Walking Like Dinosaurs (p. 3917, p. 3927)

There can't be many people who've started off thinking about dinosaurs and ended up explaining how we move, but while trying to figure out how cumbersome dinosaurs might have turned, a research team at the University of Utah might have uncovered new information about how our muscles have evolved to help us turn on a penny.

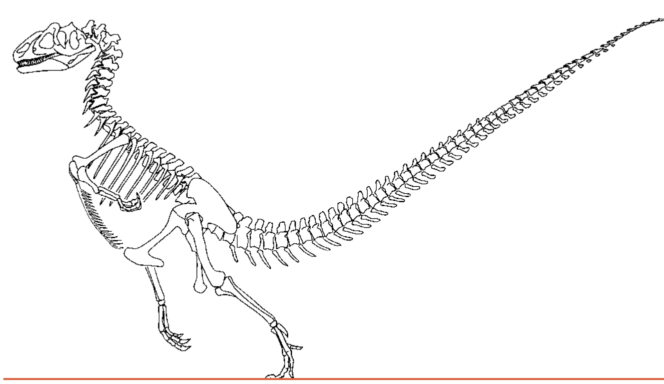
What started off this unusual train of thought? Dino-hips. David Carrier realised that some of the pelvic bones in theropod skeletons were unusually arranged, and he wondered how this would affect the beast's mobility. If these dinosaurs were carrying most of their weight close to their hips, would that reduce their moment of inertia and make it easier for them to turn? But how do you test this when the species you're interested in vanished from the planet millions of years ago? Enter nine healthy students, each ready to run and jump like a dinosaur.

At first sight, young adult humans don't look much like the ferocious carnivorous hunter Carrier's team was interested in, but as we're one of the few striding bipedal organisms left on the planet, maybe the analogy isn't too far fetched. The next problem was simulating the different distribution of mass around the dinosaur body. The Utah team overcame this by strapping a frame onto the students that stuck out in front and behind to simulate the heavy dinosaur head and tail.

First the researchers got the wanna-be-dinosaurs to do twisting jumps from a standing position. Carrier says that this isn't as strange as it may seem: all sorts of creatures do standing jump turns when reacting to danger that is approaching from behind. Then they simulated the dinosaur running through uneven terrain by asking the students to weave back and forth through a slalom course wearing the heavy dinosaur extensions (p. 3917).

Not surprisingly the hybrid-dinos were severely hampered by their heavy heads and tails. They couldn't twist as far as they had before their weight was redistributed, and while they had sprinted through the slalom course before the test, they were slowed by more then 35 % when they were carrying the wooden frame.

Seeing the results made the team wonder if theropod dinosaurs might have walked with a different posture than the one we all know from reconstructed skeletons. The new stance that Carrier's team have suggested gives the dinosaur a more angled posture with the body held up and the tail angled upwards above the horizontal. Looking at the way the dinosaur's spine was articulated, they suggest that the neck was more curved to position the heavy head over the dinosaur's hips to improve the creatures manoeuvrability when hunting. A suggestion that has set the allosaurids among the chickens!



But the scientists also noticed that the human subjects were turning much better then they'd initially predicted. The researchers calculated that the encumbered students had experienced a 900 % increase in their moment of inertia, so they reasoned that the subjects should also suffer an 89 % decrease in their ability to turn. But they didn't. So how were the human muscles producing this enhanced performance?

The Utah scientists looked closer at the students' turning performance (p. 3927). They directly measured how much turning force (torque) the students generated when jumping with and without the wooden frame. Looking at the results, they discovered the twisting humans generated larger turning forces but turned more slowly when they jumped with the frame that increased their moment of inertia. The students turned further than expected because they generated a larger turning force, but the power that they produced was reduced, because they turned more slowly.

How could that be? The Utah group speculates that the weighted and unweighted students were using a set of upper body muscles specifically adapted for turning. They suggest that this specialised muscle group produce the greatest power when humans twist fastest. Carrier accepts that most skeletal muscles have to be jacks-of-all-trades, producing a satisfactory performance to most of our physical demands. But it is possible that the muscles involved in turning might have been optimised for one task alone: agility over strength.

Can Decibels Deafen Whales? (p. 3829)

Man-made noise pollution is an uncomfortable irritation. Jet engines and burglar alarms leave our ears ringing. But noise pollution isn't restricted to the atmosphere. Water is an even better carrier of sound with marine freight churning noise out into the oceans. What effect is all this din having on the delicate ears of our sea-dwelling cousins? Are diving mammals protected from loud noise by the effects of pressure at depth more than animals that stay near the surface? Sam Ridgway and coworkers asked two white whales how well they could hear as they plumbed the depths, and it seems that sounds aren't as muffled by deep water as they'd hoped.

Whales returned to the oceans over 50 million years ago. Despite the change of life style, their ears are much the same as terrestrial mammals, with an air filled middle ear that is designed to amplify sound. It is thought that as diving mammals descend, the pressure in the middle ear increases to balance the rising water pressure outside the ear. This should thicken the air in the middle ear so that it deadens the sound that the animal hears. So would a marine mammal respond to the same sound threshold at 5 m as they did at 300 m when the pressure in the middle ear had increased by 30 atmospheres?

Sam Ridgway's team continued their long-term collaboration with two arctic white whales, MUK and NOC, which they have worked with since the whales were collected in 1977. White whales are real chatterboxes, so it was easy to train them to whistle when they'd heard a test sound. After three months of practice, MUK and NOC were responding reliably, so they headed off to the deep clear waters around San Clemente Island to have their hearing tested.

The whales were already expert divers from previous collaborations with Ridgway and his team, so they happily dived to depths as great as 300 m to listen to test tones before returning to the surface for a fish reward. Ridgway expected the whales to have a higher hearing threshold the deeper they swam, but their hearing was as acute at depth as it was at the surface. So even though the middle ear should have been attenuating the sound, the whales were still hearing at the same intensity.

Of course the obvious question is why they have a middle ear if they're not using it for hearing? Ridgway isn't sure, but is confident that they use it for something; otherwise they wouldn't have retained it. But he is certain that we can't extrapolate how other submerged mammals hear underwater. Although diving humans suffer attenuated hearing under increased pressure, not all diving mammals will be affected in the same way

Even though MUK and NOC's hearing seems to be quite robust, human noise pollution should still carry a marine health warning. Not all species might be quite so lucky.

Guided by the Lights (p. 3855)

Most of us will recognise the bewildering feeling of arriving in an unfamiliar place, not quite sure which way to turn. Most of us manage to build up some sort of mental map within a few hours to help us get around. But darkness can make the most familiar landmarks seem unrecognisable. The situation is much more complex for young birds embarking on their first migration who have to combine many different inputs while travelling over the huge distances. Henrik Mouritsen and Ole Larsen have updated an old technique to see how the inexperienced aviators find their way on their first journey to warmer climes.

Birds that navigate by day use the sun as a reference point, possibly in combination with a variety of other factors including the earth's magnetic field. But the sun moves across the sky, sweeping through approximately 15 ° every hour. The birds compensate for this drift by rotating their frame of reference at the same rate as the sun moves. But when the birds continue migrating after sunset, their moving reference point has left the sky, so, how do they navigate at night?

In autumn, migrating birds are so eager to migrate to their winter destination that they will jump in the direction they need to fly, even if they are confined inside a funnel-like cage, called an Emlen Funnel. Instead of taking off, they just slide down the side of the funnel, leaving a mark that records the direction they wanted to take-off. Mouritsen realised that if he could record the direction the birds jumped and registered the time of each event, he would have a perfect way of identifying which aspects of the night sky the birds were using to navigate. Mouritsen gave the Emlen Funnel a digital makeover and moved the equipment into a planetarium, which gave him a night sky that he could control while recording the bird's reactions.

They chose two species of migrating songbirds that migrate from Scandinavia in a southwesterly direction. Mouritsen simulated rotating and stationary versions of the night skies that the birds would see when they were migrating, and recorded the directions the birds wanted to fly throughout the night.

At the end of the night, when he looked at his electronic traces under stationary skies, he found that the birds had kept aiming towards a constant compass bearing. This means that the young birds navigating by a fixed point in the sky. Mouritsen says they are behaving like 'clock and compass machines', choosing a constant compass direction that they are born knowing they must follow, rather than navigating from a genetically inherited star map.

So, the birds that Mouritsen and Larsen studied are able to adjust their direction-finding apparatus, whether they're flying at night or day. By day they navigate using a point that moves across the sky at a fixed rate during daylight, but at night they switch to using a single fixed point in a spinning stellar sky.

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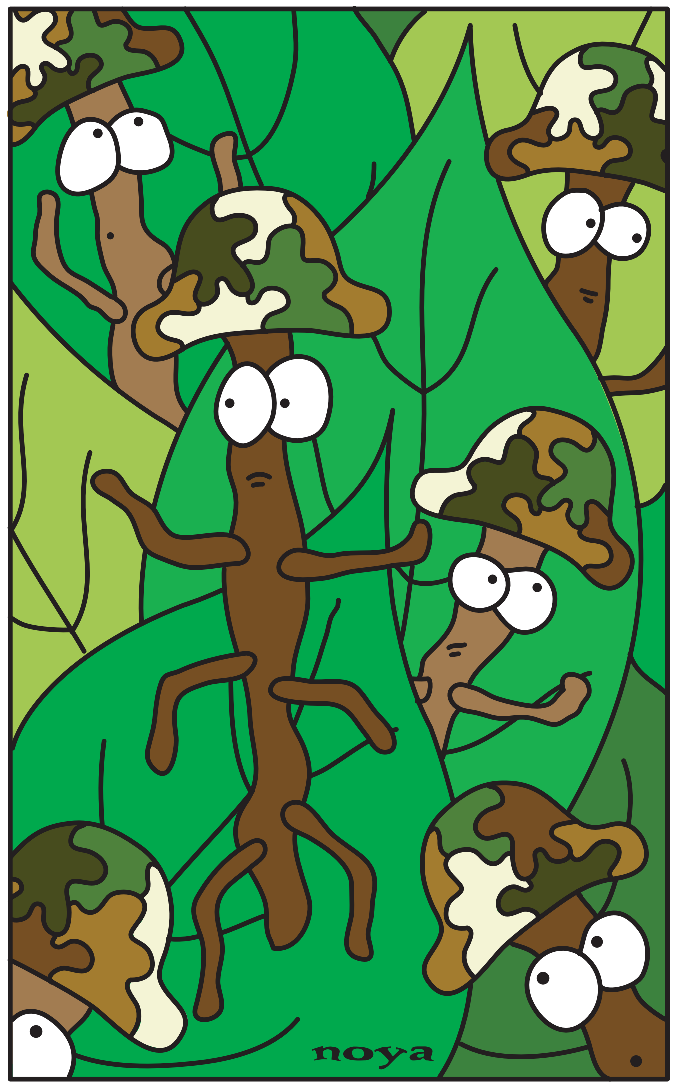

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