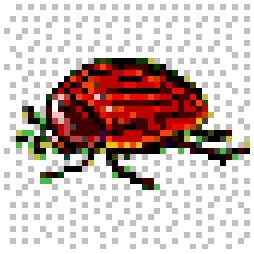

ScienceWatch - Water, Water Nowhere and Only Drops to Drink

Water is essential for life, as we know it. The special properties of water make it an ideal substance to dissolve nutrients and waste products, facilitating their passage in and out of living cells. While we might live several weeks without food, just a few days without water means coma and death. Yet some organisms are able to live in desert environments where water rarely, if ever, occurs. For example, kangaroo rats (*Dipodomys*) inhabit arid regions of the southwestern United States where they eat mostly dry seeds and go their entire lives without ever drinking any water. They have evolved a way to generate high levels of water during the metabolic breakdown of their foods, especially carbohydrates, and to use this water for their needs. Other mammals, including humans also generate some water, but it is lost as vapor in our breath.

Some desert insects have also evolved a way to cope with a waterless environment by literally extracting it from the air around them. Certain beetles live in the Namib Desert on the east coast of southern Africa, a region that gets negligible rainfall. Several times a month the Namib experiences high winds and dense early morning fogs blowing in from the Atlantic Ocean. Beetles in the genus *Stenocara* have evolved to use the fog as a water source. Some in this group crawl to the top of a dune and tilt their bodies forward into the wind, raising their hind legs, which contain fine bristles, to form a triangle and wait. Eventually a water droplet forms on the leg bristles, becoming large enough to roll forward along the beetle's underside to its mouthparts.

Writing in the November 1, 2001 issue of *Nature*, Andrew Parker and Chris Lawrence at the University of Oxford, Oxford, UK, describe a structural adaptation evolved by one *Stenocara sp*., which collects fog droplets on its back. This beetle also faces into the wind and tilts up its abdomen, but droplets form on its back, which is composed of the fused wing covers (elytra). While all beetles have elytra, Parker and Lawrence have shown that these elytra are very special. They are covered with bumps visible to the naked eye. Under the microscope each bump is seen to be composed of many tiny peaks that attract water. In between the peaks are waxy coated valleys that channel the droplets, which fall from the peaks, once they reach a certain size.

This droplet-producing system works by growing droplets on the water-attracting peaks. Once the microscopic drops are large enough to cover the peak they fall down into the waxy valleys where they continue to grow in size until heavy enough to roll down to the

beetle's mouthparts. The fog droplets are so small and light they are blown horizontally and would be lost to the desert heat and winds without this efficient collecting structure on the beetle's back.

Once Parker and Lawrence discovered the microstructure of the beetle's back they created a model composed of tiny glass spheres on a waxed microscope slide, which was highly efficient at collecting water from a fine mist even at 66^{o}C (151^{o}F). Such a collection system, they conclude, could be readily manufactured by injection molding and could collect water vapor for drinking or farming without the need for expensive cooling. They are already working on a desert tent that can gather drinking water for its occupants

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