The idea of this event, in the 350th Anniversary Year of the Royal Society, arose from discussions within the Durham Biophysical Sciences Institute in late 2008. The objective of the meeting as a whole was to consider both the positive and negative aspects of climate change and potential global shortages of both energy and natural resources; but with a perspective that embraced insights from physical, biomedical and social sciences. While it was evident to the organizers that other meetings would be taking place in this Anniversary period, which might treat many of these individual issues in more depth, an event that provided the opportunity for a wider interdisciplinary approach to these matters would also be appropriate.

In discussions of the threats, or possible threats, faced by humankind in the context of a changing environment, it is easy to be overcome by pessimism. However, it is instructive first to reflect upon the archaeological and anthropological context. Our own species, Homo sapiens, first appeared around 200,000 years ago. Our acquisition of skills, our development of technology and the growth of civilization as we know it have been a very risky process indeed. Our survival and success have been challenged at every point throughout our relatively brief history by climate change, by disease and by previous shortages of food, materials and energy. For example, anthropologists tell us that, at one point, the human population was reduced to maybe 15,000 individuals as a result of catastrophic climate change. Had the effects of that particular incident, a volcanic eruption, been just a fraction greater, then the clock would have stopped for humanity. Thus, nothing is guaranteed about the survival of H. sapiens, despite the immense progress that our species has subsequently made in science, medicine, technology and the creation of complex urban societies. So how should we face the future of the planet in the current situation of climatic swings, population growth, the ever-increasing pressure on scarce resources and the remorseless growth of new and subtle disease patterns? Is pessimism the only solution; or can we take a long, hard look at how new developments in the study of prediction and risk, together with recent advances across the physical, biological and medical sciences, can help us to overcome these inconvenient realities? Furthermore, do we have the correct economic and social models, and the attitudes and behaviour patterns, that can cope with the worst that can happen?

One contribution of 12 to a Theo Murphy Meeting Issue ‘The sustainable planet: opportunities and challenges for science, technology and society’.
The meeting, *The sustainable planet: opportunities and challenges for science, technology and society*, brought together—unusually—a group of eminent speakers from the varied fields of biology, chemistry, economics, energy supply, engineering, hydrology, medicine, meteorology, risk analysis and sociology. The forum provided an excellent opportunity to consider the latest advances in the relevant scientific and socio-scientific disciplines, but in a much broader context than usually occurs. The speakers’ contributions, all of which were thought-provoking and challenging, were reinforced by well-informed and creative discussion from the floor.

Climate change, regarded now by almost everyone as inevitable, is a key concern for discussions concerning the sustainability of our planet. Scientists cannot, of course, give precise predictions of what will happen in 100 years, or even in the next 10 years; however, they are able to give a range of possible outcomes. But how should such predictions be interpreted, and do scientists and their political masters sometimes confuse short-term fluctuations with longer-term trends? Fortunately, the world’s leading meteorological services have, over many years, accumulated sufficient data and have developed a wide range of modelling tools, enabled by the most efficient and extensive computer systems, so that they are able to assign probabilities to their projections. But there are difficulties: not only do models often disagree, especially about what type of input data should be used, but also there remains a strong public exasperation with the apparent indecisiveness of their conclusions, which often leads to indifference or, worse, to pessimism. However, evidence for climate change is now overwhelming and, furthermore, it is a reasonable conclusion that, if carbon and other emissions continue to grow at present rates, the changes will be so large and so rapid that the adverse effects will quickly outweigh any local benefits and come to dominate in all regions of the world. Rapid adaptation to such changes will also become increasingly difficult, and in some cases may even be impossible.

Our species has demonstrated an ever-increasing demand for water, energy, nourishment and medical care, and the recent process of urbanization has only accelerated these needs. But now we are faced with the ‘inconvenient truth’ of climate change that, although not a new phenomenon in the history of mankind, is itself exacerbated by atmospheric emissions from urban communities with expectations that all of these essentials will be available permanently. Once again, we have to take a careful look at the mathematical modelling that underpins scenario planning. Are simple, linear and deterministic models good enough; or are we to expect the unexpected, when ‘tipping points’ are reached and risks ensue? Clearly, energy planning is crucial to much of this discussion: not only is a balance of renewables, nuclear and carbon-based sources becoming essential, but each citizen and each household will be required to adapt their consumption patterns. Collectively, it will be incumbent upon us to become less reliant on ‘ancient sunlight’ and to become responsible for the generation of at least some part of our needs through the application of clever catalytic chemistry for energy storage and through the use of efficient biofuels and improved, lower-cost solar cells for energy generation.

The security of our food supplies is also under threat as harsher weather conditions become established and as new types of crop disease emerge. In addition, the human species has a growing addiction to animal-sourced protein.
and this implies more land usage and increased emissions. One possible solution is through genetically modified crops, taking advantage of new genomics tools to isolate and deploy disease-resistant genes. But why is Europe, as a whole, so reluctant to accept this route, which is, after all, no more than an acceleration of a natural mechanism? Once again, societal attitudes are significant and the engagement of the wider population in this vital matter is of crucial importance.

All of the above changes and shortages will, inevitably, affect the health and well-being of all of our species. The rapid growth of cities can, surprisingly, lead to advantages for medical provision as well as for energy conservation as communities become denser, supply chains are shortened and expertise is concentrated. But all too often, the effects of increased urbanization most adversely impact on the poorest sections of society. Climate change, water shortage and increased population are all implicated in the emergence, or re-emergence, of diseases such as Chagas disease, West Nile virus, Ebola virus, tuberculosis and Dengue fever. How can we deploy simple scientific tools to combat these disastrous illnesses, some of which are already present in Western Europe, and bring health and comfort to the least privileged in our world? Furthermore, how can the most advanced therapies, such as stem cell treatments, that are now becoming available in the privileged Global North, be made available to the developing world? Finally, do we have appropriate models and mechanisms available in the pharmaceutical industry, perhaps building on developments in genomics and systems biology, to provide solutions to the ever-growing demands for treatments?

As mentioned previously, this meeting attempted to address a wider range of questions than is normally the case for a highly focused scientific event. A key feature was to match potential scientific and technological solutions to the challenges faced by humankind into wider social, economic and ethical contexts. A recurring theme throughout was the need to ensure not only that the models used for prediction were well-tested, but also that all of the input data were correct and appropriate. Another general comment, echoed by many speakers, was that pessimism in the face of formidable change is not the way forward: what is needed is a sustained effort by scientists, engineers and clinicians to engage the general public, to educate and inform and, through their wider acceptance of the facts and findings, to develop national and international policies that can genuinely change the way we live, benefit *H. sapiens* as a whole and ensure that our continued survival is not merely a matter of chance. In this context, it is appropriate to remember the comments of Lord May PRS (Anniversary Address 2005) that the important aspects of science are ‘laden with values’ while the facts of science are ‘value free’. This profound view will spur future efforts to recognize, monitor and model resource changes; and hopefully to adjust individual and societal behaviour to prevent future calamity.

A number of new questions have clearly emerged from this event, held in the delightful surroundings of Chicheley Hall. Among these were: how can the public perception of, and trust in, global warming predictions be improved; how often is it the case in science that perceptions of future reality may determine that reality; how may the efficiency of carbon-based energy production be improved; will renewable energy technologies ever be sustainable and cost-effective; what is the basis of the reluctance of so many to the use of genetically modified crops; and how may new technologies be used to overcome the emergent and
re-emergent diseases caused by a changing climate and diminishing resources? No doubt some of these, at least, will lead to further discussion meetings in the future.

In this special issue of *Philosophical Transactions of the Royal Society A*, we have gathered together texts from many of the main speakers at the meeting. The organizers wish to thank sincerely not only the speakers and the contributors to this issue, but also all who attended the Kavli Centre in July 2010. In particular, we would like to thank Alan Bilsborough (Durham) who gave an inspiring summary of the complete meeting. This issue will, we hope, serve as an important point of reference for future debate in this area, which is of crucial importance to us all.

Finally, we would like to set on record our grateful thanks to all on the staff at Chicheley who made the meeting such a pleasant and convivial event; and who ensured that all went smoothly and to plan. Chief among those, of course, is Ian Cooper of the Royal Society, who did so much to make ‘Kavli’ happen and to whose memory this issue is dedicated.

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