

## Andrew Paul Haines



‘We are living (to be read as abusing the planet) on this planet as if we had another one to go to.’—Terry Swearingen, Winner of the Goldman Environmental Prize in 1997. Today, we are fighting a losing battle for a clean and sustainable environment due to the ravages of climate change as a result of anthropogenic activities and rapid industrial development. The survival of our planet will be jeopardized if we fail to take decisive and quick actions on clean energy and global warming increasingly referred to as global heating.

Andrew Paul Haines, a well-known British epidemiologist and an expert on environmental change and public health, is the second Indian Academy of Sciences – Springer Nature Chair Professor. He has been working on global climate change for over 25 years. He is also a member of the Rockefeller Council on the Economics of Planetary Health. During 2015–17, Haines was a member of the Lancet Commissions on Health and Climate Change and Pollution and Health. In 2014–2015, he chaired the Rockefeller Foundation/Lancet Commission on Planetary Health, and co-chaired the Development Group for the Health Knowledge Action Network of Future Earth. Haines was a member of Working Group II of the Intergovernmental Panel on Climate Change (IPCC) for the Second and Third Assessment Reports, and review editor of the chapter on health in the Fifth Assessment Report. He has chaired the MRC Global Health Group and was a member of the MRC Strategy Group between 2008 and 2011. In 2011, he was Chair of the WHO Task

Force on Guidance for Health Systems Strengthening and in 2013 he chaired the Scientific Advisory Panel for the 2013 WHO World Health Report on Research for universal Health Courage. He is also a member of several major international and national committees. He was formerly Chair of the Universities UK Health and Social Care Policy Committee and a member of the WHO Advisory Committee on Health Research. In 2005, Haines was knighted for his services to medicine. He was Director of London School of Hygiene and Tropical Medicine from 2001 to 2010, having previously been Professor of Primary Health Care at University College London between 1987 and 2000. He worked part-time as a general practitioner in North London for many years. Between 1993 and 1996, he was on secondment as Director of Research & Development at the NHS Executive, North Thames, and a consultant epidemiologist at the MRC Epidemiology and Medical Care Unit, Cambridge between 1980 and 1987.

To commemorate World Water Day and International Forest Day, *Current Science* interviewed Haines who shared his ideas and thoughts on global climate change, environmental sustainability and planetary health.

*Being a health practitioner, what prompted you to look into the broader perspective of global climate change and environmental sustainability?*

I started my research career as an epidemiologist and remained a clinician and academic family physician for much of my career. In the early 1990s, I became aware of the phenomenon of climate change and realized that it must have implications on human health. Since hardly any research was available in the area, I began by writing papers on various potential health outcomes arising from the effects of increase in heat, changes in infectious disease distribution, changes in nutrition, and so on. People who were also interested in this area began to write to me. Subsequently, I was asked by the World Health Organization (WHO), the UN Environment Programme and the World Meteorological Organization to co-edit with Tony McMichael, an Aus-

tralian scientist and thought leader in the area and a few other colleagues, a report on climate change and human health published in 1996, that brought together all the evidence then available. I participated in IPCC, a major international scientific collaboration, on three occasions, starting in 1994–1996 when health was included for the first time. Later, during my term as Director at the London School of Hygiene and Tropical Medicine, I was able to convene a large collaboration of 57 scientists to publish a series of articles in *The Lancet* that addressed the health benefits of moving towards a more sustainable, low-carbon economy, including reduced air pollution exposure and other pathways. In 2014, Richard Horton, editor of *The Lancet* asked me to chair the Rockefeller/Lancet Commission on Planetary Health, which focused on the interrelationship between the state of natural systems of the planet and human health. The Commission attempted to evaluate the effects of alterations in natural systems, assess how humanity could adapt to the changes and propose strategies to minimize the occurrence of these changes in the future, to reduce the risks to which the next generations would be exposed as a result of our activities. This has led to a range of follow up activities including a Council looking at the Economics of Planetary Health, chaired by the former President of Mexico, Ernesto Zedillo.

*How do you think youngsters can contribute towards the sustainability of planetary health?*

I think young people can contribute in a whole range of ways. Young researchers tend to be inspired by the issue of climate change and global health. They are the most energized, motivated and interested group, and we can see more career options for them in this transdisciplinary field. I think this kind of approach, which is devoid of the disciplinary silos that tend to dominate medical research, is attractive to many young scientists, thus enabling them to learn from each other. We are also witnessing a lot of resonance in the wider public, including young pupils in school. For example, in my country, there is growing publicity

about a group of young people standing outside their school once a week protesting that the adults are not doing enough about climate change. What they are saying is, 'if you adults aren't prepared to act like adults, then we will'. In the circumstances it is a good thing for us adults to be challenged in that way by young people. So whilst I am in favour of supporting activities to address environmental change by people of all ages, I am particularly very interested in and supportive of the work by young people, whether they be school children or young scientists. I think it is absolutely essential for the future. We also need to educate our policymakers because they often have many things on their plate and are driven by short-term imperatives. So, they are not giving enough emphasis to this agenda which requires some difficult decisions to be made now, many of which are not universally popular because they do mean somehow stepping on the toes of a few powerful interests. Moreover, the scientific evidence that we have tells us that we need to make decisions soon and act swiftly. For example, with climate change the decisions that we make over the next couple of decades will influence the climate for centuries and maybe even millennia to come. We are already at 1°C warming; so if we want to keep below 2°C of warming by the end of the century, then we need to cut greenhouse gas (GHG) emissions very quickly indeed. Most climatologists believe we should try to take that precautionary approach to reduce the risks of serious, and perhaps catastrophic, outcomes. Since many air pollutants are co-emitted with GHGs, for example, when fossil fuels are burnt, there will be large health (co-) benefits from decarbonizing the economy using clean, renewable sources of energy. Similarly, moving towards simple dietary changes and more sustainable diets, including higher consumption of fruits and vegetables is also a step towards better health and a better environment. So, many of the steps we need to take will have the middle-term and long-term benefits for humanity, but they could also have near-term benefits to health, which is an added motivation for change.

*Where do you see India in terms of promoting health and tackling climate change? And what policies do you think India lacks?*

India is an absolutely vital and key player on the global stage. It is one of the most influential countries in the world. There is no doubt that India must play and can play a very powerful role indeed. Historically countries like the US and the UK have benefitted from the burning of fossil fuels. They should acknowledge their major contributions to climate change and make deep cuts in emissions, aiming for a rapid phase-out of fossil fuels. It is therefore deeply concerning to see how the US Government is refusing to take responsibility for addressing climate change, although of course, parts of the US such as California are strongly committed to decarbonization. In terms of collective responsibilities for global climate change, countries such as India cannot say 'it is not our problem, we should just carry on, since we did not contribute much to the historic burning of fossil fuels'. It is in the interests of India to play a leading role in supporting decisive global action because in the absence of such action, soon we will see very serious effects on the global environment and indeed on climate in India. In parts of India, people are living at very high temperatures in the hottest months and are adapted up to a certain point. But with the rise in temperature, there will certainly come a point at which it becomes more difficult or impossible to adapt. There are other changes as well in the global as well as national landscape, like the depletion of freshwater. For example, many parts of India are depleting freshwater supply at an unsustainable rate. So something will need to be done in order to protect the food system, because most of the agricultural productivity relies on the availability of freshwater. I hope and think that India will play a very important role both in terms of dealing with its local problems like freshwater availability and pollution, as well as the wider global threat of climate change. We know from a very recent report that air pollution is a big killer in India, both ambient environmental air pollution and household air pollution. The Indian Government is doing a lot to clean up household air pollution through LPG, and that is a good step. It is not renewable energy, but it is a very low-impact fossil fuel energy and much cleaner than burning solid fuels. However, there is also a pressing need to clean up the outdoor (ambient) air pollution, and that means cutting out coal as

fast as possible and reducing air pollution from vehicles and other sources as well, including agriculture. So there is a lot that needs to be done in India in terms of decarbonizing the Indian economy by moving rapidly to clean renewable energy sources. This is not easy because it involves some costs upfront, but our argument is that there will be big benefits to health and the wider environment from doing so. And if the public is brought along with this operation and given the right kind of scientific information about the impacts and benefits, then it will be easier to get public support for the changes that have to be made for the sake of everyone. So, India is absolutely crucial because it faces particular environmental challenges in its own right and is also an influential player on the global stage. The policies that India puts in place will be noticed and will definitely have a big global impact.

*According to you what are the implications of climate change on infectious diseases?*

Climate change has a number of potential impacts on infectious diseases which have been described by a range of investigators around the world. It can increase the risk of some of the waterborne infections, for example, cholera and other diarrhoeal diseases. Climate change can also increase the risk and disease distribution of some vector-borne diseases like dengue and chikungunya. This is the largest vector-borne disease on the global scale, probably causing approximately 390 million infections per year; though the actual number of cases is under reported. It can be a serious disease with an appreciable death rate. Infectious diseases can be addressed by improvements in health-care systems, like early warning systems for epidemics and better disease control programmes. Climate is probably the most important environmental driver of changes in infectious disease distribution, but other environmental changes like land-use change and deforestation also play a significant role in the emerging zoonotic diseases which are transmitted from animals to humans. One example comes from work of Chris Drakeley and colleagues at the London School of Hygiene and Tropical Medicine. They have been studying a severe form of malaria, which is found in long-tailed macaques of Southeast Asia and is

caused by *Plasmodium knowlesi*. When people move into the forests to establish palm-oil plantations, they disrupt the habitat of the macaques. The closer proximity of macaques to human settlements drives the transmission of this parasite to humans, and causes severe cases of acute malaria with an appreciable death rate.

There are many other environmental changes that can influence the risk of infectious diseases, but there are also other health outcomes of environmental change such as decline in nutrition and direct effects of heat, which can increase the death rates. Extreme heat exposure, for example, leads to decline in labour productivity and efficiency, thus pushing more people back into poverty.

But environmental change also has effects on non-communicable diseases which are the dominant cause of ill health in many countries. Air pollution for example is a major cause of common NCDs such as heart disease, stroke, lung cancer and chronic obstructive pulmonary disease. Growing evidence suggests that exposure to fine particulate air pollution causes potentially irreversible changes to the epigenome. Environmental changes, including climate change, loss of pollinators, carbon dioxide fertilization and fishery decline, affect food availability and quality with potential implications for nutrition – related health outcomes.

*Based on your experience what is the most challenging part of working in a low-income country?*

There are several challenges in a lower income environment. The populations in such environments are vulnerable because they are more likely to be impoverished, and have limited health care resources. In some cases they are living close to the environmental limits that they can cope with and hence, are less resilient to environmental change. So, for example, in an event like a flood or heat wave, the subsistence farmer cannot work much during that part of the year and crop yields start declining, leading to undernutrition and increasing poverty.

However, there are also opportunities to develop in a way different from traditional forms of development; in other words, with much lower use of fossil fuels and use of cleaner energy with less waste. If you look at the traditional forms of development, exemplified by

the US or UK, it is very inefficient. Burning a lot of fossil fuels to achieve development is an inappropriate way for the whole planet to develop. So countries need to find their own paths, and I believe that we can learn from some of the traditional thinking, traditional diets, indigenous adaptations to extreme events, as well as harnessing scientific knowledge that can help us. Vernacular architecture for example, relies on passive cooling to maintain tolerable indoor temperatures and such approaches could help to reduce dependence on energy hungry air conditioning. Different disciplinary approaches are needed and certainly bringing in social scientists like anthropologists and sociologists can help us understand behaviour patterns and belief systems, how they can be influenced and what kind of knowledge may be appropriate to build on or to adapt for achieving sustainable development within environmental limits.

*Do you think there is a need to redefine science education and policies on planetary health and public health?*

Well, I think there is a need to do so because we are now living in a new geological epoch called the Anthropocene epoch which is very distinct from the Holocene, in which humanity generally flourished. So nearly for 11,500 years during the Holocene, human civilization moved from being hunter-gatherers to agriculturists to a largely urban population. As a population, we have been reaping the benefits of that progress but it has come at a cost to the environment, resulting in dramatic environmental changes that threaten to undermine human progress if left unchecked. So we need to think about fundamentally different ways of developing, with a much lower level of burden to the environment.

One big challenge of science education is the unidisciplinary or single disciplinary approach, because no single discipline can solve these problems alone. We need to respect each other's disciplines, each other's types of knowledge and learn to work together. Until now the most difficult part has been to get research funding, because most research funders also think in silos. But now we are seeing a few far-sighted research funders who are beginning to think in different terms. The Wellcome Trust, for example, has introduced a programme

called 'Our Planet, Our Health', which specifically looks at the inter-linkages between natural systems and human health, and supports the development and evaluation of solutions as well. We hope that other foundations will be set up and the national government funders like ICMR in India and MCR in the UK will also support work in this area. But I will say that the orthodox government funders in many cases are a little bit 'behind the curve' and some foundations have been rather more innovative. I very much hope that the other research funders will begin to see the opportunities in this field. Recently, the Belmont forum, which is a consortium of government funders, has for the first time, called for interdisciplinary research on climate change and health. This is a very good sign and it means that there is beginning to be a change in perception about the importance of this type of research. So, I think this is a big challenge which is beginning to be met by the funders, and we can look towards imaginative use of research funds in the future.

*Can you tell us more regarding A. J. (Tony) McMichael's visionary book 'Planetary Overload' and the opposing views that surrounded it initially?*

Actually, I was a great supporter of that book and I do not know much about the opposing views. Tony McMichael was an Australian epidemiologist, professor of environmental health and a great visionary; we lost him in 2014. But he left a powerful legacy. I think even now, the book *Planetary Overload* is still ahead of its time. His book explains how we are overloading earth's natural systems largely as a result of our high-consumption lifestyle, which cannot be sustained. Obviously population plays a role, but we also know that it is probably a relatively small proportion of the planet's population that consumes a disproportionate share of resources and largely drives environmental change. So we cannot just say that it is all due to population growth. It is also due to inequitable consumption patterns. I think a lot of great books encounter opposing views at first because they are too far-sighted or too visionary. This book covers too vast an agenda for a traditional scientist used to a narrow field of study. In the Anthropocene epoch, you need to think in a different and broader way, which is, 'how to

deal with systems problems?' You cannot tackle a systems problem by just fiddling with one tiny part of the system. You need to look at the whole system and its interactions. We have been building on Tony's legacy; the Commission that I chaired for the Rockefeller Foundation is built very much on the legacy that he has left. So, certainly he is someone who will be remembered with great respect and affection, and his contributions will certainly endure.

*What is your message for the young epidemiologist who wants to make a career in infectious disease and public health?*

Well, my message is not just for the young epidemiologist or those in infectious diseases, or non-communicable diseases. My message is that we need to be more thoughtful and consider the impacts of our work from a systems perspective, because if we do not, then we may devise solutions which will work only for a short time. Unless we think about the long-term implications of what we are

doing and how they fit into the necessary system changes, these successes will only be temporary or transient. So if we do not think about the system issues, then we can have unintended adverse consequences. For example, the French President Emmanuel Macron put forward a carbon tax to reduce GHG emission. Anyone who has looked into the literature knows that he did it the wrong way. It is not right to impose a tax on people, especially one which hits the poorest without preparing the ground carefully and redirecting the taxes back into the people's pockets or providing other tangible benefits. We may see such examples even in our health system. Sometimes we do things which appear beneficial to us, but in some ways they make us more vulnerable. For example, we can build a hospital which requires a lot of energy generated from fossil fuels, but that will have consequences for emissions, and costs. It may also have consequences for resilience, for example, when the electricity supply fails or when a building is damaged by an extreme climate event –

as in the case of hospitals built on floodplains. Thus it is always better to think about the future and what the world is going to be like in the next 40–50 years from now. So my message would be to think in a systems way, even if you work on a specific problem. Try to conceptualize how things work and how they fit into the broader system and where it is possible to do so, collaborate with different disciplines so that you can better understand the whole context of what you are studying. There is no point in introducing a new intervention, for example, if people cannot accept it or it meets with resistance. We have to understand how to change behaviours, and how to change policies. We need to think widely about the implications of what we are doing, talk to our colleagues, engage in interdisciplinary presentations and interactions and learn from each other.

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## OPINION

### Are there limits to artificial intelligence?

*Subhash Kak*

Information technology has become the big driver of change in industry and society<sup>1</sup>. Robots have transformed manufacturing, and machines using artificial intelligence (AI) are increasingly replacing humans at tasks where learning and judgment are required. Just as brick-and-mortar stores appear unable to compete with online retailers, colleges and universities will have to innovate and transform or become obsolete. What this might do to the pursuit of science in the university is hard to fathom.

Some say that the current phase of automation will create new kinds of jobs that we cannot even imagine. They point to the automobile revolution over a hundred years ago, which people feared would destroy many trades of the day. The automobile revolution did create new kinds of jobs, but it did not turn out so great for the horse. The current revolu-

tion is replacing the thinking human and so its impact on society will be enormous. These machines would save us from workaday drudgery, but a life of no work and only play is unlikely to lead to individual or social well-being even with guaranteed minimum income<sup>2</sup>. The great English novelist Aldous Huxley foresaw many parts of this unfolding future in his *Brave New World*.

#### Science and consciousness

Is it possible that the machine of the future will be aware of itself and its surroundings? It might not only drive, cook, clean, do laundry, but also keep humans company when other people are not nearby. A group of computer scientists, neuroscientists, physicists and philosophers met this past year in several workshops across the US and UK to discuss

these issues, and I would like to present my impressions of these meetings.

There was broad agreement that literally all cognitive capacities will eventually be emulated by machines. A minority believed that the phenomenon of consciousness, by which we mean awareness, will be beyond the reach of AI. Their argument was that cognitive capacities are computational but their assignment to the autobiographical self is a process that is associated with awareness and memories. This assignment occurs with consciousness as a singular phenomenon. Sentience is a complex dance between being and becoming, where the former is consciousness and the latter is the physical reality.

Another important viewpoint on consciousness comes from quantum theory, which is the deepest theory of physics. According to the orthodox Copenhagen