which supports a number of other science and technology dialogue projects, the workshops took the form of structured conversations between experts, non-experts and policymakers.

The call for sustained dialogue is reflected in the final report from the study, and features as one of the main conclusions to have been made. There is a clear recognition that the public still want sustained dialogue in the area of stem cell study and that this is vital to the development of trust in this area of research. The report stresses the importance of using dialogue not as 'a set of one-off discussions to secure a licence to operate' but as a vital tool in the continued planning and development of stem cell research. The report concludes that dialogue needs to become a habitual feature of research and that, going forward, it will become an automatic aspect of the practices and culture of stem cell research.

The report following the public dialogue will feed into decisions that Research Councils and others will make as the research matures and more stem cell treatments move closer to clinical application. The full report, 'Stem Cells Public Dialogue' is available on the Medical Research Council website.

BBSRC

The BBSRC is the UK funding agency for research in the life sciences. BBSRC is one of seven Research Councils that work together as Research Councils UK (RCUK). It is funded from the Government's Department for Innovation, Universities & Skills (DIUS). www.bbsrc.ac.uk

MRC

The MRC is a publicly-funded organisation dedicated to improving human health. The MRC supports research across the biomedical spectrum, from fundamental lab-based science to clinical trials, and in all major disease areas. It is one of seven Research Councils funded by the Government's Department for Innovation, Universities & Skills (DIUS). www.mrc.ac.uk

Sciencewise-ERC

The Sciencewise Expert Resource Centre (ERC) for Public Dialogue In Science and Innovation, funded by the Department for Innovation, Universities & Skills (DIUS), helps policy makers commission and use public dialogue to inform policy decisions in emerging areas of science and technology. The Sciencewise-ERC provides co-funding to Government departments and agencies to develop and commission public dialogue activities. www.sciencewise-erc.org.uk

BMRB

The BMRB is one of the UK's leading market research agencies. It operates within the Millward Brown Group which, in turn, is part of Kantar, WPP's insight, information and consultancy division. www.bmrb.co.uk

Institute for Science and Society

Participant feedback and quotes were collected by the Institute for Science and Society (ISS) in response to an evaluation questionnaire. The ISS is the independent evaluator of the BBSRC/MRC stem cell dialogue project.

BOOK REVIEW

GLOBAL HEATING: ACTION REQUIRED - NOW

Review of The Vanishing Face of Gaia: A Final Warning by James Lovelock

Allen Lane, 2009, 178pp

This is without doubt the most frightening book that I have ever read. Not because the author is peddling green propaganda – but because he isn't. It is written in a very urbane and personal style, and Lovelock almost goes out of his way to avoid sensationalism. However, his stark message is that global heating is happening, that the cause is unequivocally humankind, and there's virtually nothing we can now do to stop it. We are on an ever steeper slippery slope. The primary cause is simply that there are too many people on the planet (about half of all human-generated greenhouse gas emission is caused simply by our existence – our breathing, eating, and other biological activity, plus those of our pets and livestock). This makes nonsense of any long range emission reduction targets

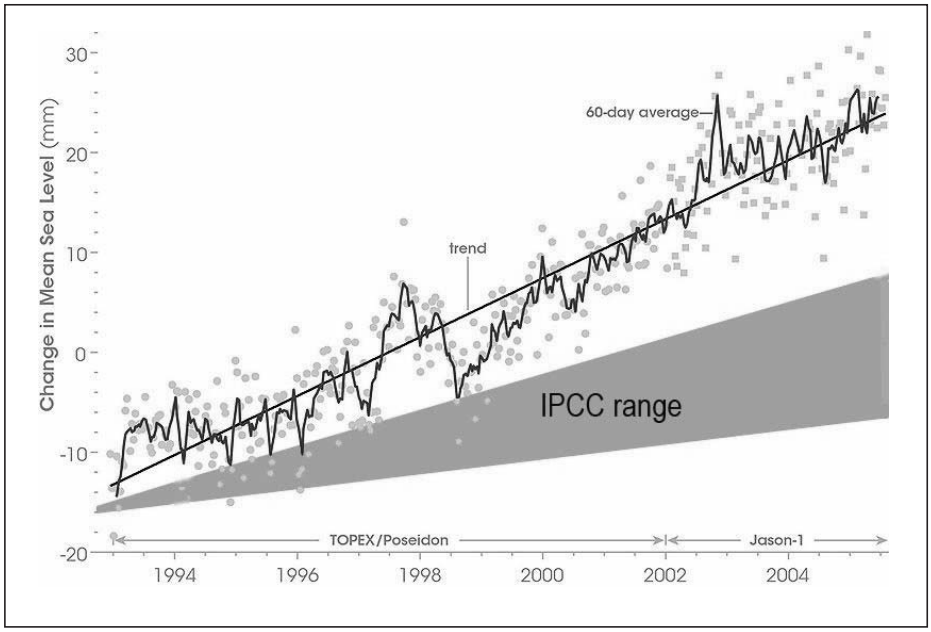

Figure 1 (reproduced by permission from James Lovelock). Observed changes in sea levels compared with predictions from the IPCC models. This is a simplified version of the upper part of Figure 1 included in the book. Sea level is a proxy for temperature change - and much more reliable as a global thermometer than trying directly to estimate average atmospheric temperatures.

for 2020 or 2050 which are unachievable without drastic reduction in the total numbers of people.

Lovelock points out that the world is heating up faster than the most pessimistic scenario from the IPCC models (Figure 1). He makes it crystal clear why the IPCC, even though it includes many excellent individual scientists among its membership, is incapable of presenting a model which actually bears any relationship with what is really happening. Consensus reached through a fundamentally political process is not a mechanism that will ever achieve scientific truth.

Entire sub-systems, such as the melting of Antarctic ice shelves, are omitted from the models because they are not yet well enough understood[1]. Furthermore, because of the nonlinear behaviour of many of the natural sub-systems involved in regulating our climate, it is certain that (as has been documented in geological history) there will be sudden shifts in temperature and other response variables. The transition to a hotter state is likely to be sudden rather than follow the smooth IPCC curve, but because the underlying factors are still poorly known, it is impossible to predict when this jump will occur.

One factor that has come to prominence recently, and which could cause such a rapid change, is the accelerated melting of Arctic ice. James Lovelock draws a useful analogy with a cold drink containing an ice cube. As long as some ice remains, the drink stays cold. Once all the ice has melted, the drink warms up rapidly.

The message is not wholly pessimistic, though. There are actions that we can take – and urgently should take – to slow this headlong rush to catastrophe even if we cannot halt or reverse it. Wholesale transition from fossil fuels to other sources of energy is necessary but not sufficient. He argues well the folly of wind power as even a partial solution, while enthusiastically supporting nuclear power. His clear presentation of the facts combined with his independence from the 'nuclear lobby' and from any green pressure group lend authority to his statements. Perhaps he understates the problems and risks of uranium/plutonium nuclear power – but at the same time he makes a convincing case that there is no alternative. He fails to mention the real potential of much safer thorium power – known for over 60 years but mostly ignored possibly because thorium cannot be used to make bombs – and the likelihood that fusion power may at last be just around the corner. Research in both of these fields urgently requires very much more funding. However, this is incidental to Lovelock's message, and should not divert us from the imperative – that we must take appropriate action now.

Lovelock also examines the prospects for various geo-engineering options though accepts that none are likely to be able to reverse global heating, and that none are risk-free. He identifies the burial of elemental carbon ('bio-char') as by far the most promising – but like all else, it will not happen unless there is a serious commitment and concerted effort. Similarly, the industrial synthesis of food and fuel from inorganic ingredients (mainly CO_2 and water), using nuclear power as an energy source, would have added benefits of reducing our demand for agricultural land and taking CO_2 out of the system.

His priority is that at least some of humanity will survive to evolve into a more intelligent component of the 'living earth' that is Gaia, and hence adaptation is actually more important than concentrating solely on reducing greenhouse gas emissions. However, he does warn that it is of crucial importance that we stop burning fossil fuels, as the survival of Earth itself as a living system could be threatened by continued burning of coal, oil, and gas in a hotter world with a more fragile ecosystem.

This is a book not only to be read but to be acted upon. Although private individuals can and should do whatever they can, many actions can be taken only at governmental level. Business, driven by short-term profit motives, cannot be expected to do anything without appropriate carrot-and-stick measures. It is vital, therefore, that parliamentarians read, understand, and accept the obligation that is theirs to ensure a long term future for humankind as an important component of our living planet. It is not good enough to wait for lengthy planning processes to run their course, even less to wait for 'lowest common denominator' international agreements. The UK is well placed to become an example for others to follow, as we shall probably be less affected by global heating than many regions especially in the tropics and continental interiors (these islands will become one of the few 'lifeboats' for humankind), and also we have the necessary science and technology expertise and infrastructure actually to achieve something. However, it will require a Churchillian statesman to galvanise Government and people into action.

Lovelock's headmaster warned him in 1938 against science as a career on the basis that it was only for "those of genius or with private means"[2]. He admitted he was not in the latter category, and modestly disclaimed the former. However, the key characteristic of genius is to recognise a fundamental and simple truth which nobody has noticed or understood before. By this standard, Lovelock is indeed a genius, and one whose message must be heeded:

The only near certain conclusion we can draw from the changing climate and people's response to it is that there is little time left in which to act. Therefore, my plea is that adaptation is made at least equal in importance to policy-driven attempts to reduce emissions. We cannot assume that because there is no way gently to reduce our numbers it is sufficient merely to improve our carbon footprints. Too many also think only of the profit to be made from carbon trading. It is not the carbon footprint alone that harms the Earth; the people's footprint is larger and more deadly.

Dr Stephen Henley FGS, FIMMM, CEng

The P&SC website manager, Stephen Henley, is an independent scientist, not affiliated to any political party or pressure group, and not beholden to any private or public sector employer.

A version of this review has been posted on the P&SC web forum for further discussion.

References

1. Fox, D., 2009: Driller thriller. New Scientist, 11 April, 2009, p.34-37

2. Lovelock, J., 1979: The independent practice of science. New Scientist, 6 Sept.1979, p.714-717