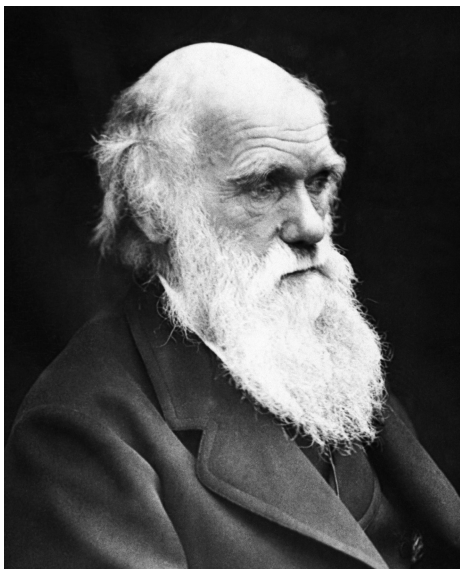
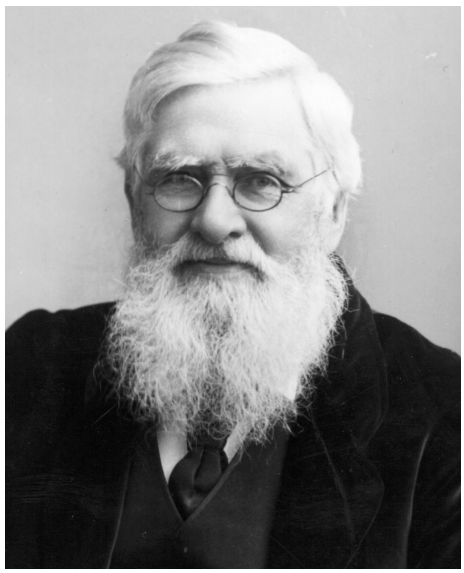

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Charles Darwin (left) rushed to publish *On the Origin of Species* after receiving a manuscript detailing similar ideas from Alfred Russel Wallace (right).

SCOOPED IN SCIENCE? RELAX, CREDIT WILL COME YOUR WAY

A study of races to solve protein structures shows that teams that come second still get recognition.

By Ewen Callaway

Being scooped to a discovery is a scientist's worst nightmare. But the penalties for coming second aren't as harsh as some might think.

Scooped papers receive only about one-quarter fewer citations than do papers that were the first to report the same discovery, according to an analysis of more than 1,600 'races' to determine the detailed 3D shape, or structure, of proteins and other biomolecules.

"You get a meaningful advantage for being first, but being scooped may not be as devastating as people seem to fear," says Carolyn Stein, an economist at the Massachusetts Institute of Technology (MIT) in Cambridge who conducted the study with her MIT colleague Ryan Hill, also an economist. Their results are described in a working paper posted to the MIT website (see go.nature.com/2xmcuyv).

Social scientists say that the research breaks new ground because it is able to identify and track scooped studies, including some that were never published – although they caution that the findings might not apply to other fields. "This is the first study I'm aware of that has been able to observe unpublished papers," says Michaël Bikard, an innovations researcher at the French campus of business school INSEAD in Fontainebleau. "This is important stuff."

The history of science is rife with competition. Charles Darwin rushed out his *On the Origin of Species* after receiving a manuscript detailing similar ideas from Alfred Russel Wallace – and Isaac Newton, Gottfried Wilhelm Leibniz and their supporters feuded over who invented calculus.

Despite the prominence of such rivalries, scholars of science know little about how credit is apportioned for competing discoveries. Theoretical models analysing patent races, for instance, often assume that to the victor go all the spoils. In the real world, however, credit for scientific discoveries is unlikely to be winner-takes-all, say researchers.

Protein probe

One problem with studying scooped projects is that some scientists abandon a research effort after someone else has beaten them to it, says Hill, a PhD student who was inspired to do the study partly as a result of being scooped during his graduate work. Alternatively, researchers modify the project in such a way that it is impossible to compare its results with those of the paper that scooped it.

In search of an 'apples-with-apples' comparison of competing projects, Hill and Stein used the Protein Data Bank (PDB), a repository of more than 150,000 structures of proteins and other biomolecules. These structures are key to understanding how proteins work, as well as how their function might be altered by drugs. Crucially for the study, scientists tend to submit structures to the PDB – under embargo – months before a paper describing the work is published in a journal (and the embargo on the PDB structure is lifted). This approach allowed the researchers to follow 1,630 'races' in which competing teams submitted to the PDB structures of the same, or closely similar, molecules between 1999 and 2017.

The cost of being scooped was moderate. Structures released second were only 2.5% less likely ever to be published, although they tended to appear in less prestigious journals (as measured by impact factor), than were structures published first. Hill and Stein estimate that, as a share of total citations out of a 100, the first paper would receive 58 and the second paper 42.

But when questioned about the effects of being scooped, scientists were much more pessimistic than those data show, according to Hill and Stein's survey of 915 structural biologists. The scientists overestimated the odds of being beaten to a discovery, and predicted that, out of 100 citations, a scooped paper would receive just 29.

But not all scientists were penalized equally for coming second, the study found. When research teams at leading universities and departments – as measured by a universities ranking table – were beaten by a team at a lower-profile institution, the second-placed team got slightly more citations. And the teams at top institutions accrued an even larger share of citations when they did the scooping.

"I was blown away by this result," says Bikard.

Race for recognition

Paula Stephan, an economist at Georgia State University in Atlanta, says the study is the first she knows of that actually measured the penalty for being scooped. "We have known for many years that science is not a winner-takes-all 'game'. This piece of research confirms this." But she cautions against generalizing the study to other fields.

And the study doesn't capture the psychological effects of being scooped, says Venki Ramakrishnan, a structural biologist at the Laboratory of Molecular Biology in Cambridge, UK. In the late 1990s and early 2000s, his group raced several teams to determine the structure of the ribosome, a cellular machine that makes proteins. In September 2000, a team led by Ada Yonath at the Weizmann Institute in Rehovot, Israel, published the structure of a ribosome subunit in *Cell*[1] that Ramakrishnan's team had also characterized. Ramakrishnan's study came out weeks later in *Nature*[2].

"For that month, I and my lab were pretty

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miserable," he says. The researchers worried that they wouldn't receive proper recognition for their work. That didn't turn out to be the case. Ramakrishnan's and Yonath's teams are both credited with working out the ribosome-subunit structure — and the scientists each shared one-third of the 2009 Nobel chemistry prize. Ramakrishnan's paper has roughly twice as many citations as the one that scooped it. "In the long run, it didn't matter," he says.

1. Schluenzen, F. *et al. Cell* **102**, 615–623 (2000).
2. Wimberly, B. T. *et al. Nature* **407**, 327–339 (2000).

GLOBAL 5G WIRELESS DEAL THREATENS WEATHER FORECASTS

Meteorologists say lax international standards could degrade crucial satellite measurements.

By Alexandra Witze

The international agency that regulates global telecommunications agreed to new radio-frequency standards on 21 November. Meteorologists say the long-awaited decision threatens the future of weather forecasting worldwide by allowing transmissions from mobile-phone networks to degrade the quality of Earth observations from space.

Wireless companies are beginning to roll out their next-generation networks, known as 5G, around the world. The new agreement is meant to designate the radio frequencies over which 5G equipment can transmit. But some of the frequencies come perilously close to those used by satellites to gather crucial weather and climate data. To keep the signals from interfering with one another, researchers have proposed turning down the amount of noise allowed to leak from 5G transmissions.

Negotiators at a meeting of the International Telecommunication Union in Sharm El-Sheikh, Egypt, agreed to introduce two stages of protection for frequencies near 24 gigahertz — a range close to those that weather satellites use to detect the amount of water in the atmosphere. Companies that operate 5G networks will have a relatively loose standard from now until 2027. After that, the regulation will get stricter. The idea is to let 5G companies start building networks now, and then to add more protection for Earth observations as 5G transmissions become denser.

But having eight years with relatively lax regulation is "of grave concern" to weather forecasters, says Eric Allaix, a meteorologist at Météo-France in Toulouse who heads a World Meteorological Organization (WMO) group on radio-frequency coordination. The WMO is so upset that it included a statement of concern in the meeting minutes, he says.

"The race for 5G is going to go fast," says Renée Leduc, a consultant with Narayan Strategy in Washington DC who works on spectrum-sharing issues. "In the early-to-mid-2020s we're going to see a very quick uptick." Although more protections for Earth observations will take effect in 2027, "I'm still really concerned about the time period between now and then", she says.

The 5G transmissions will involve many frequencies, but the key one under discussion is 23.8 gigahertz. Water vapour in the atmosphere naturally produces a weak signal at this frequency, which satellites use to measure humidity. Those data feed into weather forecasts. But if a 5G station is transmitting a signal near the 23.8-gigahertz frequency, a weather satellite might pick it up and mistakenly interpret it as water vapour.

Meteorologists say that the problem is manageable, but only if there is enough of a noise buffer between 5G transmissions and the water-vapour signal. The buffer, measured in decibel watts, is akin to a gauge of how much you might turn down the volume of your stereo so as not to bother your neighbours.

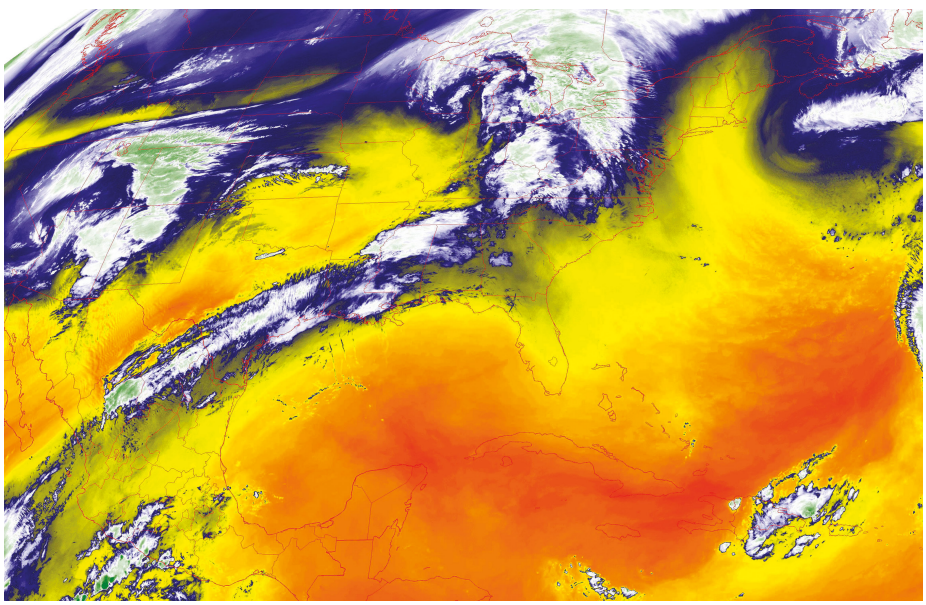
In the run-up to the Egypt conference, the WMO had been pushing for a buffer of −55 decibel watts. European regulators had settled on a less-stringent recommendation of −42 decibel watts for 5G base stations. The US Federal Communications Commission had advocated just −20 decibel watts.

The new standard hews closest to the European proposal: it is −33 decibel watts until September 2027, and −39 decibel watts after that.

"These two values were set by long negotiations between the member states," said David Botha, a counsellor with the International Telecommunication Union, at a 22 November media briefing. "These values were considered to be adequate, in the sense that they would provide protection to the weather satellite systems, to Earth-exploration satellite systems. We have nevertheless noted that there were concerns that were issued."

Even the stricter level is not enough to avoid interfering with water-vapour measurements, says Leduc. A US government study found that 5G base stations needed to transmit with a noise buffer of −52.4 decibel watts to protect the water-vapour observations.

Weather forecasters will have to gauge how to mitigate the impacts on satellite observations — perhaps by working with the wireless industry to research ways to shut down or redirect 5G transmissions when a satellite is making its measurements. Botha said that the agreement requires a "continued monitoring" of how 5G networks affect weather observations, but he provided no details on what that would involve.



NOAA/GOES

Water vapour over the Americas is shown in this US government satellite image.

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