CURRENT SCIENCE

Volume 112 Number 11 10 June 2017

GUEST EDITORIAL

Science in the post-truth era

In 2004, Keyes declared that we live in a post-truth era – a stage of social evolution that is 'beyond honesty', in which 'deception has become commonplace at all levels of contemporary life' (*The Post-Truth Era: Dishonesty and Deception in Contemporary Life*, St Martin's Press, New York, 2004; www.ralphkeyes.com/the-post-truth-era/contents/). At the time, this may have seemed a cynical comment on a new social phenomenon that could safely be ignored. Certainly, there was little initial response from the science community globally (Mohler, A., *The Post-Truth Era – Welcome to the Age of Dishonesty*, Art and Culture, 19 July 2005; www.albertmohler.com/2005/07/19/the-post-truth-era-welcome-to-the-age-of-dishonesty/). However unsettling, it was viewed only as describing a facet of informal and interpersonal exchanges where people find it convenient to dissemble; and the posturing of individuals in public life responding to the exposure of their human frailties and transgressions.

But times have changed. Unforeseen events and baffling trends in diverse domains led to the designation of 'post-truth' as the 'word of the year' by Oxford Dictionaries (Post-truth, Oxford, UK, 16 November 2016; www.oxforddictionaries.com/press/news/2016/12/11/WOTY-16) in 2016, defining it as an adjective 'relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief'. This marked a step-change and 'post-truth' behaviour has emerged as a phenomenon critically impinging on policy-making processes at social, ideological, political and economic levels and now seems to be making inroads into the scientific arena (Kasprak, A., *Snopes Science*, 8 February 2017; www.snopes.com/2017/02/08/noaa-scientists-climate-change-data/).

Historically, there is nothing new about 'post-truth' responses to the perceived 'objective facts' – observations people made about the world and the logical interpretations derived from them. Continued insistence by some philosophers and theologians that the earth is flat, centuries after the ancient Greeks began accumulating clear evidence that it is spherical; the Catholic church's denial in the 17th century of the evidence that the earth orbits the sun rather than vice versa; and the tirades of denial and invective hurled at Darwin and his theory of evolution in the 19th century (and still continuing today in some places) evidence a longstanding post-truth tendency captured in the old joke 'don't confuse me with the facts – my mind is made up'. In its present-day manifestation, the post-truth debate has engulfed many 'science facts' and voices are heard that doubt climate change and believe that vaccinations can cause autism and compact fluorescent light bulbs cause cancer (Vernon, J. L., *Am. Sci.*, 2017, **105**(1); www.americanscientist.org/issues/pub/science-in-the- post-truth-era).

In debates on many contentious issues, the dividing line between facts, opinions and interpretations is being blurred. There is a tendency on the part of post-truth proponents to skirt the time-tested method of science, based on rationality and reproducibility and objective facts as they are understood at the time, in order to promote a particular agenda and ideology. Opinions in an open society can be plentiful and diverse, but need to be related to all the sound evidence available. 'Objective facts' based on scientific methods can be interpreted variously but they are secular and their integrity is verifiable and fortifiable. Politicians and opinion makers of all hues in democratic countries are adopting post-truth strategies, disparaging both the evidence available and the motives of researchers and experts who provide it and there are signs that a watershed may have been reached. We have seen the echoes of this during debates over GM foods, nuclear energy, construction of large dams, climate change, etc. The time has come for all who support and respect the validity of the scientific method to step forward and take action to defend and promote it as a core value of society.

Have scientists and experts contributed to the post-truth trend by their own behaviour? There are a number of ways in which this may have happened, including the publication of falsified or deliberately misleading reports of research and of misleading or incorrect claims of the expert's own credentials, which provides ammunition for those who want to claim that all science and scientists should be distrusted. There has been an unfortunate toleration of plagiarism that makes it seem a widespread and unimportant phenomenon, but which ultimately undermines the credibility of all scientists. And there has sometimes been a lack of clarity or effort to explain to the public and policy makers the meaning of 'certainty' in relation to scientific facts and conclusions and the distinction between proven hypotheses and unverified theories; and the practice of selectively using partial data to

support a position (summed up in another old adage – 'there are lies, damned lies and statistics').

Indeed, there is no ultimate, absolute certainty in 'scientific facts'. But it is critically important that scientists take the time and effort to explain the scientific method. Throughout history, people have created models or 'metaphors' about the world to explain it, beginning with mystical and religious ideas. The introduction of the scientific method brought an approach based on reproducibility of observation, logic, and the removal of subjective factors from the observation and collection of data. The resulting 'scientific truths' are never final, as they depend on the level the scientific approach has reached at a certain point in time. Hence, for a scientist, an 'absolute truth' is a contradiction in terms – it is offered by religions, not science. But that does not mean alternate models are equivalent – they need to be tested against all the available evidence, gathering observations and measurements that can be made repeatedly and reproducibly under controlled conditions; and then rigorous logical processes applied to derive conclusions.

It is important that understanding and valuing the scientific method is accompanied by the inculcation of 'scientific temper', a term first coined in 1946 (Nehru, J., *The Discovery of India*, John Day, New York, 1946, p. 512). This is a way of life, a process of thinking and acting which uses the scientific method and may, consequently, include questioning, observing physical reality, testing, hypothesizing, analysing and communicating. 'Scientific temper' describes an attitude which involves the application of logic. Discussion, argument and analysis are vital parts of scientific temper. Elements of fairness, equality and democracy are built into it.

The post-truth era has exposed our vulnerability to practitioners of pseudo-science and emboldened the science sceptics. However, the burden of proof for an opinion contrary to the current scientific position rests on the shoulders of those who propose it. The process of scientific discussion between holders of different opinions is itself subject to the rules of the scientific method.

What should scientists do at this critical time? We offer a few points of action that we believe individuals and institutions should take to counter and reject the post-truth characterization of our age (Brown, T., *Br. Med. J.*, 2016, **355**, i6467; www.bmj.com/content/355/bmj.i6467/rapid-responses) and support the use of scientific evidence and logic in public discourse and decision-making at all levels.

Scientists and science institutions urgently need to develop and resource strategies to educate and communicate to the public and policy-makers the significance and implications of advances and discoveries that impact society and the environment. While doing so, the main focus should be on the methods and rigour of science and underlying evidence and validation.

In the longer term, the defence of valid science against post-truth tactics requires building a greater level of science literacy in society, the media and policy-makers, so that unreasoned attempts to discredit both the science and the scientists are recognized and rejected. This requires, first, that scientists themselves act as good models, adhering fully to the methods of science, based on rationality, reproducibility, data integrity and questioning and adopt 'scientific temper' as a way of life. They must ensure that the education system in general – not just the parts aimed at developing advanced skills in aspiring scientists – communicates the principles of the scientific method and helps foster a 'scientific temper' in all students, building science literacy through core studies from an early stage. Students should all learn about the broader context in which scientific knowledge is generated and its products interact with society. Applying contextual learning and a 'systems thinking' approach could be a way forward as we have advocated (Matlin, S. A. *et al.*, *Nature Chem.*, 2016, **8**, 393–396; www.nature.com/nchem/journal/v8/n5/full/nchem.2498.html) with regard to advancing chemistry through the concept of 'one-world chemistry'. The need to ensure that science genuinely serves to benefit society as a whole has also been emphasized (Editorial, *Nature*, 2017, **542**, 391; www.nature.com/polopoly_fs/1.21514!/menu/main/topColumns/topLeftColumn/pdf/542391a.pdf).

The science community should also operate a zero-tolerance policy towards all attempts to disseminate falsified and exaggerated data in public spaces, whether it be scholarly journals, books, reports and discourses or popular articles, programmes, blogs and tweets across the diverse social media. Measures should be evolved to ensure that all such disseminations follow scientific approaches and meet the highest standard of data integrity. This is particularly important in areas which impinge on public opinion and political or socioeconomic issues and are therefore vulnerable to 'post-truth' intrusions.

ACKNOWLEDGEMENTS. This article was prepared at a workshop supported by the International Organization for Chemical Sciences in Development and hosted by the School of Chemistry, University of Hyderbad, India.

Alain Krief[1]
Henning Hopf[2]
Goverdhan Mehta[3]
Stephen A. Matlin[4,*]

[1]International Organization for Chemical Sciences in Development,
61 rue de Bruxelles B-5000 Namur, Belgium
[2]Institute of Organic Chemistry,
Technische Universität Braunschweig,
D-38106, Germany
[3]School of Chemistry,
University of Hyderabad,
Hyderabad 500 046, India
[4]Institute of Global Health Innovation,
Imperial College London, SW7 2AZ, UK
*e-mail: s.matlin@imperial.ac.uk