities of Human Beings

Statistical data reveal a remarkable increase in the past decades of human life expectancy for people living in developed countries. This is largely due to applications of available biomedical knowledge for better healthcare, including the provision of appropriate nutrition. So far these benefits have not fully reached a majority of people living in developing countries. We are aware that this still ongoing improvement of life conditions contributes to the considerable increase in the human population on our planet.

An increasing number of technological applications of scientific knowledge also contribute to facilitating our daily lives. Historical examples are: the introduction of steam power, railroads, telegraphy, electrification, automotive transport, aviation, industrial chemistry, computing and now the digital revolution, biotechnologies, nanotechnologies and robotics. Those advances have reshaped the world economy into one that is increasingly urban and globally connected. However, just as humanity confronted “Revolutionary Change” (*Rerum Novarum*) in the Age of Industrialization one hundred and fifty years ago, today we have become a geological and geobiological force and this compells us to redefine the current age as the Age of the Anthropocene.

The Potential Risks of Human Innovations in the Anthropocene

Besides their envisaged benefits for humans and in some cases for the environment, science-based innovations may sometimes also have specific risks. It is in principle possible to predict some such risks by a good technology assessment before the introduction of the innovations. On the other hand, indicators for unexpected risks show up, often some time after the introduction of an innovation. The sustainability workshop paid particular attention to indicators of a climate shift due to a number of introduced technological applications, such as the use of coal and fossil oil as sources of energy. Obvious indicators in this case are a statistical increase in the average global temperature; glacier retreat both in high mountain areas and in polar regions, including the melting of sea ice and causing a sea level rise with increased flooding risks in coastal zones; and finally the melting of permafrost which in some cases is accompanied by the liberation of the greenhouse gas methane. Other observable effects are health-threatening air pollution in densely populated areas, as well as ocean acidification. On the other hand, increased concentrations of life-supporting components with nitrogen and phosphorus, in rivers, lakes and oceans due to the intensive use of fertilisers in agriculture, contribute to changes in life diversity in the related aqueous habitats. It is to be expected that these kinds of undesirable effects will continue to strengthen without measures being taken to prevent them.

Workshop participants also discussed both positive and negative impacts of people living in megacities, including in their slum areas providing shelter to socially excluded people.

Measures Proposed to Prevent and Mitigate Negative Impacts on the Sustainability of Cultural Development

First of all, the workshop participants favour active contributions to ameliorate the living conditions of poor populations, particularly in developing areas of our planet. This should be accompanied by measures anchored both in the natural sciences and in the social sciences. As an example, unhealthy daily nutrition only providing calories can be improved by a richer and more diverse daily diet including the regular provision of essential micronutrients. Genetically modified Golden Rice containing a precursor of vitamin A is an excellent example of the feasibility of this proposal and its beneficial effects.[1]

Secondly, a number of measures can contribute to mitigating the role of a continued anthropogenic climate change. A good example is a possible shift to alternate sources of energy, such as solar energy and wind energy. Additional technologies are within possible reach.

Thirdly, agricultural practices should be reconsidered, including those introduced by the green revolution, in order to minimise undesirable environmental impacts in the longer term. For example, nature uses biological means to fix nitrogen. This can render plant growth much less dependent on fertilizers, although with some negative effects on the yield per unit of land surface.

Fourthly, the already mentioned process of science-based technology assessment should in principle be applied before any wide application of novel technological inventions. Similarly, political measures related to environmental aspects should also become submitted to science-based policy assessment before the introduction of the proposed measure.

Fifthly, partnerships between scientists, enterprises and political leaders, rather than single individuals or enterprises, should be involved in the introduction of novel innovations.

Sixthly, special efforts should be made to rapidly integrate available scientific knowledge on the laws of nature relating to life functions, including life evolution, into everybody’s knowledge. This may require specifically devised educational programmes.

Finally, the workshop participants considered negative impacts on sustainable life conditions by the increasing density of the human population. Appropriate goals should be set to reach quickly a more stable equilibrium that can persist without a negative impact on the highly appreciated biodiversity and diversity of habitats on our planet Earth, which has a constant size and a very long life expectancy.

These defined measures can beneficially contribute to the long-term sustainability of the future evolution of life and of environmental habitats offered by Mother Nature to all living organisms.

[1] cf. *Transgenic Plants for Food Security in the Context of Development*, Proceedings of a Study Week of the Pontifical Academy of Sciences, Ingo Potrykus and Klaus Ammann (eds.), New Biotechnology, Vol. 27, Issue 5, November 2010, Elsevier, Scripta Varia 113, ISSN 1871-6784.