

Animals also discovered the wheel

The discovery of the wheel is regarded as a milestone in our cultural development. However, the benefits of rolling locomotion were exploited by the animal kingdom long before humans.

“If God had wanted animals to have wheels, he would first have built roads,” stated the American biologist Richard McCourt. It is true that the availability of roads or rails is almost essential to make efficient use of wheels; the harder and flatter the underlying surface, the less resistance is encountered during rotation. To find examples of rolling locomotion in nature, it is therefore necessary to look in areas with firm, flat surfaces such as savannas or deserts.

Rolling dung balls

This type of terrain is home to a creature that knows the secret of rolling: the dung beetles. They mold the dung excreted by herbivorous mammals into spherical balls, which it quickly rolls away using its hind legs and hides in an underground burrow. This dung serves as the beetle's own personal food supply or is used to rear young. The dung balls molded by dung beetles can easily reach a height of five centimeter—three times higher and 20 times heavier than the beetle itself. The efficiency of rolling transportation is clearly illustrated by the fact that the dung beetle can move its heavy load at the rapid rate of 20 cm/s.

In 1990, the biologist Joh Henschel discovered a living wheel in the sand dunes of the Namib Desert in southwest Africa: *Carparachne aureoflava*, the wheel spider. The vast sand dunes are its habitat; it hides in burrows that extend diagonally into the dunes to a depth of up to 50 cm. It is not easy to dig the narrow tunnels in the shifting sand but the spider succeeds by continuously lining the tunnel wall with silk to stabilize it during the burrowing process. To protect itself



Carparachne aureoflava, the wheel spider.

against predators, it seals the entrance to the burrow with a combination of sand and silk. It emerges at night to prey on insects for food.

As fast as a Ferrari

Wasps from the Pompilidae family are the deadly enemy of the wheel spider. The female spider-wasps search the dunes tirelessly for wheel spiders. If they discover a hatch constructed of silk, they break in. The spider in the narrow burrow defends itself using its front legs or rips the supportive silk amour from the walls if necessary. If the spider succeeds in repelling the first attack, the wasp becomes more determined and digs a crater into the sloping dune above the spider's hiding place. It will dig for hours in order to reach its prey in the moving sand. To mine a 15 cm deep crater, it must remove 5 kg of sand from the dune using just its legs—this is equivalent to 80 000 times its bodyweight.

If the wasp succeeds in breaking into the spider's burrow, the spider makes a final bid for survival. It rushes past the predator to the edge of the crater, sprints part of the way down the dune, and suddenly flips onto its side, curling up each of its eight legs at the third leg joint to transform itself into a wheel. The spider then cartwheels down the dune on the rim of its leg joints, gathering increasing speed. According to Joh Henschel's measurements, it rotates up to 44 times per second—the same number of revolutions as the wheels of a Ferrari travelling at a speed of 300 km/h. The wheel spider can thus easily travel approximately 10 m in 10 s and will only uncurl its legs after a distance up to 100 m, when it reaches the foot of the dune. The wasp appears to lose sight of the rolling spider and, despite being able to fly, is unable to relocate its prey.

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