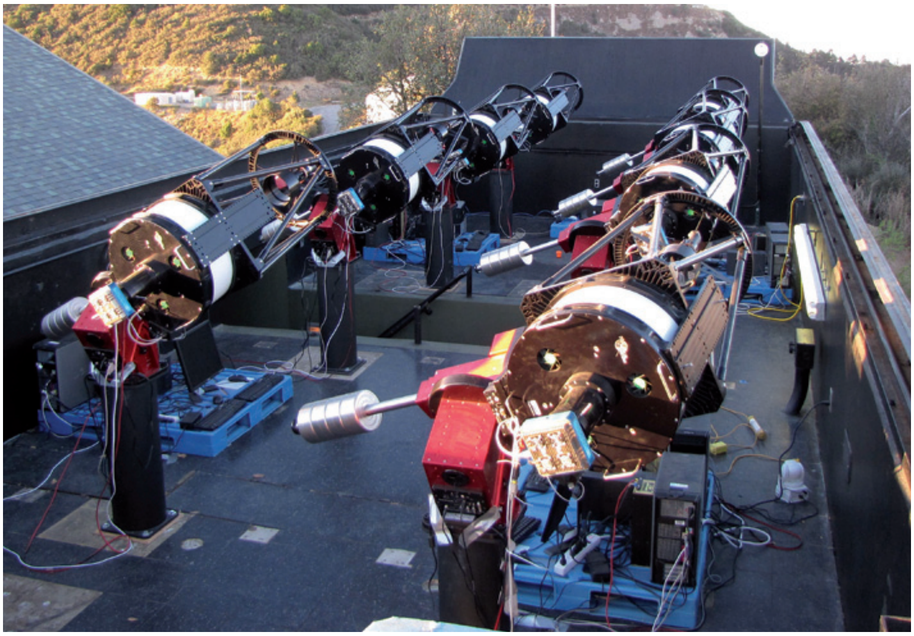

DAN BROCIOUS/CFA

The eight 40-centimetre telescopes of MEarth are hunting for Earth analogues around M-dwarf stars.

ASTRONOMY

Astronomers revisit dwarf stars' promise

Kepler data spur searches for habitable planets around small, low-temperature stars.

BY EUGENIE SAMUEL REICH

An Earth-like planet — and with it, perhaps life — does not have to orbit a Sun-like star. That idea has inspired astronomers to widen their search for habitable exoplanets to systems surrounding M-dwarfs — stars that are much smaller, redder and cooler than the Sun. Although a project begun in 2008 found just one planet near such a star, data from NASA's Kepler telescope suggest that astronomers should not give up on the approach, and several M-dwarf campaigns are now adjusting their searches.

"I want to know if life can exist on a planet like Earth in a different environment," says astronomer Zachory Berta-Thompson at the Massachusetts Institute of Technology in Cambridge. "That would be one of the most fascinating astrophysical experiments."

For scientists hunting exoplanets that could support life, M-dwarfs offer several advantages. The lower a star's temperature, the closer to the star is its 'habitable zone' — the region in which liquid water can exist on a planet. That means that a habitable planet will orbit an M-dwarf closely, and make more frequent transits across the star's face — the telltale blockages of light that can be detected from Earth. During transits, some of the starlight is altered by its passage through a planet's atmosphere, and this effect would be proportionally larger for an Earth-sized planet orbiting a star much smaller than the Sun. Astronomers hope that future missions, especially NASA's James Webb Space Telescope (JWST), due to launch in 2018, could detect this light and tease it apart into its spectral components to reveal evidence that gases in the planetary atmosphere are being altered in a way that could signify life.

Motivated by these advantages, astronomer David Charbonneau at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, began a pioneering project to look for 'other Earths' around M-dwarfs close enough to Earth that the light from their atmospheres could be detected with currently planned technology, such as the JWST. The effort, MEarth (pronounced 'mirth'), in 2009 located an uninhabitable M-dwarf planet, GJ 1214b, that was roughly 13 parsecs from Earth and twice its size. The find raised expectations of a huge bounty to come, but four years later, MEarth has not found another M-dwarf planet, let alone a habitable one. "Personally, I was disappointed," says Berta-Thompson, who worked on the project.

Now researchers think that they understand why the initial search foundered, after examining data collected by NASA's planet-hunting Kepler mission before it ended in August. Kepler surveyed hundreds of thousands of stars, including roughly 4,000 M-dwarfs, and found just 20 planets of the size that MEarth can detect — about twice as big as Earth. But planets the size of Earth or smaller seem to be more common; Kepler found 17 of this size, even though they were much harder for it to see, suggesting that the MEarth team could find habitable planets if it tweaks its search strategy.

In December, Charbonneau will open MEarth's second station of eight telescopes in Chile, to complement a first observatory in Arizona. He plans to concentrate the telescopes on fewer stars — a few hundred rather than a few thousand — for longer time periods. He hopes that spending more time on each target will allow MEarth to detect the subtler signals of the smaller planets.

The project now has competitors. In 2012, a European effort called APACHE (A Pathway Towards the Characterization of Habitable Earths) began taking data from an observatory at Nus in the Italian Alps. Because it can only detect planets about twice the size of Earth or larger, APACHE is likely to see only a handful of planets near its target M-dwarfs. But its principal investigator Alessandro Sozzetti, at the Turin Astrophysical Observatory in Italy, insists that it will be a useful check on the planetary statistics produced by Kepler. "It's still significant," he says.

Another project hoping to take advantage of M-dwarfs is SPECULOOS (Search for Habitable Planets Eclipsing Ultra-cool Stars), a European Research Council mission that will begin taking data on the coolest versions of those stars in 2016. It will use larger telescopes than MEarth (1 metre compared with 0.4 metre) and aims to find planets around smaller stars. Its principal investigator, astronomer Michaël Gillon at the University of Liège in Belgium, says that contrary to some astronomers' assumptions, his preliminary data on some 35 M-dwarfs suggest that their brightness variations are small enough for scientists to detect any Earth-sized planets transiting past them.

Although looking at M-dwarfs has its advocates, it is far from mainstream. Planet-hunting researchers still hope to find a closer analogue to the Sun and Earth. NASA's next big mission is TESS, the Transiting Exoplanet Survey Satellite, a space telescope that will spend two years identifying planets around the 500,000 brightest stars seen from Earth. TESS, which will launch in 2017, will cover many types of stars, including some 10,000 M-dwarfs. That leaves the smaller ground-based campaigns a few more years in the spotlight before TESS takes over. ■