



Courtesy of John W. M. Bush and David L. Hu/M.I.T.

The beetle larva, left, can scale a meniscus by arching its back, creating menisci of its own. Hydrometra does the same with its legs.

## A Bump for Bugs That Walk on Water

Your average water-walking insect makes a mountain out of a meniscus. For a water strider or other bug on the surface of a pond, the spot where water meets the shore, a stick or another object presents an obstacle — an upward-curving meniscus created by surface tension — that is like a mini-Mount Everest.

Some bugs can, however, scale a meniscus. As revealed by David L. Hu and John W. M. Bush, mathematicians at the Massachusetts Institute of Technology, the bugs do not stride uphill, but rather rely on capillary action to move up the slope in a fixed posture, as if on an escalator.

“They can’t run up the meniscus using their traditional means of propulsion,” said Dr. Bush, an associate professor who studies

fluid mechanics and may be one of the few mathematicians with an insect lab. “So they’ve developed this peculiar technique.”

Using a high-speed camera, Dr. Bush and Mr. Hu, a doctoral student, videotaped the meniscus-climbing behavior of different bugs, including those that tread water, and developed mathematical models of the behavior. (A video is at [nytimes.com/science](http://nytimes.com/science).) Their findings are published in the journal *Nature*.

While the insects are not walking, they are hardly taking it easy. The front and rear legs, which have retractable claws, pull up on the water’s surface, creating menisci that are drawn by capillary action to the nearby meniscus at the water’s edge. “Their muscles are straining to apply the force,” Dr. Bush said. The middle legs push down on the water, helping the bug to maintain equilibrium.

The bugs can travel the short distance up the meniscus very fast, up to 30 body lengths, or about 4 inches, per second. (By contrast, the fastest sprinters can run about five body lengths per second.) When they reach the top of the meniscus, the bugs clasp onto the dry surface and pull up the rest of the way.

Even some beetle larvae were able to ride a meniscus, Dr. Bush said, by arching their backs and pulling up on the water at the front and the rear.

He said the movement is based on the same principle that causes Champagne bubbles to migrate to the edge of a glass, or the few remaining corn flakes in a bowl to clump together.

“These bugs live in a world dominated by surface tension,” Dr. Bush said. “When things become very small, surface tension becomes important compared with gravity.”