

BIOMATERIALS

Dew catchers

Why did Incy Wincy Spider climb up the water spout? If he was after a drink, a report by Yongmei Zheng *et al.* in this issue suggests that he might have missed a trick — spiders don't need to look for water because the silk fibres that they spin are highly efficient at collecting it from moist air (Y. Zheng *et al.* *Nature* **463**, 640–643; 2010).

To uncover the water-collection mechanism, Zheng *et al.* exposed silk fibres of the cribellate spider *Uloborus walckenaerius* to humid air, and monitored them with a scanning electron microscope. They observed that initial contact with water causes the hydrophilic fibres to re-structure, so that spindle-knots form periodically

along the thread axis, separated by elongated joints roughly fourfold thinner.

Small water droplets then condense randomly onto the spindle-knots and joints, and begin to grow as they accumulate moisture from the air. When they reach a critical size, droplets that are attached to joints move towards the nearest spindle-knots, where they coalesce to form larger water drops. This leaves the joints free to start a new cycle of water condensation and collection.

Zheng *et al.* found that the structure of the silk fibres is crucial for water collection. They observed that the spindle-knots are made up of randomly arranged nanofibrils and have rough



surfaces, whereas the joints consist of aligned nanofibrils and have smooth surfaces. The difference in roughness causes a surface-energy gradient that drives water towards the spindle-knots. This effect is boosted by the different shapes of the knots and the joints, which cause the drops to deform

differently, thereby generating surface-tension forces that also drive water drops towards the spindle-knots. A final helping hand is provided by the different orientations of the nanofibrils in the fibres: water drops move easily along joint regions where the nanofibrils are aligned, but stick to the spindle-knots where the nanofibrils are randomly orientated.

The authors went on to make artificial fibres that mimicked the structure of spider silk, and found that these successfully reproduced the water-collection properties of the natural material. They speculate that their work will help in the design of fibres that could be used in devices that collect water from the atmosphere, or that remove liquid aerosols in manufacturing processes.

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result is a characteristic spectrum of emission lines, and it is one of these emission lines, distinctive to methane, that has been detected by Swain and colleagues⁵.

Fluorescent emission is relatively common in astrophysical environments. It has been detected, for example, in the accretion disks surrounding supermassive black holes⁷, in the interstellar medium⁸ and in comets⁹. Specifically, the fluorescent methane emission detected by Swain *et al.*⁵ on HD 189733b has also been observed in the atmospheres of Jupiter, Saturn and Titan¹⁰. Fluorescence of other organic compounds has been detected on Venus and Mars¹¹. These detections provide a probe of the physical structure of the upper atmosphere of these planets from the perspective of a minor atmospheric constituent. Methane is particularly important because it may help us to find and evaluate possible biological influences on extrasolar planetary atmospheres.

The upper atmosphere is a fascinating and important region where minor molecular constituents, such as methane, can play an indispensable part in establishing the overall heat budget of a planet, thereby altering the thermal profile of a considerable portion of the atmosphere. Powerful winds and vertical mixing of high-altitude atmospheric layers present the possibility for temporal and spatial variability of the fluorescent emission from such molecules. In addition, ionized particles in the upper atmosphere are affected by any global magnetic field — as is dramatically exemplified on Earth by another form of emission-line radiation, the aurorae. Because HD 189733b is extremely close to its host star (less than one-tenth the distance between Mercury and

the Sun), energetic particles from its star will interact with any magnetic field the planet may have, possibly resulting in stronger emission-line displays than we see on Earth or Jupiter. Many other observed extrasolar planets are similarly close to their host stars, so variability in emission components because of magnetic effects may be common in these systems.

Swain and colleagues' detection⁵ of a fluorescent emission line of methane on HD 189733b paves the way for future observations of alternative fluorescent emission lines of methane and other molecules in extrasolar planetary atmospheres. These observations will require sensitive, high-spectral-resolution instruments that can resolve the emission-line profile of fluorescent signals. In addition, this discovery highlights a crucial theme in modern astronomy: the necessity of making complementary observations from the ground and from space. Depending on the wavelengths of the relevant spectral features, Earth's own atmosphere may or may not interfere with detection. The authors' observations⁵ were made with the 3.0-metre NASA Infrared Telescope Facility located at the summit of Mauna Kea in Hawaii. Our increasing understanding of this one extrasolar planet — from its discovery⁶ to the growing list of known constituents of its atmosphere, which includes sodium¹², carbon monoxide¹³, carbon dioxide¹³, water vapour¹³ and methane¹⁴ — has been possible only with observations from both the ground and space.

During the past few years, we have made a transition that deserves some rumination. Rather than speculating about the possibility of other worlds in the cosmos, we can now identify them specifically and enumerate their various characteristics. Many stars that

are readily visible to the naked eye, at least from relatively dark sites that are not heavily polluted by artificial light, have planets orbiting them, the masses and orbital characteristics of which we know. A number of other worlds, soon to be discovered, will be small and rocky like Earth, and will have atmospheres that we can detect, inventory and monitor. It is quite possible that, within our lifetimes, atmospheric studies of these extrasolar planets will provide the first evidence of biological life beyond Earth. Swain and colleagues' detection of the fluorescence of a hydrocarbon in the upper atmosphere of an extrasolar planet not only provides insight into the structure of the atmospheres of other worlds, but is also an important step in the far-reaching journey to uncover what may be below them. ■

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