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## Fake News in the Post-Truth World

As scientists, we tend to tell our story through breakthroughs — paradigm shifts that shake the foundations of knowledge and remake everyone's understanding of how the world works. It's a tale of high-flying, singular brilliance, of Einsteins and Darwins, of pure genius.

Such a narrative of exceptionalism isn't entirely wrong, but it's wrong enough to help skew the way society thinks about science and to sow doubt about its findings. It puts us and our work too far out of the reach of too many people, and earns us epithets like "elitist" and "arrogant."

The truth about science is much more prosaic. Detailed case studies on the history of chemistry and physics show that the role of genius in advancing those fields — and even the role of rationality — is overstated. Rather than a hyper-intellectual, alien activity practiced by a remote priesthood, science is hit and miss, the ever-changing product of less-than-brilliant people, just like every other human activity.

Have you ever heard of John Nicholson, Anton Van den Broek, Richard Abegg, Charles Bury, John Main Smith, Edmund Stoner and Charles Janet? Don't worry, chances are many experts in the field of atomic structure — on which all of the above-named scientists worked — haven't heard of them either. After all, the feature linking these men is that, broadly speaking, they didn't always know what they were doing. In some cases, much of what they published turned out to be incorrect.

And yet each of them proposed one or two key ideas in their lifetimes that were picked up by others, modified and tested, and eventually led to major breakthroughs.

In the 1910s, the English mathematical physicist John Nicholson published a number of articles in which he proposed that several proto-elements (his term) existed in outer space and were the basis of our familiar terrestrial elements. Their presence in a number of celestial bodies, he claimed, enabled him for the first time to do successful calculations on the light reaching us from the Orion nebula and the solar corona.

At first his findings seemed to hold up, but it soon became clear that the calculations were incorrect or the result of numerological speculations. Nevertheless in the course of his work Nicholson also proposed that the angular momentum of electrons circulating around a nucleus should be "quantized," meaning that it could only occur with specific definite values. This notion would set Danish physicist (and, ultimately, Nobel Prize winner) Niels Bohr off on his theory of the structure of the hydrogen atom. From that, quantum mechanics and all the technological applications based on it — including lasers and semiconductors — would follow.

Something similar happened with each of the other unknown scientists on my list. Their haphazard, often pedestrian work still provided keys to, for example, how the elements in the periodic table should be ordered (Van den Broek) and the "octet rule" that explains much of chemical bonding (Abegg).

When the whole of the history of atomic theory is understood, it's clear that the missing links turned up by these "regular people" scientists, and the details and even the dead ends they accumulated, are every bit as important as the insights of a star such as Bohr.

This view of science casts a dim light on priority disputes — the intense battles over who was or should be considered first to a discovery — which happens even among otherwise perfectly modest scientists. It helps explain why multiple researchers arrive at the same conclusion so often: Science is a cumulative, incremental, collective effort. Fierce competition among individuals is inevitable, and it may serve to develop better science in the short run, but overall, even heroic individual achievements are simply not as important as the ever-evolving whole.

In these doubting days, almost everyone at least accepts the utility of some science. Very few people so doubt the findings of aeronautics, for example, that they won't board an airplane. But a significant portion of the general public still finds science baffling. What is incomprehensible is regarded as questionable; what is puzzling can be dismissed. It doesn't help that science represents our deepest and most reliable knowledge of the world and yet is also provisional — what we know is constantly being adjusted, tested.

In this too, however, science isn't unusual. Like life itself, it progresses by trial and error. It depends on humans simply trying things out, even if its practitioners don't always want to admit it.

Science is what we know to the best of our human abilities. Such as: Vaccinations don't cause autism; GMO corn is as safe as every other crop that has been genetically modified by other means for thousands of years; and Earth is warming past dangerous levels. The process that resulted in these findings isn't incomprehensible, remote or elitist. Even the rarefied field of atomic theory is built on human error and serendipity, on non-geniuses randomly groping around.

The better science communicates this notion, along with its fundamental ordinariness, the better its chances of being heard, understood and valued.

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This opinion piece first appeared in *The Los Angeles Times* on February 20th, 2017.

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(Originally published, *The New Zealand Herald*, December 26, 2016.)

It's no lie! The Oxford Dictionaries international word for 2016 is 'post-truth'. This new, fancy word, tells us: 'objective facts are less influential in shaping public opinion than appeals to emotion and personal belief'. In getting our opinions there is no need for truth; it is yesteryear's notion.

Does a new phenomenon underlie this coinage? There is nothing new about public opinion being shaped in this way; this was prevalent long before the Ancient Greek philosopher Plato condemned it about 2,400 years ago.

Plato got us to see that our beliefs can be shaped by either rational or non-rational factors. On the rational side, we have knowledge when our beliefs are both true and we have evidence sufficient for their being true. Without truth and evidence, we only have opinion.

We can also get our beliefs in non-rational, or even irrational, ways when they are formed by persuasion, rhetoric, emotional appeal, wish-fulfilment and the powers others exert on us; or we adopt beliefs which increase our desire to be happy or comport with our interests. We can now add modern shapers of belief such as conformational bias, brain washing and the whole panoply of techniques of persuasion due to advertising.

The trouble with these ways of forming beliefs is that they do not appeal to evidence. Worse, they are not reliable for the truth of what is believed. As a result, we can pick up false, as well as true, beliefs as the prevalence of fake news shows. And we have no way of telling which is which.

Which way do we want our beliefs, and the beliefs of others, to be formed? Shockingly there might be no shame in showing one's beliefs are not based on evidence, or are due to non-rational factors. The non-rational pathway undermines and discredits our powers to think about what we believe and to discover truths. The dismal prospect of the post-truth era are beliefs which are indifferent to truth or falsity but they are adopted because, say, they are power-enhancing.

As an illustration pick your own favourite post-truth which has become prominent in the "Brexit" referendum or the recent US presidential election. There was the bus in the UK that was emblazoned with the false claim that 'we send the EU £350 million a week'; fact checking shows that to be wrong and even Nigel Farage eventually stepped away from the claim. Again there is the Trump "birther" claim that Obama was not a US citizen. Eventually he grudgingly backtracked on this.

"But, hey! Who cares about truth! What matters is not truth but outcomes - we won our elections!" What is dismaying is the contempt in which liars hold those to whom they deliberately lie in order to further their ends.

In both these cases there is a truth to be found and evidence and argument play an important role in showing such claims to be false. But doing this might require some courage on the part of the investigator exposing the falsehood. And it might require institutional arrangements which help us track the truth (such as newspapers committed to accuracy in reporting and to providing argued evidence).

A more sinister aspect of post-truth now emerges. It is not merely that evidence and truth can be ignored; rather this new term can be taken to mean that there is no truth to consider.

In my own academic subject, philosophy, there is, on the whole, a very healthy debate about the

nature of truth. But unfortunately there is also a sinister underbelly of “post-truther” views which have prominence well beyond their merit, especially amongst postmodernists (another post- word!). Readers might not be aware of them so here are a few cases.

The USA philosopher Richard Rorty, a darling of postmodernists and followers of a French philosopher Jacques Derrida, often toyed with the claim that the truth is what your contemporaries will let you get away with. Not so! Tell that to Galileo who said that the earth moved but his contemporaries would not let him get away with it and put him under house arrest. But is not Galileo right despite what his contemporaries would not let him get away with?

Notoriously the 19th-century German philosopher Friedrich Nietzsche said (in his late Notebooks) that ‘truth is an error’ and that ‘there are no facts but only interpretations’. Commentators have bent over backwards trying to “interpret” him, supposing that there are profundities to be found here. A quick riposte to such views (first suggested by Plato) might be: are you claiming that it is a fact that there are no facts? And: is it not just another interpretation that there are only interpretations?

Nietzsche, an advocate of the “will to power”, has softened us up for the Trump post-truth era. A Trump surrogate Scottie Nell Hughes tells us: ‘there’s no such thing, unfortunately, anymore, of facts’; and ‘everybody has a way of interpreting them [facts] to be the truth or not true’. [sic] Illiterate but somewhat Nietzschean! Hughes made these claims concerning a Trump tweet about the recent USA election in which he alleged that “millions of people voted illegally”. This is a bit of fake news; but somehow believing this is alleged to show that there are no facts!

Finally, I will mention one further darling of postmodernists, the Frenchman Michael Foucault, who downplayed truth and replaced it by a muddle about ‘regimes of truth’ and truths produced by ‘multiple forms of constraint’ – i.e., power. This Nietzschean stance would appear to even deny Plato’s distinction between rational and non-rational believing.

That is enough post-truthers! In so far as studies in humanities and education have not resisted their views – too bad for them. But what of science? It would be quite alien for science to follow post-truthers in rejecting the search for truth and evidence, the core of critical methods in science. It is no accident that post-truthers are suspicious of science, when it comes to claims concerning climate change or evolution. But in science we have models of what the rational approach to believing ought to be. If followed they are an important way of keeping the post-truth era from totally engulfing us.