

THIS WEEK

EDITORIALS

MESSAGES Keep marriage proposals and animal authors out of papers **p.276**

WORLD VIEW Train PhD students to use critical-thinking skills **p.277**



BEETLEBUM Insect squirts from rear end to escape predators **p.279**

SpaceX ignites big dreams

The successful launch of the Falcon Heavy rocket was a stunning moment that opens the way for commercial exploration of deep space.

When David Bowie revealed the inspiration for his breakthrough hit ‘Space Oddity’, it came as a surprise to many: not the Apollo missions to the Moon but the film *2001: A Space Odyssey* (Kubrick, 1968). And it’s easy to see why: the film’s ballet of the spinning space station and dark themes about our place in the Universe has a distinct aesthetic appeal.

Does space travel still inspire? The continuing high profile of the International Space Station (ISS) and the welcome early steps of China and others aside, an extraordinary thing has happened. For much of the public, humanity’s adventures in space have become history, something people used to do in the old days. (Exhibit A: the Space Shuttle, once a means to escape the surly bonds of Earth, is now a museum piece.)

But spaceflight suddenly seems futuristic again. How else to explain the reaction to the spectacle of last week’s successful maiden launch of Falcon Heavy, the giant rocket built by Elon Musk and his company SpaceX. The hashtag generation has witnessed its own moment of inspiration writ large in the heavens.

The launch wasn’t perfect, but it still came across as a stunning synchrony of power and control. The 27 Merlin engines blazed to lift their giant cargo towards the sky, accompanied by cheers and whoops on the ground. And then, with exquisite control, the side boosters separated, back-flipped in tandem towards Earth and settled on landing pads at Florida’s Cape Canaveral Air Force Station with a rapid volley of ear-splitting sonic booms.

The Saturn V rocket NASA created in the 1960s for the Apollo missions remains the most powerful rocket ever built. But since Apollo there has been an almost 50-year hiatus in missions to take people beyond low Earth orbit. The successful launch of the Falcon Heavy will surely mark the beginning of the end of this hiatus. It is nothing short of historic, and Musk deserves enormous credit. Yes it was flashy — gimmicky, even — but there was substance behind the style.

Not without his faults, Musk has nevertheless shown himself to be a visionary with verve, can-do grit, a dash of genius and an abundance of hubris. SpaceX has roundly confounded many naysayers and upended the launcher industry. Tesla, Musk’s electric-vehicle company, faces enormous challenges, but has still helped to persuade many in the automotive industry that fossil-fuel engines belong in museums alongside the shuttle.

Musk’s goals for space are characteristically audacious. He intends SpaceX’s Dragon capsule to carry people later this year, and Falcon Heavy’s less powerful sibling — the Falcon 9 workhorse — to ferry astronauts to the ISS.

But it is the void beyond on which all sights are now set. Commercial companies have finally cracked access to deep space. Access to interplanetary trajectories — and the decisions about where to head — is no longer limited to governments. Musk wants to take people to Mars, which still seems a long shot — but space tourism

suddenly feels like a more realistic prospect.

Together, Musk and his rocket are showing what a combination of big ideas and big money can achieve, and so inspiring the next generation to dream big. Still, for all the thrill of the new, it’s worth remembering just how much last week’s launch — like so much in

“Access to interplanetary trajectories is no longer limited to governments.”

science — builds on the achievements of others. Falcon Heavy took off from the historic Launch Complex 39A (LC-39A) at the Kennedy Space Center on Merritt Island in Florida, from where the Apollo Moon landings also began their journeys.

And although Musk’s choice of test payload — his own cherry-red Tesla Roadster with a mannequin at the wheel and playing ‘Space Oddity’ on a loop — received as much attention as the rocket that carried it, SpaceX is not the first to put a car into space. From LC-39A, NASA did the same. Then it landed its car on the Moon. And then it drove it around. Not bad for the old days. ■

Climate conflict

Many studies that link global warming to civil unrest are biased and exacerbate stigma.

The people of Cape Town, South Africa, are enduring a terrible drought, and the resulting water shortages could soon force authorities to turn off the taps. Could civil unrest follow? When southern Brazil experienced a similar shortage in 2015, stories circulated about the authorities running drills to prepare a response to desperate people attacking water infrastructure. And a study published last year of some 1,800 riots in sub-Saharan Africa over 20 years concluded that drought can indeed be a powerful contributor to civil disorder (C. Almer *et al.* *J. Environ. Econ. Manage.* <http://doi.org/ckdj>; 2017).

Such retrospective analyses raise two questions related to cause and effect: did climate change alter the weather? And did the change in the weather provoke the conflict? Only a solid yes to both can justify bold statements that global warming promotes violence — and establishing this answer is difficult, if not impossible, in many cases.

That hasn’t stopped such controversial claims being made. A decade ago, the United Nations went as far as to state that climate warming and desertification were one of the causes of the Darfur conflict in Sudan, which started in 2003 and led to the deaths of up to half a million people over five years of revolt. That daring claim, based on

sketchy information, met with harsh criticism and outright disbelief from researchers familiar with the region. But it also triggered growing interest in climate–conflict research.

Results so far are largely ambiguous and have been frequently questioned by political scientists, economists, social scientists and climate experts, on various grounds. This week, a systematic review of the literature highlights one problem: efforts to find links between climate and social conflict are hampered by a severe sampling bias, including a statistically and politically dubious focus on mainly African countries formerly under British colonial rule.

The study, published in *Nature Climate Change*, states what critics have long suspected: conclusions that climate change is triggering violent conflict cannot be generalized, and are hard to substantiate even in individual cases (C. Adams *et al.* *Nature Clim. Change* <http://doi.org/ckfw>; 2018). Researchers are drawn to regions that experience violence, rather than to those where climate change is most severe, they write. And the countries that are easiest to study — because of historical links, language and ease of transport — are often prioritized over nations that might experience more climate change or more violence, but are less convenient for research. (Kenya is a good example: it is one of the most studied countries, yet it is not near the top of the list in terms of either violence or climate impacts.)

Skewed results pay a disservice to science and can undermine peace-keeping efforts. Climate change is never the sole cause of war, violence, unrest or migration. Syria and Jordan have both been stricken by drought this decade. But it's clear that different social, political and economic factors in the two nations explain why people are desperate to flee from Syria and not from Jordan.

Done correctly, climate–conflict research is certainly valuable. As a

global human enterprise, any science must be concerned with social justice and peace. Rigorous investigation into how climate change might affect — and perhaps violently disrupt — societies or human civilization at large has its place. But first, researchers in the field must improve their methods.

There is a political implication to this sampling bias, too. To search for climate–conflict links in places where violent struggle is taking place, or has only recently ended — and to pursue such research with a geographical bias towards a few, relatively accessible regions in Africa — threatens to stigmatize troubled countries as being prone to even more instability in the future. With a view to social justice in science, this would be grossly undesirable. And it is a flawed approach to answering important questions about the socioeconomic and political conditions in which climate-related conflict is likely to emerge. Instead, scientists must consider whether peaceful responses to climate change are the norm in most countries.

There is a yawning disconnect between the needs of countries in the developing world, many of which sit on the front line of climate change, and the priorities of scientists in the developed world who carry out most of the research. To address this, climate researchers must seek fresh opportunities to provide decision-makers in the developing world with the kinds of data and projections that they most need — including attribution studies, which aim to assess the extent to which specific weather events are due to climate change. This will help the most vulnerable societies mobilize to adapt to climate change, and will offer some much-needed security. ■

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Personal papers

From proposals to gripes, scientists sneak messages into their papers.

To mark St Valentine's Day, *Nature* this week published a collection of stories of romance kindled and sealed by science (see go.nature.com/2foalrk). One describes a science writer who was asked to investigate unusual crystals in a particle collider, and on her arrival there, was surprised by her partner, who proposed; another concerns a palaeontologist who stashed an engagement ring in a stream bed.

Then there are the declarations and proposals buried in the acknowledgements of a scientific paper. What could be more romantic than an analysis of the cooling power of a fridge? Answer: an analysis of the cooling power of a fridge that ends with the words: Will you marry me?

That's how Rui Long, a PhD student in engineering at Huazhong University of Science and Technology in Wuhan, China, proposed to his partner Panpan Mao, in a paper published online last month in *Physica A: Statistical Mechanics and its Applications*.

He is not the first: a similar line in the acknowledgements of a 2015 *Current Biology* paper describing a new dinosaur sent viral the proposal of Caleb Brown to his girlfriend and fellow museum scientist Lorna O'Brien. The proposal method has its risks: it relies, of course, on the person being proposed to actually reading the acknowledgements. (In at least one case, an anxious proposer had to ask his partner to try again.) There are other more serious concerns: that the person proposed to will feel coerced. Many critics argue against public proposals — from those in YouTube videos to hijacked sporting events — for this reason.

Proposals are certainly not the only messages that scientists have smuggled into their academic acknowledgements. Funding agencies have been 'thanked' for steering research by refusing

previous applications, and scolded for not paying their bills. Sports fans have slipped in references to favourite teams, and imaginary people have been credited to pay homage to popular culture, such as *The Simpsons* TV show and, in one case, the thrash-metal band Slayer.

Even the text of the paper is not immune. Peer reviewers, it seems, must be on the lookout for striking similarities to lines from *Star Wars* — and, infamously, everybody missed that an interloper had drawn a stick man fishing in a water tank in a schematic diagram included in a 1955 paper in the *Journal of the American Chemical Society*.

Authorship of papers is also ripe for mischief making. *Physical Review Letters* published a paper in 1973 written by the US physicist and mathematician Jack Hetherington and F. D. C. Willard. Willard — who subsequently published as a sole author — was Hetherington's cat. And in 2001, materials scientist Andre Geim co-authored a *Physica B: Condensed Matter* paper on Earth's rotation with “H. A. M. S. ter Tisha”. (It's not clear how the hamster contributed.) Various groups of authors have claimed in their papers that the order in which their names appear was determined by non-standard methods, including in one case, a 25-game croquet series.

Tinkering with the names on academic publications should not be undertaken lightly. South Korea announced earlier this month that it was widening an investigation into the possibility that some scientists added the names of their children and other relatives. In certain cases, the practice is thought to be intended to give the children an edge when applying to university, a highly competitive process in which, it seems, a publication record might help (see *Nature* 554, 154–155; 2018).

How common are personal messages in papers? A straw poll of *Nature's* manuscript editors failed to produce any confirmed examples in our pages. But at least one has slipped through. In an online discussion of the practice from 2011, microbiologist Rosie Redfield writes: “I once thanked Howard Ochman for ‘pharmacological support’ on a theory paper (in *Nature!*). He had given me a pound of excellent coffee beans.” We checked, and it's true. But no more, please. As our guidelines to authors state: focus on the science, and avoid the risks and distractions of personal messages that might misfire. ■