The challenge of the post-truth era

Science denial is not new but, in the digital age, evidence-based conclusions appear to be increasingly threatened by beliefs based on emotion and isolated personal experience. When confronting a post-truth world, scientists must defend the scientific method and increase public engagement.

A few weeks ago the Nobel Prize in Chemistry was awarded to Frances H. Arnold for the directed evolution of enzymes, and to George P. Smith and Gregory P. Winter for the phage display of peptides and antibodies. The Royal Swedish Academy of Sciences recognized that the Nobel Laureates' work used the principles of evolution, and hailed the benefit it heralds for humankind. The counterweight to this celebration is the fierce denial the theory of evolution currently faces in certain parts of the world. Efforts to introduce creationism and pseudoscientific theories, such as intelligent design, in US teaching curricula are well documented, as is the American public's scepticism towards evolution. According to a 2018 report by the National Science Board (https://go.nature.com/2IQdScc) only 52% of Americans agree that, "human beings, as we know them today, developed from earlier species of animals". Although this proportion has increased from 42% in 2004, it lags behind the ~70% of Canadian, Chinese and EU respondents to similar surveys. Anti-evolution agendas have been adopted in educational systems elsewhere: Saudi Arabia excludes the teaching of evolution and, last year, Turkey announced the removal of the relevant chapter from high-school books.

The influence of science denialism on education and policy is far-reaching. Despite the scientific consensus that anthropogenic climate change is a pressing problem, the general public's beliefs on the matter vary widely. A 2015 Pew Research Center survey (https://go.nature.com/2EiEq7v) found that although 54% of global respondents consider climate change a very serious problem, only 18% of Chinese and 45% of US residents agree with this view despite these two countries being the highest CO_2 emitters worldwide. The same report indicates that in many economically advanced countries, including the US, UK, Canada, Germany and Australia, attitudes towards climate change are divided based on political ideologies, something that is made sadly apparent by the current state of the US Environmental Protection Agency. The recent report on 'Global Warming of 1.5 °C' by the Intergovernmental Panel on Climate Change (https://go.nature.com/2yztjRf) paints a grave image for our planet if we fail to curb global warming. Whether the science-sceptic public and policymakers will heed this call for drastic changes remains unclear.

Pseudoscience also poses an immediate threat to public health in the form of anti-vaccination movements, which can lead to epidemics of otherwise preventable diseases. A prominent example stems from a, now fully retracted, 1998 paper that alleged a link between autism and the measles, mumps and rubella (MMR) vaccine. Despite the fact that the original paper was scientifically discredited and the leading author struck from the medical register, the possibility that vaccination could lead to autism received high media coverage and influenced public attitudes to the point that MMR vaccination rates dropped in the UK (https://go.nature.com/2QH9sae). Two decades later, anti-vaccination campaigns continue and, alarmingly, measles cases have been on the rise in Europe, with low immunization coverage remaining a concern (WHO; 20 August, 2018).

Perhaps the most unexpected example of science denial is the apparent revival of the belief that the Earth is flat. The topic was much discussed on mass and social media this year, with a US survey reporting that only 84% of respondents have always believed that the world is round, whereas 2% believe it is flat, and the rest expressed uncertainty (Nugyen, H. *YouGov*; 2018). Considering the amount of evidence to the contrary, it is surprising that anyone with access to basic education would express flat-Earth views today. The Greek mathematician Eratosthenes managed to calculate the Earth's circumference with remarkable accuracy in the third century BC and the Magellan-Elcano expedition succeeded in circumnavigating the Earth in the 1500s. In the twentieth century, space exploration finally permitted us to see and study our planet as a celestial body. More extensive data are needed to determine whether flat-Earth beliefs have resurged, but the possibility is concerning.

These prominent examples of the public failing to accept essential scientific knowledge go against the increased importance of education in science, technology, engineering and mathematics (STEM) for contemporary society to continue to thrive. Indeed, global expenditure on research and development has more than doubled between 2000 and 2015, with the US investing the most in STEM, followed by China and the EU (https://go.nature.com/2IQdScc). In the US alone the number of STEM jobs is estimated to grow by 13% by 2027, a rate higher than that projected for non-STEM positions (https://go.nature.com/2yA1l88). But despite the high demand for STEM-educated workers, STEM education in US high schools is less than impressive. The latest report from the Programme for International Student Assessment that evaluates science, mathematics and reading abilities among 15-year-olds around the world, ranked the US nineteenth in science and thirty-eighth in mathematics, among 71 countries (https://go.nature.com/2EcDSzM).

How can we bridge the gap between rising STEM needs and less than desirable uptake by the younger generation? How can we increase the understanding and acceptance of science in contemporary society, and counter the spread of misinformation? It is important to recognize that STEM education is not equally available to all, even in the most economically advanced countries. Scientists must work with policymakers to address this shortcoming and an essential first step is to engage more in public life. We should also aim to cultivate the interest of children in the natural world by tapping into their inherent curiosity early. Developing programmes between schools, universities and research institutes to bring scientists into the classroom and young students into the lab, will be valuable. More generally, we should encourage informal science outreach if we are to inspire young minds and debunk the tired stereotypes of dusty textbooks and researchers disengaged from every-day life. Linked to this is the need to teach scientists how to communicate more effectively with the general public, so that scientific principles and the scientific method can become more accessible to the average person. In the post-truth era, when facts are disputed and science deniers have gained ample space in public fora, this is the challenge we need to embrace. ❐

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