THIS WEEK

EDITORIALS

POSTDOCS Survey reveals alarming new abuse of young scientists **p.444**

WORLD VIEW Visa applications show United States is blocking talent **p.445**

CHEMISTRY Molecule that grabs sugar points to better diabetes care **p.447**

Flight test for ion drive

The first flight of a remarkable aircraft propelled by ionic wind could signal a future with cleaner and quieter aeroplanes.

In February 1904, a short news item in *Nature* marked a monumental event. It recorded the achievements of the American brothers Orville and Wilbur Wright and the contraption that they had launched from a hill in North Carolina a couple of months earlier. "They now appear to have succeeded in raising themselves from the ground by a motor-driven machine," *Nature* stated. It was, "the first successful achievement of artificial flight". That first trip lasted barely 12 seconds.

Nearly 115 years later, *Nature* reports on another historic brief flight, which this time lasted 8–9 seconds. On page 532, researchers at the Massachusetts Institute of Technology (MIT) in Cambridge describe an aviation breakthrough that will draw inevitable comparisons to that wobbly and fragile first journey by air. The aeroplane is powered by a battery connected to a type of engine called an ion drive that has no moving parts.

There are no passengers, either. The whole device — which has a 5-metre wingspan — weighs just 2.5 kilograms, about one-tenth of a typical commercial flight passenger's baggage allowance. The aeroplane barely gets off the ground, cruising in tests at an altitude of 1.5 feet (0.47 metres). But anyone who watches the machine fly (see go.nature.com/2kk86jz for a *Nature* video) can surely see glimpses of a future with cleaner and quieter aircraft.

A News and Views article on page 476 delves into the technical details and the challenges that must be addressed to scale up the prototype plane. Is such a goal achievable? Conventional wisdom would say probably not. But then it also said that aircraft with ion-drive, or electroaerodynamic, engines — which create thrust by using electrical forces to accelerate ions in a fluid to form an ionic wind — would never fly at all. The thrust, after all, is produced only by the wind generated by the movement of ionized air molecules as current passes between two electrodes, one thinner than the other.

Ionic wind was first identified in the 1960s, but most scientists and aviation professionals since have insisted that the process was never going to be efficient enough to be useful, and left experiments to enthusiasts and hobbyists. Yet, not only do the MIT researchers demonstrate the first flight of an aeroplane propelled in this way, but they also show that the efficiency will increase as the velocity of the aircraft increases, because the electrodes that act as the engine create such little aerodynamic drag.

The scientists' success will surely spur on others to re-explore a technology that was long forgotten. This will no doubt include military research, and some of the possible applications — silent drones and engines with no infrared signal that are thus impossible to detect — will rightly worry many and should be openly discussed.

This first flight will stimulate both awe and anxiety — just as the first powered flight by the Wright brothers did. Will it prove as influential? As you read this, between 6,000 and 12,000 commercial aircraft are airborne, and those are a fraction of the 100,000 or so flights scheduled each day. And every one of these aircraft is sending greenhouse-gas emissions high into Earth's atmosphere.

Predictions about the future of flight are dangerous because work can be overtaken by events or exposed as wishful thinking. (Just four years before the aerial carnage of the Second World War, *Nature* solemnly predicted that the risk of attack from the air was remote. And in the 1970s, it reported claims that a hydrogen-powered aircraft could take to the skies by the end of the twentieth century.)

"This first flight will stimulate both awe and anxiety."

When the Wright brothers made their historic flight in December 1903, it didn't receive that much attention. In part, that was because their idea was just one of several being explored to achieve flight — with others betting on the success of gliders, airships and even kites. The same is true today. Ion-drive engines are just one much-needed option to improve the efficiency and environmental impact of aircraft engines, alongside tweaks to fuel and design. Let's hope some of them take off. ■

Brexit end game

The impact on science of Britain leaving the EU is still uncertain.

The *Daily Express* UK tabloid newspaper has been one of the loudest voices to argue that Britain should exit the European Union. But last week it admitted that the move could have some downsides. In what it labelled as a "BREXIT BOMBSHELL", the paper reported the fears of industry scientists that: "Leaving the EU will be bad for UK science."

No arguments here. Long before the 2016 referendum and the bitter disputes that have followed, it was clear that the United Kingdom's membership of the political bloc benefits its research in numerous ways. (And European science benefits from Britain's input, as well.) Leading figures and Nobel prizewinners have queued up to say the same. But although the *Daily Express* bombshell might not be news to *Nature* readers, its publication should remind researchers in Britain and elsewhere that what is obvious to them is not so to everyone. Some messages bear — indeed, demand — repetition, and the unnecessary damage that Brexit will cause to research is one of them. The need to continue to emphasize this message is especially crucial as political negotiations on how and when Britain severs its ties with the EU approach the end game.

The Brexit waters remain murky, but the superstructure of a possible 'divorce' deal that would set the terms of Britain's withdrawal is just about visible through the gloom. Last week, the British government and

the EU produced a 585-page document that marks their joint attempt to set the terms. It's a draft of a deal, and the current alternative to a 'no-deal' scenario. The British public got to see it only after a fractious meeting of members of the ruling Cabinet had approved the wording — only for some Cabinet members to then promptly resign.

Anyone brave enough to read the full tome will find few references to science (and few were expected). It largely covers the thorny matters of Britain's divorce bill and a political and trading mechanism to avoid having to reinstate a hard border with Ireland. It leaves most of the key issues that are important for scientists — including immigration and access to funding — to form part of a future agreement on the EU–UK relationship. On this, the government released only a meagre outline. On the downside, this prolongs the uncertainty and unrest that is already affecting researchers. But for those determined to seek positives, it does mean that much remains in play — and that means scientists and their advocates must keep on keeping on about how Brexit is bad for them and for UK research, and how policymakers must find ways to limit the damage

Among the continuing uncertainties, we still do not know whether UK-based scientists will be able to continue to draw grants from big-money EU research-funding programmes. Nor do we have any details on the likely shape of Britain's future immigration system, and thus how easily highly skilled EU citizens, including scientists, will be able to come to work in Britain. Freedom of movement between the EU and the United Kingdom, which has proved a boon to science in both directions, was not part of the deal, but in the days after its publication, Prime Minister Theresa May reiterated that, in the long term, EU citizens would enter on an equal footing with migrants from the rest of the world. (That EU citizens already in the United Kingdom should be able to remain was one welcome detail that the agreement did spell out and one that should ease the anxieties of many researchers and their families.)

Needless to say, this journal argues that skilled scientists should be able to move to the United Kingdom after Brexit with few restrictions, and the evidence that this will benefit science should make it a political priority. A briefing document published alongside the agreement text does hint at provisions for some visa-free travel between Britain and EU countries. This is encouraging news for researchers who are used to travelling for collaborations and conferences.

The draft agreement text does place one field of British science and technology on firmer post-Brexit ground. It confirms that Britain will leave Euratom, the pan-EU nuclear regulator, and that responsibility for issues such as ensuring non-proliferation will pass to the control of the United Kingdom's own regulator. But the text adds nothing on issues that concern UK nuclear-fusion scientists, such as whether an independent Britain will be able to negotiate continued membership of the ITER fusion experiment in France.

"Scientists must continue to lobby for a Brexit settlement that protects and promotes research."

Brexit is due at the end of March 2019. Before then, the agreement text must overcome a series of hurdles, not least a vote in the UK Parliament next month. The political landscape is highly volatile — Britain is already on its third Brexit minister since July, and hard-line Brexit supporters could yet trigger a leadership challenge to May, and possibly a general election. Meanwhile, there is growing support for a 'people's vote' on any agreement passed by Parliament — effectively, a second public referendum.

Much remains at stake. Scientists must continue to lobby for a Brexit settlement that protects and promotes research. There is still time to have a voice. ■

Protect postdocs

A survey of young scientists in the United States highlights the exploitation of visa holders.

Most of the research and analysis on the fate and experiences of young scientists focus on PhD students. This is probably because these students, in theory at least, have a broader spectrum of opportunity. Many postdoctoral researchers tend to have chosen a path to an academic career. What determines the outcome? And what happens to those who choose a different route? Better information and tracking would help to inform those making this decision.

Some useful — and worrying — research on this issue was published last month by two US academics in the journal *Research Policy*. The study is based on interviews with 97 postdocs from 5 major US research institutions, as well as 35 principal investigators (PIs), university administrators and industry employers (C. S. Hayter and M. A. Parker *Res. Pol.* http://doi.org/cw62; 2018). The interviews were conducted in 2016 and 2017. More than half of the postdocs (52.6%) worked in the life sciences.

Many of the issues these postdocs report are familiar: chiefly, how hard it is to land a tenured full-time position in academia. But the research also revealed a new — and alarming — complaint from a handful of these young scientists. Some PIs are exploiting the fact that overseas scientists rely on them for continued visas. The responses suggest that senior scientists are using this reliance to force postdocs to work longer hours and endure unacceptable conditions.

The following was said to the study's authors by a postdoc at a leading US university: "When I arrived at [the university] my PI explained to me that he approved my visa renewal … he then told me he was going to pay me 70 per cent of the salary he promised before I got here … when I asked him if this is normal, he just asked me if I was serious about working [at the university]."

And this came from another: "Our PI creates this pressure cooker environment in our lab … you see the foreign postdocs sleeping on the floor of the labs, working 100-plus hours a week … PIs know what they are doing … they take advantage of these guys."

Here is the view of a university administrator: "I see something bad almost every week and it seems to be getting worse … postdocs come into my office and ask me if this or that seems wrong to me … the visa issue is a big one because foreign postdocs are afraid to report their PIs … these are small scientific communities and PIs will blackball their postdocs if you cross them."

The paper labels such behaviour as socially irresponsible, but that seems too mild. It is exploitation. It is unacceptable. And it must stop. These are anecdotal reports, and we have no way of knowing how large the problem is, or whether the increased political scrutiny of foreign visitors to the United States has changed the situation.

Most estimates agree that about half of the postdocs working in the United States are overseas visitors who rely on short-term visas. Institutions typically sponsor the renewals and extensions. This is largely done by individual departments and lab heads, with universities' central administrations having little formal role in the recruitment and experiences of postdocs. This puts senior scientists in a position of power. None should use this as leverage against less senior colleagues — many of whom are far from home and vulnerable. Colleagues who see such actions should report them.

Future assessments and surveys of postdocs should probe this issue further. "This was a qualitative study, so it's important to recognize that our findings are not generalizable to broader populations of postdocs," the study authors told *Nature*. Let's hope not. Everyone should agree with the postdoc who told the interviewers: "[I] realized that students can really be taken advantage of and this left a bad taste in [my] mouth with academia." ■