It's also about how a planet's geology and chemistry interconnect to create a welcoming or hostile environment, she says.

Astronomers have catalogued thousands of exoplanets, of which more than a dozen are potentially habitable. The most recent, announced on 15 November, is Ross 128b, which is 3.4 parsecs (11 light years) away from Earth. It resembles the target that scientists have spent decades hunting: an Earth-sized planet orbiting a nearby star, probably at the right distance to allow liquid water.

Most of these planets have some qualities that stop them being true Earth twins (see 'Looking for life'). But Tasker says the usual metrics that scientists use to rank how habitable a world is, such as its location relative to its star, are misguided (E. Tasker *et al. Nature Astron.* 1, 0042; 2017).

To figure out how to parcel out valuable observing time, some scientists suggest targeting planets that are thought to have both ocean and land. Worlds whose surfaces are covered by water may not have key nutrients available in forms that can support life — if that life is based on the same chemistry as Earth's.

"We have this stereotype that if we have oceans, we have life," says Tessa Fisher, a microbial ecologist at Arizona State. But that is not what she and her colleagues found when they studied a hypothetical "aqua planet" with a surface almost or completely covered by enough water to fill Earth's oceans five times.

On Earth, rainwater hitting rocks washes phosphorus and other nutrients into the oceans. But without any exposed land, there is no way for phosphorus to enrich water on an aqua planet over time, Fisher reported at the Laramie meeting. There would be no ocean organisms, such as plankton, to build up oxygen in the planet's atmosphere, she says — making such a world a terrible place to find life.

The wettest planets would run into another sort of trouble, says Cayman Unterborn, a geologist at Arizona State who analysed the planet-wide effects of having as much as 50 Earth oceans' worth of water. The sheer weight of all that liquid would exert so much pressure on the sea floor that the planet's interior would not melt at all, Unterborn found.

Planets need at least some internal melting to sustain geological activity, such as plate tectonics, and to provide the right chemical environment for life. In this case, Unterborn says, "too much water is too much of a good thing".

Water-rich worlds are easy to make. Many planets are likely to have formed far from their parent star, Tasker says, in chilly temperatures where they could have coalesced from fragments of rock and lots of ice. If such a planet later migrated closer to its star, the ice would melt and cover the surface in vast oceans.

Instead of instinctively studying such water worlds, Tasker says, astronomers need to think more deeply about how planets have evolved through time. "We need to look carefully at picking the right planet," she says.

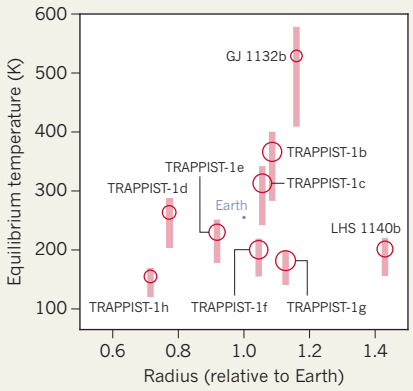
The James Webb Space Telescope is set to launch in 2019. Once in space, it will spend much of its time studying potentially Earth-like worlds. Researchers have already begun to analyse how oxygen or other 'biosignature' gases in exoplanet atmospheres might appear to the telescope's view (C. V. Morley *et al.* Preprint at https://arxiv.org/abs/1708.04239; 2017).

Towards the end of the Laramie meeting, attendees voted on whether scientists will find evidence of life on an exoplanet by 2040. Forty-seven said no and twenty-nine said yes. But a greater share was willing to bet that life would be found in the 2050s or 2060s.

That's presumably enough time to work through the debate over which worlds are the best to target. ■

LOOKING FOR LIFE

Astronomers are debating how to definitively detect life on planets outside the Solar System. Here's a look at how nine promising candidates compare to Earth.



SOURCE: C. V. MORLEY *ET AL.* PREPRINT AT HTTPS://ARXIV.ORG/ABS/1708.04239 (2017)

REPRODUCIBILITY

Tool spots DNA errors in papers

Online software scrutinizes research papers to identify mistakes in gene sequences.

BY NICKY PHILLIPS

Two scientists have rolled out a program that spots incorrect gene sequences reported in experiments — and they have used it to identify flaws in more than 60 papers, almost all of them studies of cancer.

Jennifer Byrne, a cancer researcher at the Kids Research Institute of the Children's Hospital at Westmead in Sydney, Australia, and Cyril Labbé, a computer scientist at the University of Grenoble Alpes in France, made public an early version of the program, called Seek & Blastn, in October. Now, they want other researchers to test the program and help to improve it. They plan eventually to offer it to journal editors and publishers as an addition to the tools that most already use to check papers, such as software to detect plagiarism.

Byrne has been working on identifying errors in human-cancer papers since 2015, when she noticed problems with five papers on gene function in cancer cells. The authors of the papers described performing a common experiment in which they had inactivated a gene using a short targeted nucleotide sequence, to observe its effects on tumour cells.

"You do get concerned about how the results were produced."

Byrne was familiar with the gene because she was part of the team that reported it in 1998. And she realized that the 2015 papers reported using the wrong nucleotide sequences for the experiment they claimed to conduct. Two of these papers have since been retracted. Another two are expected to be retracted on 21 November.

After noticing similar errors in another 25 papers, Byrne and Labbé developed the Seek & Blastn tool to discover more papers with incorrectly identified nucleotide fragments. The software extracts nucleotide sequences from uploaded papers and cross-checks them against a public database of nucleotides, called the Nucleotide Basic Local Alignment Search Tool (Blastn).

"Seek & Blastn tries to find mismatches between the claimed status of a sequence — what the paper says it does — and what the sequence actually is," says Byrne. A mismatch is flagged, for instance, when a sequence described as targeting a human gene doesn't find a match in the Blastn database. Sequences described as non-targeting that do have a match in Blastn are also detected.

So far, the program detects only misidentified

human sequences, says Labbé, but the pair hope to develop it to check sequences from other species, such as mice. The program also struggles to pick up misidentified sequences if the description is unclear in the original paper. This can cause it to miss some mistakes and to flag papers that have no errors, so all papers put through the software should also be checked manually, he says.

The pair say that they used Seek & Blastn to detect mismatched sequences in another 60 papers. Many of these manuscripts have other problems, such as poor-quality images, graphs and large chunks of overlapping text, all of which make some of the papers "strikingly similar" to each other, says Byrne. With the help of colleagues, they are now manually checking the papers.

Although some errors are minor or accidental, Byrne says, the majority of the mismatches they have detected in papers may invalidate the results and conclusions. When you see these incorrectly identified sequences, she says, "you do get concerned about how the results were produced and whether the results in the paper actually reflect the experiments that were done".

In a study in *Scientometrics*, Byrne and Labbé reported 48 problematic papers, including the 30 papers that had incorrectly identified nucleotide fragments (J. A. Byrne and C. Labbé *Scientometrics* **110,** 1471–1493; 2017). These were all written by authors from China. The duo did not publicly identify the papers, apart from the five papers from 2015, but privately contacted journal editors, Byrne says. Many of the editors have not responded, she says. But three more papers have been retracted. In total, the pair have identified incorrect sequences in more than 90 papers.

Automated tools such as Seek & Blastn are most valuable if they are used to promote good scientific practice and encourage scientists to avoid errors in the first place, rather than just catch people out, says statistician David Allison at Indiana University Bloomington, who has spotted many papers with substantial errors.

Such tools could also help to quantify error rates in particular journals and fields, he says.

Matt Hodgkinson, head of research integrity for open-access publisher Hindawi in London, which retracted two of the papers from its journal *BioMed Research International*, says that he could see publishers using Seek & Blastn as part of the article-screening process.

"It would depend on the cost and ease of use, whether it can be used and interpreted at scale," says Hodgkinson. Staff or academic editors would also need to check the output, given the risk of false positives, he says. ■

MUJAHID SAFODIEN/AFP/GETTY

South Africa is building its part of the Square Kilometre Array radio telescope in Northern Cape province.

RADIO ASTRONOMY

Telescope will hit phone signals

Side effect of South African radio array riles residents.

BY SARAH WILD

A map showing how mobile-phone use might be restricted because of a giant radio telescope in South Africa has angered people who will live near the instrument — deepening a rift between the local farming community and those backing the project.

The row has arisen over the South African portion of the Square Kilometre Array (SKA), which will eventually consist of thousands of radio dishes in Africa and up to one million antennas in Australia. The array, which begins construction in 2019 for completion in the 2030s, will have a total signal-collecting area of more than 1 square kilometre, making it the world's largest radio telescope. The telescope's first phase in South Africa involves 194 radio dishes, to be laid out like a galaxy with three arms spiralling out from a core cluster.

Local residents in the Northern Cape province, where the government has acquired nearly 1,400 square kilometres of land for the initial phase, have already expressed concerns about the telescope. Some are angry that the SKA won't boost the region's economy as much as expected; others fear that the land acquisition will damage local agricultural activity — in particular, sheep farming.

But the map of projected mobile-phone coverage around the project, uploaded to Facebook on 2 November, has brought to light another problem facing the local community. It shows the area around the SKA's radio dishes where the use of electronic devices will eventually be restricted, because their signals would interfere with the relatively weak radio signals that the dishes will try to pick up from the distant Universe.

COMMUNICATIONS PROBLEM

Nearby residents had been aware that mobile-reception 'dead zones' could be a side effect of the SKA. But Eric Torr, a light-aircraft-business owner who uploaded the map, says it shows that the area affected is "larger than we were led to believe". The map suggests that six towns fall into the dead zone, he says, and this could have serious implications for their farming economies.

The map was produced by the South African Radio Astronomy Observatory (SARAO), which is leading the SKA project in South Africa. Lorenzo Raynard, head of communications at the SARAO, says it shows areas where mobile-phone coverage could be reduced by 20% or more. The chart was part of a presentation calling on businesses to submit alternative communications solutions for affected areas, he says.

An informal collection of farming ▶