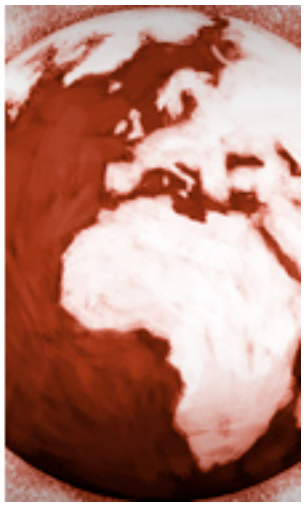
Interactions between Global Change and Human Health

Working Group





The Pontifical Academy of Sciences is sponsoring a workshop on *Interactions between Global Change and Human Health* which will take place 31 October - 2 November 2004. This workshop will have as its goal to identify the connections and feedbacks by which the various aspects of Global Change can affect human health (with a focus on infectious disease), and the potential mechanisms by which disease events may influence the biogeophysical environment.

Workshop Goals

As humanity is entering the 21st century, three issues related to our well-being figure prominently in the public concern: Socio-economic development, adverse changes in the environment, and human and animal health. Each of these issues is written about in the media, each has a community of scientists researching and discussing it, and each is the subject of national and international political activity. Yet, while they have usually been discussed as separate issues, they are really components of a coupled system. The workshop has as its central purpose to analyze the feedbacks and interactions between the three components of this system:

The challenge will be to hypothesize on so far unsuspected links between the three components. For this purpose, the workshop will bring together experts from the three fields, carefully chosen not only for their knowledge in their own field, but also for their ability to look across boundaries of scientific disciplines and communities.

Developments in Socio-economics, Health and Environment

Socio-economic Development. It is widely acknowledged that sustainable socio-economic development is the shortest way for the promotion of well-being and good health. Such development is characterized by a healthy economy and low inflation, full employment and high incomes, efficient social security and assistance, good educational systems, adequate public infrastructure, increased material production and access to goods, and political freedom and stability. (Furthermore, a comprehensive approach to sustainable development requires that these social changes occur within the constraints of the biosphere – i.e., are in accord with the criteria of ecological sustainability.) However, at the global level, this process has been an uneven achievement, and major inequalities are persisting and even increasing among regions and countries. Various factors resulting from social development (advances in medical technology, increased health awareness and efficient transmission of data and information, large-scale industrial production, and the expansion of health and humanitarian care) are available globally, at least in principle, and should enhance disease control. In reality, however, these factors have actually neither prevented the spread nor mitigated the impacts of infectious diseases worldwide. Not only the poor countries are vulnerable to the emerging/resurging infections, but several infectious processes have emerged or have spread uncontrolled in developed countries: SARS; AIDS; West Nile Virus; Lyme disease; hantavirus pulmonary syndrome; hemolytic-uremic syndrome (E. coli H7O157) and methicillin-resistent Staphylococcus aureus. This is a clear indication that the interactions of factors other than those usually associated with poverty also play an important role in this process.

Human Health: Although infectious and parasitic diseases have been part of human life for thousands of years, as the paleopathological records have shown, the current rates of their emergence and spread and the magnitude of their impacts are unprecedented in history. At least 30 infectious agents either became known as new human pathogens and/or have increased globally in the past 25 years. Humans are spreading into the last corners of the tropical forest, where they are encountering diseases for which they have not evolved resistance. Existing national and international surveillance systems and control programs were not able to detect the emergence of new diseases quickly enough to prevent their spread. There is evidence that this threatening prospect arises from a complex association of phenomena of different types: increasing population densities and mobility; rapid and long-distance trade; decreased biological resistance of the human host (psychological stress; malnutrition; chronic diseases and ageing; drugs); failure of public health systems; fast technological change; feeding habits; large scale environmental modifications, and genetic changes in microorganisms, to name but a few.

Global (Bio/geophysical) Change has in the public discussion been used almost synonymously with Climate Change. The issue is much broader, however. Over the past two centuries, the tremendous growth of the human population and the high resource demand of technologically developed societies have made humanity a geochemical and geophysical force, able to compete with Nature’s forces and to threaten the functioning of the Earth System. Human activities are changing the composition of the biosphere, atmosphere and hydrosphere, are affecting global climate, and may even perturb the main circulation patterns of the Ocean. Because of the

numerous feedbacks and teleconnections in the Earth System, the changes resulting from such perturbations are likely to be non-linear and may contain abrupt discontinuities. Examples are sudden changes in atmospheric composition (e.g., the Ozone Hole), the collapse of the Amazon forest, or the breakdown of the Gulf-Stream circulation in the North Atlantic.

Examples of Linkages Between the Three Components

Diseases can cause massive disruptions in human societies. History is full of examples: syphilis, malaria, plague, cholera, Spanish influenza, tuberculosis, and AIDS are among the most well known. Others loom on the horizon: dengue fever, Ebola, Hantavirus, west Nile fever, SARS, etc. In many instances, disease outbreaks have destroyed societies to the point where they were not able to recover. In a less globally-connected world, such effects were more or less regionally contained and could not spread globally. Nowadays, in a contiguous worldwide human population with high connectivities and few barriers to transmission, infectious agents can move about quickly. At the same time, socio-economic effects can propagate worldwide in a very short time. Disease outbreaks do not arrive out of nowhere – in most cases agents and vectors have already been present, but specific environmental conditions and social-environmental characteristics were required before an epidemic or pandemic could occur. Often these are suggestive, but hard to pin down. Was the socioeconomic disruption and movement of people in World War I a prerequisite for the 1918 Spanish Flu pandemic that is thought to have cost 20-40 million lives worldwide? What were the linkages between trade and plague, travel and SARS? High population densities in close contact with animal reservoirs of infectious disease make possible the rapid exchange of genetic material. Malnutrition is of epidemic proportions in many developing countries, providing large immune-compromised populations that diseases can spread into very rapidly. Climate change may play a similar role: Warmer and wetter climate conditions may facilitate the spread of diseases, such as malaria and dengue fever.

What is the nature and importance of the environmental impacts associated with large-scale disease outbreaks? Human activity and the global environment have become inseparable, and consequently the future of the bio/geophysical Earth System is dependent on human stewardship. Conversely, the human economy and society is totally dependent on the functioning of the life support systems of the Planet to provide clean air and water, nutrition, a stable climate, etc. What would be the consequences of the economic losses, changes in human behavior, abrupt demographic change, etc. for the way humanity manages its environment? How would this influence climate change scenarios?

At present, we are already witnessing one way in which human health issues affect climate change: The concern about the health effects of pollution aerosols from power plants etc. is leading to much more efforts to control emissions than had been anticipated. Since these aerosols would have a cooling effect on climate, such emission reductions may lead to accelerated climate warming over the next century.

While the interactions between infectious disease and climate change will be the focus of this workshop, we should not fail to mention that climate change, and especially the extreme climate events associated with it, are already taking a toll in human lives, as exemplified in the substantial

number of excess deaths associated with the extreme heat period in Europe during the summer of 2003.

Looking into the Future

Scientists in socioeconomics, health, environmental and climate science have all evolved scenarios for the future. In some cases they have been combined, such as in the climate change scenarios of the Intergovernmental Panel of Climate Change. Many potential scenario parameters and feedback loops are, however, missing.

What are the prospects for the occurrence of large disease events now and in the near future? New diseases are showing up all the time, and old ones may be staging a comeback. Do we know enough about influenza and its socioeconomic drivers to anticipate a recurrence of the 1918 flue epidemic, with the potential of tens of millions of fatalities? Is society better prepared if such an outbreak occurs? Medical science may be more advanced now than in 1918, but what would be the chances to deliver its benefits to 6 billion people fast enough?

Socioeconomic behavior is as much driven by perception and psychology as by “hard facts”. The perception of an impending pandemic may lead to rapid economic collapse in a World economy dependent on fast global exchange of goods and services – see the recent economic effects of a very few cases of SARS! On the other hand, the ongoing socioeconomic devastation by AIDS in Africa has led to relatively little action, even in some of the most affected countries.

Global change is difficult to measure – this applies to climate change, but even more so to sustainable development in socioeconomics, environment and health. What are the current indicators of well-being that could be considered markers of global vulnerability to the emergence and impacts of these outbreaks? What are indicators of potential breakpoints and thresholds in the system? Could a measure of population health serve as an index of sustainable development in a more general sense?

Prevention and Mitigation

Finally, there should be no diagnosis without at least a suggestion of therapy. What can be done to prevent health disasters from occurring or to mitigate their effects? How can we manage the Earth environment to minimize the threat to human health? What are the available resources, on a global scale, to cope with these threats, from the scientific, economic, institutional and political perspectives? These and other emerging questions will be discussed at the workshop.