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Letter from the Desk of David Challinor
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Matthew, in Chapter 14, verse 25, reports, "...and in the 4th watch of the night, Jesus came to them walking upon the sea." Whether you believe this account of Jesus walking on water to the Disciples in their boat literally or allegorically, it is relevant to the wonderment we experience when watching invertebrates walk on water, the topic of this month's Letter.

Myriad invertebrates can scurry across the surface of still water, but perhaps the best known are the water striders of the family *Veliinae*. These insects have evolved an important aquatic niche, flat water (a surface on which they move quickly and agilely) while hunting their microscopic prey and avoiding potential fish predators from below.

To walk on water, an insect has to be light enough so that its weight, distributed to its six feet, is not too great to break the molecular bonding of the water surface. The strength of this bonding is clearly illustrated when we fill a tumbler just above its rim without the water overflowing; this is because surface tension keeps the water above the rim. The feet, and often the bodies, of water striders are covered by dense, very fine hydrofugic hair. Hair of this kind is water-repellent because it is so fine and so dense that water molecules cannot penetrate it. Thus it is a combination of the water's molecular attraction and the insect's hydrofugic hairs that keep water striders afloat. If kept experimentally in a tank, for example, the water striders would sink if enough detergent was added to the water. Fortunately, this is not a problem in most ponds.

Within the water strider family an extraordinary new species was discovered in February 1985 by Paul Spangler, a Smithsonian entomologist specializing in aquatic insects. He was on an expedition to a high mesa, one of a group known as the Mountains of the Mist on the Venezuelan-Brazilian border. These mesas, locally called tepuis, are the eroded sandstone remnants of the ancient Guiana Shield, an enormous plateau present when Africa and South America were joined. The vertical walls of the tepuis rise 1000 m (3300') or more above the canopy of the forest below, and plant and animal life is thus very different there from that at the base.

While investigating a small stream on the tepui, Spangler noticed a dead stone fly on some cream-colored foam that had formed in a riffle of the stream. Looking closer he watched a cluster of foam-colored insects feeding on the fly. When he removed the fly, the small insects (3mm or 1/8" long) scurried on the top of the foam bubbles and from time to time disappeared between their interstices. The insects were later identified as a new species, *Oiovelia spumicola*, of mostly wingless water striders. Walking on a foam bubble may be the ultimate in light-footedness.

Although we can easily picture small insects such as water striders walking on water, we wonder how big can an animal be and still perform such a feat without sinking? To help answer this question, Smithsonian herpetologist Stan Rand and a colleague caught 89 basilisks while the lizards were sleeping on branches overhanging the waters around Barro Colorado Island, Panama. Basilisks are brown, long-tailed lizards about a foot in length from nose to tail tip. They run on their hind feet and are locally known as Jesu Christos for their ability to run across the water. They do this by churning the surface with their feet, which have long-fringed toes. Basilisks also swim well, and when threatened they either dive, run across the surface, or perform a combination of the two strategies.

In his experiment Rand put individual basilisks of varying age and sex on a small elevated platform about 25 feet from the shore. When Rand approached or tapped the platform, the lizards responded by diving off, by running on the water and then diving, or by running all the way to shore. By varying their escape patterns, basilisks presumably can confuse their predators. Rand found that although both adults and juveniles ran across the water at about the same speed (average 5.6 mph), juveniles tended to run all the way to shore, whereas the larger adults tended to sink after a short run. It evidently takes more energy to stay on top of the water when the animal is heavier.

Besides basilisks, other similar or larger-sized animals that run on the water surface are molting ducks and geese. Their temporary flightlessness makes them more vulnerable to some predators for a few weeks each year, but the speed they generate over the surface is a remarkably effective means of escape. In fact there is a large (up to 14 lbs) duck that has given up flight altogether. The flightless steamer duck (*Tachyeres*, 2 spp) lives along the Patagonian coast and the shores of the Falkland Islands. It escapes from predators by running rapidly (<8 mph) using both its strong legs and flightless wings, which Darwin reported strike the water alternately, almost like a paddle wheel, hence its local name: pato vapor or steamer duck.

There are other water walkers or runners, such as certain spiders, but I want to emphasize that for such specially adapted animals, the water surface is an effective escape route. The study of the techniques used by water walkers requires both biology and physics to explain what for humans is a truly miraculous feat -- one that impressed and probably baffled some Galilean fishermen two millennia ago.

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