8th EMBO/EMBL Conference on Science and Society

The Future of Our Species – Evolution, Disease and Sustainable Development

2–3 November 2007

at the

European Molecular Biology Laboratory,
Heidelberg, Germany

Organising Committee:
Andrew Moore (EMBO, Chair)
Halldór Stefánsson (EMBL)
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Some say the world will end in fire;
Some say in ice.
From what I've tasted of desire
I hold with those who favor fire.
But if it had to perish twice,
I think I know enough of hate
To know that for destruction ice
Is also great
And would suffice.

Robert Frost (1874 – 1963)

But what of the human race?...

Welcome Message

The Earth will theoretically be habitable for another 5 billion years – based on the predicted life-span of the sun – so there is much more time in front of, than behind, *Homo sapiens*. Since we have existed for between 50,000 and 100,000 years, we may have between 100,000 and 50,000 times as long again – on Earth, that is. If we survive that long, what will we look like? Humans started evolving from early hominids around 4 – 5 million years ago, and we might have up to 1,000 times as much evolutionary time still at our disposal – plus some interesting genetic tools.

In "The Time Machine" HG Wells wrote of a human race that had diverged into two sub-species, one dependent on the other for menial but vital tasks, both reduced to a level of intelligence verging on idiocy. The theme of divergent evolution never fails to capture our credulity, even though it remains science fiction: just a year ago, newspaper headlines around the world were reverberating with references to a work predicting that humans would split into a genetically well-endowed upper class and a dim-witted underclass in around 100,000 years time. According to the author, Oliver Curry, at the London School of Economics, his "think piece", produced for Bravo Tele vision, was picked up by the media and reported as fact.

Given the timescale involved, the question as to why we care about our future evolution is interesting in its own right. But care we do, even if phenomena that we are currently experiencing (or hearing about) arguably hold sway over our future in the short term. Our fast-changing environment is a major factor influencing our future, and considerations of sustainability for *human* survival may not be identical to those needed to sustain every species on the planet. The changing face of humanity depends very much on our social and economic evolution, and strategies for sustainability. These in turn mesh with the gears of nature in an intricate interplay of exogenous factors such as climate change and disease. It is with such topics – themselves intimately intertwined – that we begin this conference, which aims to promote greater dialogue, expression of views and understanding between various sectors of society, professional and lay. We wish you an engaging and enjoyable two days.

Andrew Moore, PhD
Manager, EMBO Science & Society Programme, Chair of the conference organising committee

EMBO

EMBO was founded in 1964 by European scientists at the forefront of the molecular study of biological entities. Its mission is to promote the life sciences in Europe and neighbouring countries.
Today EMBO has over 1,200 members from all areas of the life sciences, elected annually on the basis of proven excellence in research. The core EMBO activities consist of transnational long-term and short-term fellowships and courses and workshops in the latest molecular biology results and methods. More recently, Science & Society and a programme of support for young group leaders have also been added to the General Programme. These activities are funded through contributions from the 26 member states of the EMBC (European Molecular Biology Conference). *EMBO reports*, a relatively new publication, complements the established and respected *EMBO Journal*, hosting not only excellent scientific articles, reviews and meeting reports but also a large section on Science & Society, science politics and policy. March 2005 saw the launch of a new open-access, online publication from EMBO and Nature Publishing Group (NPG), *Molecular Systems Biology*, which is dedicated to the emerging field of systems biology. In general terms, EMBO plays an increasing role in policy-making at European level, having driven discussions on the European Research Council and playing a pivotal role in supporting the European Commission in this area.
EMBO's Science & Society Programme, the main organiser of this conference, develops and organises resources and events that directly or indirectly support the communication of the scientific community with the public, media and policy makers. From international practical workshops for science teachers to the EMBO Award for Communication in the Life Sciences, the programme helps to create a balanced public dialogue on molecular biology and its applications.

More information on EMBO and the Science & Society Programme is available at: *www.embo.org*

EMBL

The European Molecular Biology Laboratory (EMBL) was established in 1974 and is supported by nineteen member states including nearly all of Western Europe and Israel. EMBL consists of five facilities: the main Laboratory in Heidelberg (Germany) and Outstations in Hamburg (Germany), Grenoble (France), Hinxton (UK) and Monterotondo (Italy).
EMBL is one of the top research institutions in the world; it is the flagship of European molecular biology, ranking as the highest non-US institute in research performance in a study by ISI Science Indicator for 1992-2002. More than 1400 people from 60 nations currently work at EMBL; the more than 3,000 alumni form a network of connections throughout Europe and the world. EMBL is a world-renowned international centre for advanced training and has had the right to award its own PhD degrees since 1997.
The cornerstones of EMBL's mission are: to conduct basic research in molecular biology, to provide essential services to scientists in its Member States, to provide high-level training to its staff, students, and visitors, to develop new instrumentation for biological research, and technology transfer. These core functions are combined with significant outreach activities in the areas of Science and Society and training for science teachers.
EMBL's Science and Society Programme, the main organizer of this conference, was established in 1998 with the aim to promote a better and broader understanding of the life sciences and of their impact on societies. The EMBL Science and Society Programme organizes a variety of activities and events at which members of the life science community, scholars from other disciplines, as well as members of the public meet to dialogue and debate. The new ways in which science is now being applied for the production of knowledge and economic wealth must be carefully adjusted to public interests and values in multicultural societies. It is the common responsibility of all, scientists as well as non-scientists, to engage in an ongoing process of carving out a shared understanding of science. Our efforts at the EMBL are motivated by such concerns.

For more information about EMBL and its Science and Society Programme please consult: *www.embl.org*

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Session I

Emerging, re-emerging and persistent diseases

New and re-emerging infectious diseases pose a rising threat to global health as well as to economic growth and development and will complicate global security over the next 20 years. Infectious diseases have played a major role throughout evolution, and major pandemics had an enormous impact on our history and the development of the modern world. Also today, infectious diseases are a leading cause of death, accounting for about one third of the estimated 54 million deaths worldwide, according to data from the WHO. Sub-Saharan Africa will remain the region most affected with nearly half of the infectious disease-caused deaths worldwide. The spread of infectious diseases results as much from changes in human behaviour – including lifestyles and land use patterns, increased trade and travel, and inappropriate use of antimicrobial drugs – as from mutations and changes in pathogens. Twenty well-known diseases, including malaria and tuberculosis, have re-emerged or spread geographically during the past 30 years, often in more virulent and drug-resistant forms. Drug-resistant microorganisms increasingly affect our options to treat severe infections and threaten to largely disarm our therapeutic arsenal. Furthermore, at least 30 previously unknown disease agents, including human immunodeficiency virus, the causative agent of AIDS, and hepatitis C virus have been identified during the last few decades. New pathogens of potential major importance are constantly appearing or lurking around the corner with recent examples including the agents causing mad cow disease, SARS, and bird flu. Most if not all of these new additions originate from animal to human transmission with many more pathogens affecting animal health, economic development and biodiversity. Today, perhaps for the first time in history, it is possible to launch a truly global response to the major infectious diseases. While some effective prevention and treatment strategies have been available, political will and social support are materializing to help the world to fight the deadly epidemics. The principal questions guiding the theme of this session are: (i) What are the examples of serious emerging diseases, and how/where do they originate? (ii) What can we predict, and how can we prepare and react? (iii) What progress are we making against existing serious diseases worldwide?

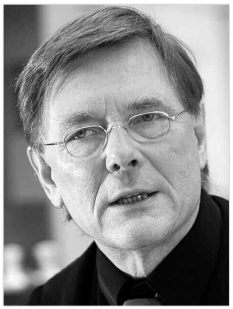
Session chaired by Hans-Georg Kräusslich
Speakers: Albert Osterhaus, Peter Fonkwo
Panellists: Riccardo Cortese, Julian Davies, Innocent Nzeyimana, Gérard Krause

Hans-Georg Kräusslich

University of Heidelberg,
Germany

Hans-Georg Kräusslich obtained his doctoral degree from the University of Munich in 1985. After a three year post-doc in virology at the State University of New York in Stony Brook, he established his group at the German Cancer Research Center in Heidelberg. In 1995 he accepted an offer to head the department of cell biology and virology at the Heinrich-Pette-Institute in Hamburg, and in 1997 he became director of the same institute. Since January 2000, Hans-Georg Kräusslich is professor for virology and director of the department of virology at Heidelberg University.

For most of his career, Hans-Georg Kräusslich has been studying the replication of human immunodeficiency virus, focusing on the late steps of replication, including virus formation and maturation. This work addressed important aspects regarding function and inhibition of HIV protease and resistance development. More recent studies also involve the viral entry mechanism as well as host cell factors involved in virus replication including systems biology approaches. Currently, he is coordinator of an EU-project on HIV protease-inhibitor resistance, of a center grant on control of tropical infectious diseases at the University of Heidelberg and of a cluster of excellence on cellular networks



Albert Osterhaus

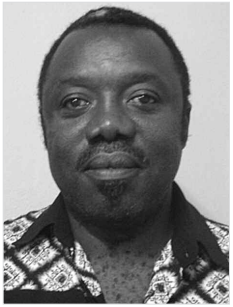
Erasmus MC,
Rotterdam, The Netherlands

Professor Osterhaus started his career in Utrecht (The Netherlands) where he graduated with distinction at the faculty of veterinary sciences. In 1978 he received his PhD degree with Prof. Horzinek. He then moved to the RIVM in Bilthoven, where he stayed until 1994. Since then, he has been working at Erasmus MC in Rotterdam. Thirty years of experience in animal and human virology have resulted in a specific interest in viruses that ordinarily affect only animals but that can cross the species barrier. He is now a leading authority, able to identify dangerous and elusive new viruses with speed and precision. His team reacted with exceptional speed to the SARS outbreak of 2003 and identified the responsible coronavirus within days. This allowed the WHO to effectively diagnose and isolate suspected cases immediately, and in part as a direct result of Osterhaus' determination, passion and commitment, SARS was brought under control and countless lives were saved. In 1997 he and his team silenced skeptics when they proved that Avian Influenza (H5N1) could be transmitted to humans. On the basis of this discovery professor Osterhaus has enabled health authorities to prepare for potential outbreaks, and, as an individual, has campaigned determinedly for awareness, calling for a global taskforce to prepare for and combat viruses such as H5N1. Throughout his professional career Osterhaus and his team have identified around twenty 'new' viruses (such as the human metapneumovirus, hMPV and a novel human coronavirus, HcoV-NL) as well as countless new possible hosts. His research includes studies on virus reservoirs in wildlife, mechanisms of transmission and pathogenesis of zoonotic viruses. In addition, innovative fundamental research on the natural and vaccine-induced immune response and on antiviral drugs is performed to combat the threat posed by (zoonotic) virus infections. As part of his tireless active interest in public health, Osterhaus has acted as PhD mentor for ~40 students, written over 700 academic articles, created biotech companies and held several editorial positions. The continuous and groundbreaking work of the so-called "virus hunter" has helped prevent and control the spread of deadly viruses and will continue to do so, saving countless lives and changing the face of world health today.

Emerging viral threats to human health in the last 25 years

In the past century, pandemic outbreaks of influenza and AIDS have cost the lives of tens of millions of people. These events were all caused by multiple introductions of animal viruses – influenza A viruses and SIV of birds and non-human primates respectively – into the human population. Besides these introductions causing major pandemics in humans, a large number of other virus infections have spilled over from animal reservoirs to humans or other susceptible species, resulting in considerable morbidity and mortality as "virgin soil" epidemics. The most recent examples in humans are the introduction of SARS coronavirus and influenza A viruses (H5N1 and H7N7) from the animal world, which caused global concern about their potential to be at the origin of new pandemics. Over the last decades there seems to be a dramatic increase in the emergence or re-emergence of virus threats in humans and animals worldwide. A long list of exotic names like Ebola, Lassa, Rift-Valley, Crimea-Congo, Hendra, Nipah and West-Nile is the illustration of names of just some of the places associated with the origin of viruses that crossed the species boundary to humans, with dramatic consequences in the last ten years alone. Similarly, recent mass mortalities among wild aquatic and terrestrial mammals caused by previously known and newly discovered morbiliviruses, as well as outbreaks of hog cholera, foot-and-mouth disease and fowl plague among domestic animals, highlight this trend

Although improved detection and surveillance techniques, as well as increased media attention may have contributed to our perception of an increase in the incidence of outbreaks of virus infections, it is becoming more and more clear that major changes in our modern society increasingly create new opportunities for virus infections to emerge: a complex mix of changes in social environments, medical and agricultural technologies and ecosystems continues to create new niches for viruses to cross species boundaries and to rapidly adapt to new species. In combating this global threat, we should make optimal use of the new tools provided by the unprecedented advances made in the research areas of virology, molecular biology, immunology, epidemiology, genomics and bioinformatics. Serious investment in these areas in the future will not only be highly cost-effective but will also save many lives of humans and animals. In addition, better collaboration and coordination between all the stakeholders is urgently needed, to establish early warning systems and effective preparedness plans.



Peter Ndeboc Fonkwo

Freelance International Consultant in Public Health, Cameroon

Born in Cameroon, Peter Fonkwo is a public health physician, is married and father of five children. He studied first at the Faculty of Sciences of the University of Yaounde, Cameroon, and then at the University Centre for Health Science in Yaounde, from September 1980 to June 1986, where he received a Doctorate in Medicine. In June 1986 he was appointed as Sub-Divisional Chief Of Service for Public Health and Medical Officer of Bangem Sub-divisional Hospital until June 1990.

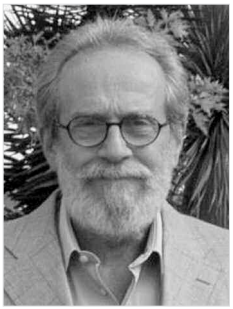
From September 1990 to September 1991, he attended the University of Heidelberg Germany, and earned a Masters degree in Community Health and Health Management. Back in Cameroon, he worked for the Ministry of Health until August 1999, first as Divisional Chief of Service for Public Health and District Medical Officer for Nkam Division, and then as Provincial Chief of Service for Community Health in the Southwest Province of Cameroon. From August 1999 to October 2003, he was recruited by JHPIEGO (an international health organization affiliated with The Johns Hopkins University in Baltimore, USA) as Resident Advisor in charge of the in-country management of a USAID-funded "Projet Santé Familialle et Prevention du SIDA en Afrique de l'Ouest et Centrale". Between 2003 and 2004 he served the Ministry of Public Health of Cameroon as sub-director in charge of international partnership and JHPIEGO Corporation Baltimore as Country Representative on a 50 to 50% basis. Since June 2004 to date, he has worked mostly in African countries for international organisations like WHO, GTZ (German Society for Technical Co-operation), CARE, UNFPA (United Nations Population Fund), OCCEAC/KFW (Common Organization for Economic Cooperation in Central Africa), and EPOS Germany as freelance international consultant in public health.

The public health implications of emerging, re-emerging and persistent diseases for the future of the human species

Emerging and re-emerging diseases are fast becoming a major public health concern the world over. Infectious diseases like tuberculosis, cholera, and even diphtheria, which once seemed to be getting under control, are making major comebacks. They are re-emerging. Even though some diseases such as poliomyelitis have been nearly wiped out, it is most likely that the vast majority of them will not be eliminated in our lifetime. According to the World Health Organization reports, at least 30 new diseases have been scientifically recognized around the world in the last 20 years. These emerging diseases include diseases caused by the Ebola virus from Africa, HIV and *Cryptosporidium*.

So far researchers have generally been lucky in finding new answers to the hurdles of persistent, re-emerging and most new disease entities. Specialists in community and individual health education are in contact with the population in the bid to foster preventive measures as complementary interventions to such public health research. The major and dreadful question now is what happens if the human species ran out of luck and found itself without an appropriate response to any emerging or re-emerging disease?

This presentation takes us back into history to look at some major events the world over that are related to outburst of infectious diseases, and to gather some lessons which we might be forgetting, in the bid to set the basis for future actions against this major problem. It highlights the many changes taking place within the ecosystem with the human species at the centre as actor or victim. This phenomenon seems to spare no continent and no population, especially given the increasingly easy inter-population mix these days. While some of favoring factors are man-made, others are more due to a natural evolution of things. Unfortunately scientists can't predict with precision how our species will adapt to changes over the next millennium, let alone the next million years. Based on the lessons learnt from past events, which sometimes had devastating impact on the human species, this presentation highlights the dangers the human species might run into if appropriate action is not taken immediately. It ends with some proposal of lines of action for the future.



Riccardo Cortese

Okairòs,
Basel, Switzerland

Riccardo Cortese is the president and Chief Executive Officer of Okairòs (www.okairos.it), a new Biotech Company dedicated to the development of vaccines for chronic infectious diseases, including Hepatitis C, Malaria, Tuberculosis.
He received his medical degree from the University of Naples, Italy, and his PhD at the University of California at Berkeley, USA. He is full professor of Molecular Biology at the Medical School of the University of Naples. He has been the Founder and first Director of the Gene Expression Program at the European Molecular Biology Laboratories, Heidelberg, and Founder and Scientific Director of IRBM, now a fully owned Merck subsidiary. He has coordinated the efforts leading to the development of several novel antiviral drugs and vaccines which are now at various stages of clinical development. He has published in leading scientific journals including Nature, Science and Cell, on a range of topics in immunology, molecular medicine and drug discovery. He is an elected member of several international associations, including the Academie Francaise, The Academia Europea and EMBO.

Julian Davies

University of British Columbia,
Vancouver, Canada

Julian Davies is Emeritus Professor of Microbiology and Immunology at U.B.C. Trained as an organic chemist, he switched to molecular microbiology in 1962 when he joined the Department of Bacteriology and Immunology at Harvard Medical School. Subsequently, he held academic positions at the University of Wisconsin, University of Geneva, and Institut Pasteur before joining the University of British Columbia in 1992. Davies was Research Director and President of Biogen (Geneva) from 1980-1985 and founded TerraGen Discovery (Vancouver) in 1996. He is a Fellow of the Royal Society (London) and the Royal Society of Canada and has served as President of the American Society for Microbiology and President of the International Union of Microbiological Societies.
Davies' research interests concern various aspects of medical-microbial ecology. He has studied the biochemical mechanisms of antibiotic mode of action and antibiotic resistance in bacteria; including the origins of resistance genes, their acquisition and horizontal gene transfer. He has worked on practical applications of antibiotic resistance genes as markers in inter-kingdom gene cloning and developed geneticin, hygromycin and streptothricin for this purpose. Recent work in his laboratory has led to new insights on antibiotic function and the potential role of antibiotics as bacterial cell-cell signaling molecules in nature. His laboratory participated in sequencing the genome of Rhodococcus *RHA1, a potent biodegrader. This study demonstrated the complexity of biochemical processes involved in the survival and growth of bacteria in the environment, and provided indications on the mechanism by which* Mycobacterium tuberculosis *survives and grows in human macrophages.*

Innocent Nzeyimana

WHO sub-office Abéchè,
Chad

Since January 2006, Innocent Nzeyimana has been the Coordinator of the activities of the WHO sub office in Abéchè, East Chad, as well as in charge of the implementation of the Early Warning System for high epidemic potential diseases in East Chad.
His areas of intervention are Public Health, Humanitarian Health, Epidemiology, Paludology, Epidemiologic control.
In 2005 he was in charge of the production of a monthly "Bulletin of morbidity and mortality nutrition control in Niger", and of the technical support to the National Health Information system for the WHO sub office in Abéchè, East Chad.
He is member of different national associations and societies, such as Association Internationale de Santé Humanitaire (France), Société Française de Pathologie Exotique (France), l'Association Ivoirienne pour le Bien-être Familial (Ivory Coast) and Ligue Ivoirienne des droits de l'homme (Ivory Coast).
Innocent Nzeyimana studied Medicine at the National University of Rwanda, and specialized in Statistics applied to Medicine (epidemiology) at the University of Paris VI in 1999-2000. At the same time he also specialized in Health and Development in Mediterranean and Tropical Regions, at the Université de la Méditerranée, Marseille (France).
In 2003 he obtained his PhD in Epidemiology of Paludism at the Université de la Méditerranée, Marseille.
Between 2003-2004 he obtained a diploma in Humanitarian Health from the Centre Européen de Santé Humanitaire, Lyon, (France), as well as a certificate in Control and Epidemiology of infectious and tropical diseases at IMTSSA/Université de la Méditerranée, Marseille (France).

Gérard Krause

Robert-Koch-Institute,
Berlin, Germany

Gérard Krause is medical epidemiologist and director of the Department for Infectious Disease Epidemiology at the Robert Koch Institute (RKI), Berlin. He has a PhD in epidemiology and hygiene (Charité University, Berlin), and a doctorate in tropical medicine (Heidelberg University). He is board certified in hygiene and environmental medicine as well as in tropical medicine. From 1993 to 1998 he worked as a clinician in internal medicine and travel medicine and as a researcher in the field of tropical medicine and health system research at a hospital in Osnabrück, the University of Heidelberg and the University Hospital of Freiburg. Before joining the RKI he was Epidemic Intelligence Service officer at the Centers for Diseases Control and Prevention, Atlanta from 1998 to 2000. He is member of the Advisory Forum of the European Centre for Disease Prevention and Control (ECDC) and Chairman of the Steering Committee of the European Programme for Intervention Epidemiology (EPIET). His current focus of interest is infectious disease surveillance and evidence based public health.

Session II

Global sustainability and biology

The anthroposphere – that part of the environment that is made or modified by humans for use in human activities – is still at an immature stage as it interacts with the global bio-/geosphere in more predatory and parasitic rather than a symbiotic manner. Most of the resources used today are non-renewable, and the global extraction of mineral resources is growing with the increasing economic wealth of nations. If all countries adopted the consumption patterns and technologies of the industrial countries, in the coming fifty years the extraction/replacement in the Earth's crust would be increased by a factor of 2 to 5. The demand for agricultural goods is increasing, not only due to a growing world population, but also mainly due to changed production and consumption patterns. Increasing demands for non-food biomass such as agrofuels, currently favoured by environmental policies and economic interests, threaten natural ecosystems through the expansion of arable land at the expense of savannas and tropical forests. Besides direct and indirect impacts on land use and land cover, the anthroposphere also has an impact on natural systems through changing basic life conditions such as climate.
All those impacts will lead to changes within natural systems (e.g. species extinction and spreading of species formerly alien to certain regions), and will have repercussions on the conditions for human existence and the chances for a good life in various parts of the world. A key challenge for sustainable development is thus to enhance the decoupling of economic growth and resource consumption through a massive increase in energy and material efficiency. The implementation of principles of industrial ecology may help to sustain the relation of technical and natural systems.
Policies for sustainable resource use have started to recognise that there are biological limits as well as options for the future development of economies and societies. A further global learning process will be required to develop and agree upon rules for international sustainable resource use which should limit the amount of mineral and biomass extraction and harvest to acceptable levels and minimize the ongoing shifting of environmental burden between regions.

Session chaired by Stefan Bringezu
Speakers: Chris Thomas, Donald Bruce
Panellists: Thomas Gale Moore, Ilkka Hanski, Thomas Henningsen, Ralf Kindervater

Stefan Bringezu

Wuppertal Institute,
Germany

Born in 1958, Stefan Bringezu trained as a biologist (ecology, biochemistry, microbiology) and obtained his Ph.D. in ecosystems analysis. He gained his post-doc graduation (venia legendi) at the faculty for Environment and Society at Technical University of Berlin. From 1987 to 1992 he worked at the Chemicals Assessment department of the German Federal Environment Agency. 1992 he joined the new Wuppertal Institute working on the development of methods to assess the environmental performance of products, infrastructures, regions and economies. From 1997 to 1998 he was Visiting Professor at the University of Dortmund as Acting Head of the Department of Supply Systems and Environmental Planning. He fully rejoined the Wuppertal Institute, was acting Head of the Department for Material Flows and Structural Change and took over as Director of the newly formed group in 2003. His main study subjects are the analysis of the socio-industrial metabolism and land use, material flow analysis and LCA-MIPS (incl. "hidden flows"), indicators for sustainability (macro-meso-micro), integrated sustainability assessment, resource efficient supply and infrastructure systems, analysis of drivers of resource use (biomass and minerals) and scenarios for sectoral and economy-wide sustainable resource management. He pioneered research as co-developer of the MIPS concept (on the "ecological rucksack") created by Friedrich Schmidt-Bleek, who together with Ernst U. von Weizsäcker was honoured by the prestigous Takeda award. He developed new indicators of economy-wide material flow analysis such as TMR which were tested through international cooperation, gave orientation to research and contributed to standard setting in national and European statistics.
Dr. Bringezu has been involved in teaching activities at various universities. He initiated the ConAccount network on material flow analysis and was founding member and councilor of the International Society of Industrial Ecology. He is member of various advisory panels such as the National Committee of SCOPE Germany (Scientific Committee on Problems of the Environment) and worked as a reviewer for German and other European Science Foundations and consultant to OECD, EEA and the European Commission. He had coordinated various national, European and international research projects.
He authored more than 140 scientific articles and several books. Some of the reports he initiated found considerable resonance such as the international report on "Resource Flows" and the subsequent "Weight of Nations" report.

Chris Thomas

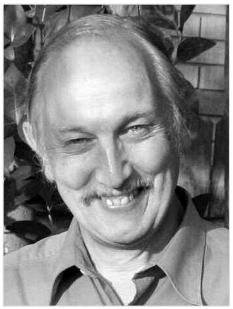
University of York,
UK

Chris Thomas works on the ecological and evolutionary impacts of human activities on species and habitats. His research concentrates on the recent and potential future impact of climate and land use changes on the distributions of species, and on population- and species-level extinctions. This involves a combination of field work and modelling.
After completing undergraduate (Cambridge) and Masters (Bangor) degrees in the UK, he did his PhD at the University of Texas at Austin (1984-88), working on evolutionary changes in the diets of butterflies, in response to habitat change. The next two years were spent in New Zealand, mainly working on the impacts of introduced European wasps species on native animals. Then it moved back to the UK, to a post-doc at Silwood Park. During this period, he initiated a research programme on how butterfly populations respond to the loss of habitat, and how to protect species when their habitats are highly fragmented; work that continues to this day. After Silwood, he took up a lectureship at Birmingham University for three years, followed by a research fellowship and then chair at the University of Leeds. During this period, an increasing proportion of the research aimed to understand how species were responding to climate change.
Three years ago, he moved to the University of York, where he is Professor of Conservation Biology.

Climate change: the global export and import of changes to natural biological systems

Climate change is rapidly becoming a major cause of imbalance between rich and poor nations, and this applies to the natural biological resources of countries as well as to the impact of climate change on human infrastructure. The largest effects of climate change on ecosystems are set to be felt in the poorest countries, where humans rely most directly on natural ecosystems for their livelihoods. We provide an analysis of where these effects are likely to be most severe and of how the responsibility for those changes is distributed across the world.

Potential ecosystem changes and climatic disruption to species by 2045 are likely to be largest in countries that contain high levels of biodiversity. Vegetation changes and the extent to which the future climate will lie outside historical bounds are predicted to be greatest in countries that contain large numbers of species in total, large numbers of endemic species (that do not occur in other countries), and large numbers of already-threatened species. These impacts are felt disproportionately in countries with relatively low fossil fuel CO_2 emissions (i.e., that are not responsible for climate change) and low GDPs (i.e., that cannot afford to pay for adaptive management). Finding ways to direct resources to help such countries adapt to climate change is a daunting task.



Donald Bruce

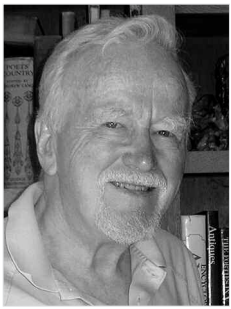
Edinethics Ltd,
Edinburgh, UK

Dr Donald Bruce is managing director of the newly formed ethical consultancy Edinethics Ltd. He holds doctorates in chemistry and theology. From 1976-92 he worked in nuclear energy research, safety and risk regulation, and Government energy policy. From 1992-2007 he was Director of the Church of Scotland's Society, Religion and Technology Project (SRT), examining ethical and societal issues in emerging technologies. He has done pioneering ethical assessments on GM crops and animals, cloning, stem cells and most recently nanobiotechnology. He chairs an expert ethical working group on human enhancement in the EC FP6 NanoBioRaise programme. He has worked extensively on issues of sustainable development, climate change and energy policy in both UK and European policy contexts, and with the environmental network and working groups of the European churches. He was invited by the Scottish government as a representative of Scottish civil society at the 2002 Johannesburg World Summit on Sustainable Development. He is a member of the Societal Issues Panel of the UK Engineering and Physical Sciences Research Council, and the Office of Science and Innovation horizon scanning programme on the ethical and societal impact of future technologies. He was a member of the Scottish Science Advisory Committee, 2002-04. He has worked on public engagement in science with the New Economics Foundation on the Democs card game. He is a regular speaker, writer and broadcaster on ethics and technology.

How sustainable are we?

Part of being human is our capacity to transform the natural world around us. We rightly rejoice in our science and technology. But in wider cultural and religious understandings, humans are equally understood as stewards and companions of what we call 'nature'. How we handle the tension between these two roles of intervener and conserver has become a central issue, not only for European civilisation but globally. As human technological powers have gone beyond locally harnessing forces to controlling and redirecting on a large scale, we are increasingly aware of our damage. If all the world's peoples achieved levels consumption of the today's richest industrial nations, key aspects of the planet's systems would not sustain the burden – for example in climate, fresh water, soil and wastes. No longer can we rely simply on our ability to fix ourselves technologically out of problems of our own creating.

How to find models to use our powers sustainably has become urgent. Since the 1970's many have questioned the sustainability of our present assumed trajectory of one way growth. This paper critiques four models of human attitude to nature - ownership, worship, partnership, maintenance engineer - and looks for alternatives. To what should 'developed' and 'developing' nations be aspiring, technologically, given the prospects for the state of the planet? An underlying issue concerns our humanness in an unchecked pursuit of technological progress. For example, whenever as humans we begin to see the natural world primarily in terms of resources to be exploited, is something vital lost, which is difficult then to regain, not only in our relating to the natural world, but also in our humanity itself? Are there eventually human limits to technology?



Thomas Gale Moore

Hoover Institution, Stanford University,
USA

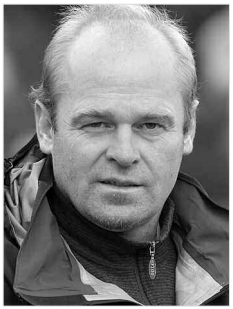
Thomas Gale Moore, Senior Fellow at the Hoover Institution, specializes in international trade, regulation, the environment, and privatization. He has written on airline deregulation, trucking regulation and deregulation, stock market margins, minimum wages, energy policy, environmental policy and privatization. Recently, he has been researching the economic consequences of global warming, should it occur, and has written a book, which the Cato Institute *published in 1998 on the subject, entitled:* Climate of Fear: Why We Shouldn't Worry about Global Warming. *He has written many essays on the subject of climate change and continues to research the topic. He attended MIT, then enlisted in the U.S. Navy, where he served for four years during the Korean War. After his tour of duty, he earned his B.A. degree from George Washington University in 1957, and his M.A. and Ph.D. in economics from the University of Chicago in 1959 and 1961.*

Dr. Moore was a member of President Ronald Reagan's Council on Economic Advisers from 1985 to 1989. In that capacity, he supervised a staff of economists who advised the President on trade, tax, regulation, agriculture, transportation, environment, and health issues. During 1968-70, he had served as Senior Staff Economist on the Council covering regulatory and industrial organization issues.

Ilkka Hanski

University of Helsinki,
Finland

Professor Hanski has worked in population and community ecology and conservation biology since the early 1980s. He has made contributions to the study of population regulation, cyclic population dynamics, and the mechanisms of coexistence in communities. Research conducted by him and his research group has been instrumental for the development of metapopulation biology, an important branch of biology with great significance for conservation and management. The long-term and large-scale research project on the metapopulation biology of the Glanville fritillary butterfly is one of the best examples of how theoretical work can be effectively linked with empirical studies in ecology. Professor Hanski is a foreign member of the Royal Society and of many other national science academies. He has received several prizes and awards. He is a research professor at the University of Helsinki, Finland.



Thomas Henningsen

Greenpeace,
Germany

Thomas Henningsen is a true "Kieler Jung" from the north of Germany. He studied Zoologie and Marine Science at the Universities of Kiel and Bremen in Germany, and at Texas A&M in Galveston in the USA. He lived in Texas and in Peru, where he carried out his research for his diploma- and doctor thesis on the behaviour ecology of wild bottlenose dolphins in the Gulf of Mexico and the river dolphins in the Amazon.
Since 1991 he has been working for the environmental organisation Greenpeace, where he has taken part and coordinated several national, international and global campaigns for the protection of the marine and forest environment. He is currently the international Campaign Director for Greenpeace Germany. Thomas Henningsen is specialized in dolphins, whales, fisheries, forests and all environmental issues of Amazonia.
He has published several scientific and popular articles, and is the author of a 13-part TV documentary about faboulus animals.
Thomas Henningsen is 46 years old and father of 3 wonderful boys.

Ralf Kindervater

BIOPRO Baden-Württemberg,
Germany

Ralf Kindervater studied chemistry at Braunschweig University, Germany, and obtained his Ph.D. in biochemistry/biotechnology at the GBF – National Research Center for Biotechnology, Braunschweig. Following a postdoctoral fellowship at Tübingen University and the Fraunhofer Institute (IGB) in Stuttgart, he became the project leader for a European technology transfer project. He moved on to Eppendorf AG, where he acted as area sales manager, product manager, and international sales specialist. As part of the first BioRegio contest in Germany, he was requested to set up a marketing organization (Biostart GmbH) in Jena, before finally moving to Stuttgart, where he became the CEO of BIOPRO Baden-Württemberg GmbH, a state-owned non-profit service organization. Within these activities, he set up a new economic development program for the biotech sector in order to foster an interconnection between biotechnology and the classical industry sectors. Using modern communication and knowledge management tools, he succeeded in developing a strategic approach to interconnecting partners throughout the entire scientific and economic value chain. The recent success of this strategy is reflected in a second prize in the BMBF's "BioIndustry 2021" funding contest, which was awarded for the "bio-based polymers and biomaterials" concept, in which industrial-scale biotechnological processes will be used to produce CO_2-neutral polymers and other plastic materials, as well as developing innovative polymeric systems. The goal is to eventually replace the production of plastics from fossil carbon sources with CO_2-neutral or even CO_2-binding processes by using the current biotechnological process development combined with metabolic engineering strategies.

EMBO Award for Communication in the Life Sciences

The European Molecular Biology Organization launched this award in 2002 in order to give recognition to the huge efforts that some scientists make to communicate their science to the public while remaining fully active in research. The winners of the EMBO Award are nominated for the EU Descartes Prize for science communication.

French cell biologists Christian Sardet and Ali Saib are joint winners of the **2007 EMBO Award for Communication in the Life Sciences**. Both recipients present science in a unique format that is both enlightening and entertaining, a key requirement in winning the award. Using different media, they have produced resources for researchers, as well as for teaching and communicating science to the broader community.

Dr. Christian Sardet, through his highly original use of interactive multimedia technology, communicates scientific information including detailed molecular events. An established embryologist, he presently heads the BioMarCell group in Villefranche-sur-Mer, at the Marine Center of the University of Paris 6 (UPMC) and the Centre National de la Recherche Scientifique (CNRS). His establishment of a creative team to produce educational animations called BioClips evolved into the annual International Festival Cinema of the Cell held during ELSO meetings in Nice, and Dresden, and relayed by the BioClips.com website.
Outside of molecular and cellular embryology, Sardet challenges cell biology to *"go visual, go public, and go interactive"*.

Exploring the Living Cell, the recent DVD made vith Véronique Kleiner is rich in film and animations on the subject of cells. We learn how cells were discovered, how they function, how they impact health and disease and what the future holds. The DVD also includes *"Voyage Inside the Cell",* a short version of Sardet's prized 3D film on exhibit in Science Centers in Paris, Amsterdam and Berlin.

Professor Ali Saib of the University of Paris 7 receives the award in recognition of his steadfast interest in communicating scientific material to the broad public and students of all ages. He initiated a project to educate young people in the inner city of Marseille on infectious diseases such as HIV/AIDS and STD. Following its success, he established an innovative project named *"Les Apprentis-Chercheurs" – novice researchers",* an action of *"L'arbre des connaissances" - the tree of knowledge"*, an association he founded. This project collaborates with high schools, universities, the INSERM and CNRS Research Institutes allowing undergraduate students to visit research labs and work directly with scientists on research projects, bridging the gap between science and society.

Saib recently collaborated with FRANCE 5 as scientific author on a film project on the merging world of viruses to raise public awareness on this complex but critically important field. The documentary *"Dr Virus and Mr. Hyde"* received the *"Grand Prize"* at the International Festival of Science Documentaries and the *"Science Prize"* at the International Festival of SCOOP and Journalism. Additional film projects are currently under development. As a researcher, he has focused on the cellular mechanisms of the traffic of incoming retroviruses from the plasma membrane to the host chromosome. Models he has drawn with his team for the Primate Foamy Virus were confirmed for many other retroviruses, including HIV, and may represent a novel target for therapeutic intervention on the incoming phases of retroviral infections.

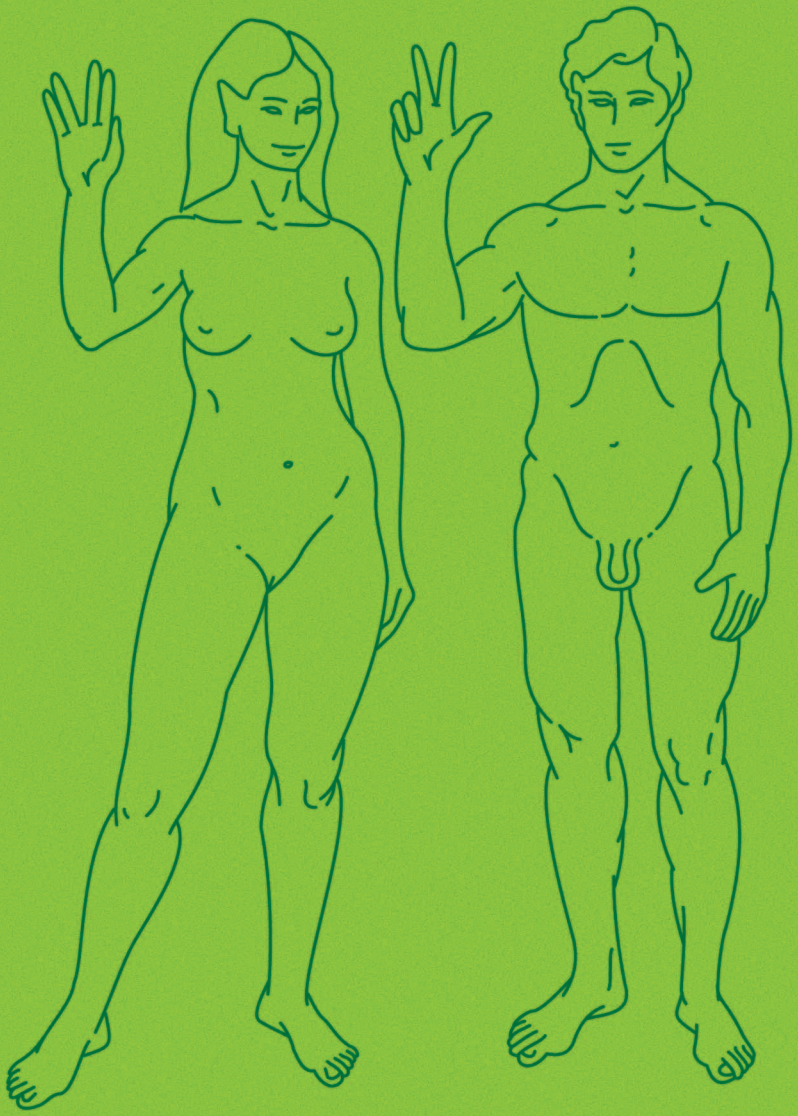
Special evening talk

The future of humans in space

Marc Heppener

European Space Agency,
Noordwijk, The Netherlands

Since 1999, Marc Heppener has been Head of the Science and Applications Division, at ESA (European Space Agency), Directorate of Human Spaceflight, Microgravity and Exploration.
He received a Masters degree in Physical Chemistry from the University of Amsterdam in 1981 and a PhD from the same University in 1986 with a thesis on "Intramolecular Energy Distribution in Van der Waals Molecules".
From 1986-1989 he was team leader for X-ray detector development the Laboratory for Space Research at Leiden University.
From 1989 to 1999 he was Programme Manager for External Research at the Space Research Organisation of the Netherlands (SRON), as well as Responsible for Dutch National Programmes in Microgravity and Earth Observation, Space Policy Advisor of the Dutch Government, Responsible for the Dutch National Programmes in Microgravity and Earth Observation, Member of the Dutch Earth Observation Policy Committee, Member of several instrument development steering committees (GOME, SCIAMACHY, GOCE), Chairman of the Dutch Earth Observation Data Infrastructure Development, Dutch Delegate of the ESA Microgravity Programme Board, Manned Spaceflight Programme Board, and Chairman of the ESA Microgravity Programme Board.
He is a Member of the Netherlands Platform for Planetary Research (NPP), the President of Nederlandse Vereniging voor Ruimtevaart (Netherlands Society for Aerospace), and the president of the Space and Society Committee, International Federation of Astronautics.

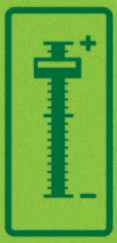


INTELLIGENCE

SENSOR & MOTOR FUNCTION

SUSCEPTIBILITY TO DISEASE

LIFE EXPECTANCY



Session III

Treatment and enhancement

In this session we will discuss the treatment of human genetic diseases and the enhancement of humans via genetic intervention. Clearly, research into repairing a genetic defect that causes a recognised (serious) disease – or replacing the faulty gene altogether – falls in the domain of medical research. The (for some) tantalising prospect of using the very same technology to increase human performance in various areas (be they physical or mental) arguably has nothing to do with medical progress. And yet the line between the two is remarkably thin. Take research into muscular dystrophy – a good example of the combined use of stem cells and genetic repair. Such research gives insights not only into how to treat, and possibly cure, this tragic disease, but also into how to deal with a more "natural" condition. Muscular atrophy – the gradual loss of muscle bulk – affects everyone as they age. Some people are affected more than others, and as age-related conditions are increasingly categorised as diseases that we should be able to treat – hence improving life quality for our aging population – so too may normal muscle wastage. Treatment earlier in life may give certain senior citizens an "unnatural" – some might say "unfair" – advantage over others, particularly given the great discrepancy in abilities to pay for such "deluxe" treatment. Here we run into the ubiquitous problem of what exactly is categorised as a "disease". But more generally, we are dealing with a typical example of the "dual use" problem of scientific research and its applications. How wide-spread will the use of genetic intervention become? How might it shape the landscape of genetic diseases and human "fitness" in future?
The session provides an ideal introduction for the discussion of the last topic in the programme, that of the future of human evolution itself.

Session chaired by Claudio Bordignon
Speakers: Fulvio Mavilio, Sarah Chan
Panellists: Eve-Marie Engels, Jan Staman, James Hughes, Elaine Dzierzak

Claudio Bordignon

Vita Salute San Raffaele Institute,
and MolMed S.p.A., Milan, Italy

Claudio Bordignon is currently Scientific Director and Professor of Hematology at the San Raffaele Institute, Milan, Italy. He graduated in Medicine from the University of Milan, where he specialized in Internal Medicine and in Hematology. He completed his training in transplantation immunology at the SUNY, Buffalo, and in bone marrow transplantation at Memorial Sloan Kettering Cancer Center in New York, where he began his research in gene therapy of cancer and hereditary diseases. In the '90s he returned to Milan at San Raffaele where he directed the Bone Marrow Transplantation Program, and founded and led the group that performed the first worldwide experience of gene therapy in hematopoietic stem cells for hereditary diseases. In 2002 this work led to the publication of the first successful gene therapy treatment of adenosine deaminase-deficient SCID. He expanded this experience to stem cell gene therapy of other genetic diseases and AIDS, and to immuno-gene therapy of cancer. Dr. Bordignon has been President of the European Society of Genetic Therapy and Member of major Scientific Committees. Since 1998, he has been Scientific Director and Professor of Hematology at the San Raffaele Institute. He is also Founder and President of MolMed, a biotech company dedicated to the development of new anticancer molecular treatments. He received numerous scientific awards and prices from scientific societies including the Italian Association for Cancer Research, the Leukemia Society of America, the European Society for Gene Therapy, the Italian League Against Tumors. In 2002 he was awarded the Invernizzi Price for Medicine, the most important medical award in Italy.

Fulvio Mavilio

University of Modena and Reggio Emilia, Modena and Scientific Institute S. San Raffaele, Milan, Italy

Fulvio Mavilio is Professor of Molecular Biology at the University of Modena and member of the Human Gene Therapy Program of the San Raffaele Institute in Milan, Italy. He was Director of Discovery of Molmed S.p.A. (2002-2005) and Founder and Chief Scientific Officer of Genera S.p.A. (1999-2002), two biotechnology companies in Milan. He had previously served as head of the Molecular Hematology Unit at the San Raffaele Institute (1989 to 1992), as Visiting Scientist at the Wistar Institute, Philadelphia, (1986 to 1988), as group leader in the Department of Hematology-Oncology of the Italian National Institute of Health in Rome (1984 to 1988), and as staff scientist of the Institute of Experimental Medicine of the Italian National Research Council in Rome (1982 to 1984). Prof. Mavilio is an expert and a pioneer in the fields of gene therapy and stem cell research, and author of over 100 articles in major international journals. He is member of the European Molecular Biology Association (EMBO), Chairman of the Educational Committee of the European Society of Gene Therapy (ESGT), and member of the Educational Committee of the American Society of Gene Therapy (ASGT). Prof. Mavilio graduated in Biology at the University of Rome in 1976, and obtained a Ph. D. in Medical Genetics in 1979. He was awarded a Special Fellowship by the Italian National Research Council, Rome (1978-1982), and a U.S. Public Health Service International Research Fellowship by the Fogarty International Center, NIH, Bethesda (1986-1988).
He was born in Naples in 1953.

Genetic modification of stem cells for the therapy of inherited diseases

Stem cell transplantation is an established therapeutic approach in cancer therapy and tissue replacement. Genetic modification of stem cells opens entirely new perspectives for the treatment a variety of genetic disorders of blood and epithelial cells. On the long term, transplantation of genetically modified stem cells might impact on the therapy of diseases of wider social interest, such as muscular dystrophy, cystic fibrosis, neurodegenerative disorders and diabetes. Genetic manipulation requires sophisticated tools to insert, or replace, genes into the human genome. For over two decades, vectors derived from retroviruses provided a simple and efficient tool to deliver, and integrate, genes into human stem cells for clinical application. Pioneer studies have demonstrated the potential of these vectors for the treatment of immunodeficiencies and skin diseases, but raised serious safety concerns due to uncontrolled insertion into the target cell genome and interference with normal gene regulation. Several years of close genetic analysis of the interaction between retroviral vectors and the human genome have provided a wealth of information that now allow the design of safer and more efficient tools for gene transfer into stem cells. Research of new gene transfer tools allowing targeted integration or homologous recombination is also under way, and might lead to the development of much safer vectors in a near future. At the moment, however, there is little alternative to the use of vectors derived from animal or human (HIV) retroviruses. Since transplantation of genetically corrected stem cells has proven its efficacy in several diseases with little or no therapeutic alternative, finding a sensible balance between risks and benefit is the only way to meet a medical need and continue a technological development that might eventually solve all problems. All therapies have side effects, and the medical community has learned how to deal with them in decades of practice. Genetic manipulation should not be considered an exception.

Sarah Chan

University of Manchester,
UK

Sarah Chan is a Research Fellow at the Centre for Social Ethics and Policy, University of Manchester. She holds qualifications in law and in science from the University of Melbourne, where she undertook a PhD in molecular biology before entering the field of bioethics as a researcher with the Ethics Unit at the Murdoch Childrens Research Institute in Melbourne, working in the area of Australian law and policy on embryo and stem cell research. During this time she was involved in a number of public engagement and education projects, and developed further research interests in the field of bioethics. Since 2005 Sarah has been at the University of Manchester, where she completed an MA in Health Care Ethics and Law.
Her research interests include the ethics of new genetic technologies, stem cell research and cloning, gene therapy and genetic medicine, transhumanism and human enhancement. She is currently involved in a European project to investigate the ethics of "creating and redesigning human beings".

Enhancement and evolution: the future of humankind?

Humanity is constantly reinventing itself. From the earliest days of our species, humans have attempted to alter their environment and to shape the world around them The flow of technological change across the history of humankind has been a stream of discoveries, major and minor, that have collectively helped to direct the course of humanity's evolution.

Probably the most significant technological advances in recent human history have been those produced in biomedical science. Our ever-increasing understanding of human biology and consequent ability to treat and prevent disease have resulted in phenomenal improvements to health care over the last century. Today's emerging medical technologies suggest even greater possibilities for the relatively near future: stem cell therapy and regenerative medicine, genetic manipulation, and novel pharmacological agents all promise new horizons in the field of medicine.

Why, though, should we limit ourselves to treating disease and injury? The same technologies also hold the potential to allow us improve further upon myriad aspects of human function – to enhance ourselves and future generations. The possibility of human enhancement has raised significant debate: is human enhancement permissible, and how far should we go in pursuit of this goal? What will the use of enhancement technologies mean for the future course of humanity – and what exactly do we mean when we speak of humanity?

This paper will address the ethical issues associated with human enhancement, including what sorts of enhancement might be acceptable, whether there is a meaningful difference between medical treatment and enhancement and whether enhancement, far from being ethically questionable, is a morally preferable goal of humankind.

In particular I will consider how we might view human enhancement in the context of our past, present and future evolution. A prominent concern regarding enhancement technologies is that their use might compromise our humanity, render us somehow other than human and thereby jeopardise our species. I shall argue that these concerns are misplaced. The use of enhancements, genetic or otherwise, will not cause us to cease to be human or to lose the essential qualities of humanity; indeed, enhancements and the desire to use them may be seen as an expression of our humanity. The advent of human genetic enhancement signifies not the end of the human race but rather the next step in the continuing process of human evolution.

Eve-Marie Engels

University of Tübingen,
Germany

Eve-Marie Engels is Full Professor of Ethics in the Life Sciences in the Faculty of Biology and a member of the Faculty of Philosophy and History at the University of Tübingen. She is also the spokeswoman of the Interdepartmental Centre for Ethics in the Sciences and Humanities (IZEW) of the University of Tübingen as well as the spokeswoman of the DFG-postgraduate programme "Bioethics – On the Self-Design of Human Beings by Use of Biotechniques" at this Centre. Her main areas of research and teaching are the philosophy of biology (ethics, theory and history of biology), philosophical anthropology and epistemology. She studied at the Ruhr-University of Bochum where she received her PhD in philosophy and passed her Habilitation. She had a Heisenberg grant from the DFG (German Research Association) and held guest professorships at the Universities of Bielefeld, Göttingen and Hamburg. She was professor of theoretical philosophy (epistemology, philosophy of science, natural philosophy) at the University of Kassel (1993-1996) before she went to Tübingen. Eve-Marie Engels spent one year as Research Associate in the Dept. of Philosophy at the State University of New York at Stony Brook and four months as a Visiting Scholar at the Center for the Study of Science in Society in Blacksburg/Virginia. She is a member of the German National Ethics Council since 2001 and was a member of the ethics committee of HUGO- International from 1999-2004. She has published on a variety of subjects (bioethics: animal ethics, medical ethics, neuroethics; philosophy and history of science, particularly of biology, evolutionary theory, Darwin and his reception).
Forthcoming in September 2007 by her: Charles Darwin. München: C.H. Beck 2007.
Homepage: http://www.uni-tuebingen.de/bioethik/index.htm

Jan Staman

Rathenau Institute,
Den Haag, The Netherlands

Jan Staman is managing director of the Rathenau Institute, the Dutch organization responsible for two related domains in science and technology: technology assessment – the evaluation of individual, mainly new technologies; and national science system assessment – the evaluation of the Dutch science and technology world as a whole. His special personal interest is how ethical and societal issues are processed in scientific and technological practice, in politics and in the creation of government policy. Jan Staman has a degree in Veterinary Medicine and in Law.

Most activities and decisions in science and technology are part of the normal internal procedures of the science and technology system, governmental and political decision making included. Contentious issues may arise when complex technological systems dysfunction and generate crises or scandals. They may also arise when new developments change or risk changing habits, norms and values in a revolutionary manner. Foresight, something that plays an important role in creating new directions in science and technology and mobilizing funds, is essential in handling both challenges. Technology assessment likewise. However foresight is at the discretion of the policy-making process whereas technology assessment has a public deliberative character. Technology assessment and foresight should go hand in hand in the optimal co-evolution of science and society.

James Hughes

Trinity College,
Hartford, USA

Dr James J. Hughes serves as the Executive Director of the Institute for Ethics and Emerging Technologies (IEET, ieet.org) in Hartford, USA. The IEET comprises several dozen fellows, staff and interns around the world working to promote healthy life extension, catastrophic risk reduction, rights to technological self-determination, and a technoprogressive approach to public policy. Dr. Hughes teaches health policy at Trinity College in Hartford Connecticut, and serves as Trinity College's Associate Director of Institutional Research and Planning. Dr. Hughes is the author of "Citizen Cyborg: Why Democratic Societies Must Respond to the Redesigned Human of the Future", and is writing a second book tentatively titled "Cyborg Buddha: Using Neurotechnology to Become Better People". Dr. Hughes produces the weekly syndicated public affairs talk show Changesurfer Radio, and speaks often on medical ethics, health care policy and future studies worldwide. He is a Fellow of the World Academy of Arts and Sciences, and a member of the Neuroethics Society, the American Society of Bioethics and Humanities and the Working Group on Ethics and Technology at Yale University. Dr. Hughes holds a doctorate in Sociology from the University of Chicago (1994), where he taught medical ethics as Assistant Research Director of the Maclean Center for Clinical Medical Ethics. Dr. Hughes lives in rural eastern Connecticut with his wife, the artist Monica Bock, and their two children.

Elaine Dzierzak

Erasmus University,
Rotterdam, The Netherlands

Elaine Dzierzak received her PhD in Biology from Yale University, where she studied the molecular basis for immunoglobulin specificity and regulated expression. She did her postdoctoral training at the Whitehead Institute for Biomedical Research (MIT) and was the first to demonstrate the expression of a retrovially transduced therapeutic gene in hematopoietic cells after bone marrow stem cell transplantation. At the National Institute for Medical Research (London), her research laboratory initiated novel studies on the embryonic origins of hematopoietic stem cells. Her results changed the long-held textbook dogma of the yolk sac origins of the adult hematopoietic system and showed that the first hematopoietic stem cells are autonomously generated in the body of the mammalian embryo, the aorta-gonads-mesonephros region. In 1996 she moved her research group to Erasmus University (Rotterdam), where she has been Professor of Developmental Biology and Co-director of the Master of Science Program in Molecular Medicine. Her research continues to be focused on the development and molecular biology of the long-lived, rare stem cells for the blood. Recently, she showed that the first hematopoietic stem cells are derived from specialized cells lining the major embryonic blood vessels. Her work is also focused on the development of mesenchymal stem cells that serve to support the growth of hematopoietic stem cells. It is expected that the identification of molecules involved in the embryonic generation and expansion of hematopoietic stem cells will provide unique insights for the improvement of clinical cell replacement therapies for blood-related genetic diseases and leukemias.


Colonization of other galaxies
Gene technology
H. sapiens
H. neanderthalensis †
H. heidelbergensis †
H. erectus †
H. ergaster †
nabilis †

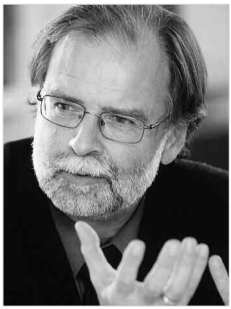
Session IV

Human evolution: once were apes…

Unfortunately, there is no way to predict the future evolution of our species, nor of any other species. Nevertheless, we may speculate a bit about what might happen with *Homo sapiens* in the near future by looking back and analysing how we evolved. Most – but not all – experts agree that Africa is the cradle of the genus Homo and that this continent witnessed most of the biological evolution of humans. There is good evidence that climatic and ecosystem changes played at least some role in the evolution of human traits such as upright posture and culture. In several expansion waves "out of Africa" humans left their home continent, the last expansion starting around 100,000 years ago: it led to the colonisation of the entire globe by *Homo sapiens* and to the extinction of competing human species (or subspecies) like the Neanderthals. We still do not know what caused these early "human migrations" – was it environmental change, biological evolution and adaptation or rather development of new technologies and demographic changes?

In any case, eventually cultural evolution took the lead over biological evolution – at least in the 21st century, Darwinian Natural Selection is no longer shaping the evolution of our species. What is then controlling our genes and cultural evolution? More and more we learn that "soft" factors such as demography, (evolutionary) psychology and behaviour of complex (social) systems were highly influential in human evolution and continue to be so. During this session experts from various disciplines will tell us what they know about human evolution and about the perspectives of our species.

Session chaired by Volker Mosbrugger
Speakers: Mark Stoneking, Ian Pearson
Panellists: Jay T. Stock, Frans Willekens, Jürgen Klüver, Jerome H. Barkow



Volker Mosbrugger

Senckenberg Research Institute and Museum,
Frankfurt am Main, Germany

Professor Volker Mosbrugger, born 1953 in Konstanz, Germany, has been the Director of the Senckenberg Research Institute and Natural History Museum with headquarters in Frankfurt am Main. since 2005. He is also is Professor of Historical Geology and Palaeontology at the University of Frankfurt am Main.

He studied Biology, Marine Biology and Chemistry at the University of Freiburg, Germany and Montpellier, France, and obtained his PhD in Geology and Palaeontology at the University of Freiburg in 1983. After his Habilitation at the University of Bonn in 1989 with the thesis "The tree habit in land plants: A functional comparison of trunk constructions with a brief introduction into the biomechanics of trees" (published in 1990 in Lecture Notes in Earth Sciences 28), between 1990 and 2005 he held a chair in Palaeontology at the Institute of Geoscience, University of Tübingen, Germany.

He is a member of several Scientific Advisory Boards, and elected member of several Academies of Sciences. In February 1999 he received the Leibniz-Award of the German Research Council (DFG) (750.000 €). Since 2002, he is head of the Commission of the DFG-Senate on "Geowissenschaftliche Gemeinschaftsforschung" ("Collaborative Research in Geoscience"). The Jilin University, Changchun, China awarded him a honorary professorship in 2001. In 2005 he received an honorary doctorate from the University of Lyon, France.

To the present he has supervised more than 15 successful doctoral thesis. His scientific area of expertise is palaeontology, palaeobotany, and palaeoclimatology, with special interests in evolution and construction of land plants, evolution of terrestrial ecosystems and the biosphere, and terrestrial palaeoclimatology.

Mark Stoneking

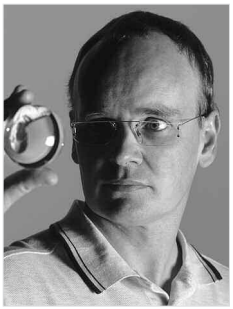
Max-Planck-Institute for Evolutionary Anthropology, Leipzig, Germany

Mark Stoneking received his PhD in genetics from the University of California, Berkeley in 1986. After postdoctoral work at Berkeley, the Human Genome Center at Lawrence Berkeley Laboratory, and the Cetus Corporation, he joined the faculty of the anthropology department at the Pennsylvania State University in 1990. In 1999 he left Penn State for the newly-established Max Planck Institute for Evolutionary Anthropology in Leipzig, where he supervises the Molecular Anthropology group and is honorary Professor of Biological Anthropology at the University of Leipzig. His research interests involve using molecular genetic methods to address questions of anthropological interest concerning the origins, migrations, and relationships of human populations, and the influence of selection.

Human origins: the molecular perspective

Who are our nearest living relatives? How did our species originate? These two fundamental questions about the nature of humans, although subject to intense investigation and discussion for centuries, were only recently answered. And, the answers came not from traditional lines of anthropological inquiry, but rather from analyses of molecular genetic variation.

This presentation will show how molecular anthropology has answered these questions, what the answers tell us about ourselves, and also explain why such seemingly simple questions proved so difficult to answer.



Ian Pearson

BT Group Chief Technology Office,
Ipswich, UK

Ian Pearson graduated in Maths and Physics from Queens University, Belfast. After four years in missile design, he joined British Telecom Labs as a performance engineer, and has since worked in areas from chip design to mobile telephony. He currently works as BT's futurologist, studying the future of technology and its likely implications across the whole of industry, government and society. He spends a lot of time at conferences and talking to the media, but he still dabbles in research. He is a fellow of the British Computer Society, the World Academy of Art and Science, the Royal Society of Arts, the World Innovation Foundation, and the Institute of Nanotechnology.

The future of life on earth

There are millions of species of life on earth, but it is all still based on the same shared biological life processes. This will change dramatically over the next century, as humans discover how life works at the most basic levels, how to replicate and manipulate it, and how to create new life forms from scratch. New life is not necessarily restricted to conventional biology, even if it is inspired by it. It might be electronic, conventionally biological but of a new design, or based on new types of synthetic biology, or any combination of these. Additionally, in the same way as biology has single celled organisms, complex multi-cellular organisms and many varieties of cooperative systems such as slime moulds, the potential scope for totally new life forms once cyberspace is added into the mix of electronics with synthetic and real biology will be enormous. For example, we could design and build a networked organism that physically spans the whole world, which exists partially in cyberspace and partially in the real physical world.

Jay T. Stock

University of Cambridge,
UK

Jay Stock was born in Canada, where he studied at Trent University (BA, 1994), the University of Guelph (MSc, 1998), and the University of Toronto (PhD, 2002).
Since 2002 he has been a Lecturer in Human Evolution and Development at the University of Cambridge, in the Leverhulme Centre for Human Evolutionary Studies. He is also a Fellow of Downing College, Cambridge.
He is an evolutionary morphologist and archaeologist whose research has primarily focused on the relationship between evolution and plasticity in determining human variation, through the study of variability in the human fossil record. In this context, Jay has studied fossil and subfossil human remains from South Africa, Kenya, Libya, Algeria, Egypt, the Levant, Australia, Southeast Asia, Siberia, North and South America, and throughout Europe.
Through his research on human variation, Jay has become particularly interested in the interface between culture and biology, and the ways in which the human cultural environment and habitual behaviour relate to biological adaptation and selection. Jay is currently directing an archaeological project, funded by the AHRC-UK, investigating the behaviour and ecology of foraging societies in Azraq Basin of Jordan, approximately 14,000 years ago, a period that is critical to understanding the environmental and behavioural precursors of the earliest development of agriculture.

Frans Willekens

Netherlands Interdisciplinary Demographic Institute, The Hague, The Netherlands

Prof. Willekens (born in 1946) is director of the Netherlands Interdisciplinary Demographic Institute (NIDI) (www.nidi.nl) and professor of Population Studies, University of Groningen, The Netherlands. He is a member of the Royal Netherlands Academy of Sciences (KNAW), and has been elected to the Cream of Science, which consists of about 200 top scientists in The Netherlands (http://www.creamofscience.org).

He studied agricultural sciences and economics at the University of Leuven, Belgium, and holds a PhD in Urban Systems Engineering and Policy Planning from Nortwestern University, Evanston, Illinois, USA (1976). His main research interest is the development of simulation models to describe the life courses of individuals and groups. These biographic models are state-space models that integrate insights from demography, epidemiology and actuarial sciences, and use longitudinal data. The research produces biographies of synthetic individuals that provide the detailed information on changing lives that is needed for designing sustainable pension systems and health care systems (www.micmac-projections.org).

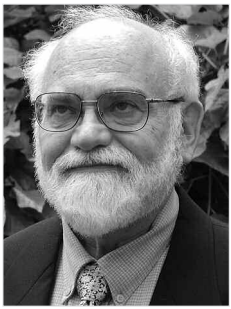
Frans Willekens and some colleagues took the initiative to establish the European Doctoral School of Demography (EDSD; http://www.eds-demography.org). Currently more than 20 universities and research institutes participate in the EDSD. The aim is a solid knowledge base to confront the demographic challenges Europe faces in the 21st century.

Jürgen Klüver

University of Duisburg-Essen,
Germany

Prof. Jürgen Klüver studied Philosophy and Mathematics at the Universities of Kiel and Hamburg in Germany. He was Head of the Interdisciplinary Center of Research in Higher Education at the University of Duisburg-Essen, and then Professor of Information Technologies and Educational Processes at the same university. His research is centered on the analysis of complex social and cognitive systems by constructing mathematical models and simulation computer programs of social-cognitive processes. His work includes the simulation and mathematical analysis of the evolution of whole societies and cultures as well as the micro simulations of social groups and the cognitive processes of single human individuals. In addition he studies the mathematical characteristics of formal dynamical systems like cellular automata and Boolean networks in order to obtain universal regularities of complex systems in general.

His recent books are:
The Dynamics and Evolution of Social Systems. New Foundations of a Mathematical Sociology. Dordrecht, NL 2000: Kluwer Academic Publishers;
An Essay Concerning Socio-Cultural Evolution. Theoretical Principles and Mathematical Models. Dordrecht 2002: Kluwer Academic Publisher;
Together with Christina Stoica and Jörn Schmidt: Computersimulationen und soziale Einzelfallstudien. Eine Einführung in die Modellierung des Sozialen. Bochum-Witten 2006: W3l-Verlag;
Together with Christina Stoica and Jörn Schmidt: Mathematisch-logische Grundlagen der Informatik. Bochum-Witten 2006: W3l Verlag;
Together with Christina Klüver: On Communication. An Interdisciplinary and Mathematical Approach. Dordrecht, NL 2007: Springer



Jerome H. Barkow

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Jerome H. Barkow received a B.A. in Psychology from Brooklyn College in 1964 and a Ph.D. in Human Development from the University of Chicago in 1970. He is Professor of Social Anthropology at Dalhousie University and a Distinguished International Fellow at the Institute of Cognition and Culture, Queen's University Belfast (Northern Ireland). He has published on topics ranging from sex workers in Nigeria to the kinds of sentients SETI might find. He is best known as the author of "Darwin, Sex, and Status: Biological Approaches to Mind and Culture", and as an editor of "The Adapted Mind", Recently (2006), he edited "Missing the Revolution: Darwinism for Social Scientists". His current project involves evolutionary psychology as the infrastructure of capitalism, with special reference to mass media. Barkow's future research will deal with the possibility that mass media and the increase of scale associated with "globalization" have subverted our evolved culture-revision/editing mechanisms. Attentional mechanisms that maintained the adaptive value of culture by ensuring that we learned preferentially from the locally successful may now have been captured by mass media, so that we learn preferentially from celebrities and other figures who in actual fact are irrelevant to the circumstances of our lives. Our cultures are thus prevented from adapting to local realities and become increasingly incoherent, perhaps explaining much of today's social disorganization and other malaises

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Acknowledgments

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Conference booklet preparation: Sylke Helbing

Conference booklet layout: Udo Ringeisen

Cover design & inside illustrations: Uta Mackensen

Printed by: MeraDruck, Sandhausen

Conference organisation: Andrew Moore, Alessandra Bendiscioli, Sylke Helbing

Technical support: Computer Group EMBL, Photolab EMBL

Catering: EMBL canteen staff

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