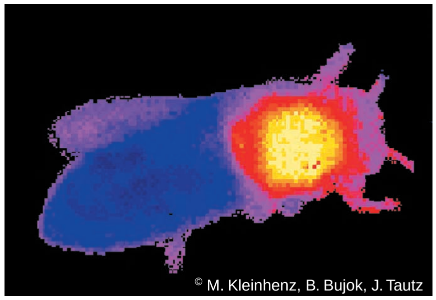
Inside JEB, formerly known as 'In this issue', is a twice monthly feature, which highlights the key developments in the *Journal of Experimental Biology*. Written by science journalists, the short reports give the inside view of the science in JEB.

Inside JEB

CLIMATE CONTROL, BEE STYLE



© M. Kleinhenz, B. Bujok, J. Tautz

Whatever the weather, no self-respecting hive lets the temperature drop inside; the future of the next generation depends on it. If the hive's temperature falls a few degrees below 35°C, the incubating young's development is seriously threatened. Marco Kleinhenz explains that much of the hive's heat derives from general hive-keeping activity, but workers also help raise the temperature by congregating at the brood and vibrating their thoracic muscles to warm the incubating young. But how each individual worker contributes to the heating sum wasn't clear. Brigitte Bujok had noticed that some of the workers appear to position themselves over an incubating brood cell and press their thoraxes against the sealing caps 'leaving a hot spot behind' explains Kleinhenz. But not much more was known about the brood's central heating strategy until Kleinhenz and Bujok teamed up with Stefan Fuchs and Jürgen Tautz to take a closer look at the heating bee's activity (p. 4217).

Setting up a series of hives where they could monitor the bee's brood heating antics, Kleinhenz and his colleauges recorded individual's body temperatures with an infrared camera, and watched their behaviour. Some of the workers were happy to stay completely motionless on a brood cap for several minutes, pressing their thoraxes against the cap to warm the young within. But many of the bees preferred to find an empty cell amongst sealed brood cells, and take up residence, sometimes for over an hour. Kleinhenz explains that this apparently lazy behaviour had been noticed before, so he suspected that the bees were simply taking a rest; until he looked at their temperature. They were warming themselves before they vanished inside, and some bees emerged even warmer than when they went in! Were the bees really taking a nap, or were they taking up residence in an empty cell to warm the adjacent pupae?

The team built a close observation hive where they could monitor bees' thoracic temperatures as they hunkered down in vacant cells. This time it was clear. Far from easing off and taking a rest, closeted bees were vibrating their thoracic muscles and reaching temperatures up to 41°C. Far from being idle, the workers were warming the brood.

But how effective is the bee's novel heating strategy? Fitting a small resistor inside a bee's thorax, the team placed the simulated bee heater inside a cell, and recorded the temperature in adjacent cells. After 30 minutes, the heater bee's effect could be felt three chambers away. Kleinhenz also realised that once in place, a hot worker makes the most of its heat, warming all six of the surrounding cells, while usually a single occupant is the only beneficiary from a worker perched above it on the comb. What is more, the heater bees aren't profligate with their valuable resource, staying cool when surrounded by honey or vacant brood cells that don't require warmth, or when the brood is already warm enough.

Kleinhenz also noticed that this dedicated band of bees also take great care not to over-heat their precious charges. They monitor the brood cells' temperatures and ensure a comfortable clime for all, by never letting the hive rise above 35.9°C.

10.1242/jeb.00728

Kleinhenz, M., Bujok, B., Fuchs, S. and Tautz, J. (2003). Hot bees in empty broodnest cells: heating from within. *J. Exp. Biol.* **206**, 4217-4231.

IN A FLICK OF A TAIL

Picture provided by Richard Peters

Unlike their fire-breathing counterparts, Jacky dragons are rather gentle lizards. These dragons spend most of their lives perched in trees waiting to trap a passing morsel. But they don't take kindly to intruders. If a Jacky dragon invades another's personal space, the diminutive lizard begins an elaborate dance routine, warning the trespasser that it's time to move on. So how does the dragon catch an intruder's eye before getting the message over? Richard Peters explains that most animals either call or flash a patch of brightly coloured skin to attract attention, but the Jacky dragon has neither of these options. Peters and his supervisor Christopher Evans suspected that the lizard relies on its enormously long flicking tail to catch an intruder's eye, so they decided to test the reptile's reactions to a variety of tail flick techniques (p. 4293).

But could Peters convince a Jacky dragon to vary its tail flicks so that he could discover the flicks' eye-catching formula? Unfortunately not, so he turned to a technique more familiar to moviegoers. Peter's learned to animate. Next he needed to be sure that the lizards were taken in by his home animations. Choosing a 6.5 s tail flick sequence, Peters painstakingly fitted the tail animation to each frame of the real tail's movement's. After carefully simulating the lizard's skin tones and lighting conditions, the results looked convincing. And the dragons were taken in too, turning quickly to watch the cinematography. Knowing that most dragons have to react to a tail set against a shifting foliage background, Peters also superimposed the tail movie over footage of rustling trees, and again the dragons jerked to attention. Peters was ready to manipulate his movie to see what made a tail flick attractive.

Speeding up and slowing down the animation, Peters monitored the lizard's reactions. Surprisingly, the Jacky dragons were more attentive to a long slow flick than an abrupt movement, even though most other lizards seem more responsive to fast movements.

But what else would attract the lizard's attention? Peter's played the lizards tail flicks with a variety of amplitudes, from a narrow flick to a wide waggle. The lizards reacted no matter how wide the amplitude of the movement, so Peters switched his attention to the speed and duration of a train of flicks. Playing the lizards a sequence of animations that ranged from a short series of slow flicks to a long series of fast flicks, Peters realised that long duration flicks were the best at catching a Jacky dragon's eye.

So why does the Jacky dragon introduce its brief territorial display so languidly? Peters explains that it's much harder to attract attention with a visual signal than a loud cry. He suspects that a lengthy series of flicks is probably the most effective way to catch an intruder's eye to make sure they get the rest of the message.

10.1242/jeb.00726

Peters, R. A. and Evans, C. S. (2003). Introductory tail-flick of the Jacky dragon visual display: signal efficacy depends upon duration. *J. Exp. Biol.* **206**, 4293-4307.

PYTHONS KEEP THE PRESSURE UP

Staying warm takes an awful lot of effort. Mammals, and other warm-blooded creatures, ramp up their metabolic rates to keep the internal fires burning. However, fires don't rage unless they're well stoked, so mammals have souped-up their cardiac systems and raised their systemic blood pressure for efficient oxygen delivery. However high blood pressures wouldn't suit all systems, so endothermic animals divided their cardiac flow in two, developing two ventricles that separate low-pressure blood directed to the lungs, from the high-pressure systemic flow. On the other hand, ectothermic creatures with their meagre metabolic loads have no need for high blood pressure to keep their bodies fuelled. Instead they retained a partially divided cardiac ventricle that serves both body and lungs with a low pressure blood supply. All that is except for a few particularly active reptiles; their dividing ventricular ridge is much more developed. Knowing that the modified ridge was capable of separating the pulmonary and systemic blood flows in *Python molurus*, Tobias Wang wondered whether the ridge might produce sufficient separation to allow both halves of the ventricle to generate separate pressures too. Teaming up with Jordi Altimiras, Wilfried Klein and Michael Axelsson, Wang measured the pressure inside a *Python molurus*' beating heart; the systemic pressure was seven times higher! The ridged ventricle was behaving just like a mammal's divided heart (p. 4241).

Converging at Wang's lab in Denmark, the team fitted young pythons with catheters and waited for them to regain consciousness before measuring the arterial blood pressures. Wang explains that the measurements were quite straightforward, and he was delighted when his suspicions were confirmed; the blood pressure in the systemic artery was seven times greater than the pressure in the pulmonary artery. Next the team inserted catheters into the ventricle, and measured the pressures generated in both halves. The ventricle was behaving as if it had two separate chambers. Although the muscular ridge doesn't entirely separate the ventricle, it somehow allows the heart to deliver blood at high pressure to the systemic system, while protecting the lungs from pressure damage.

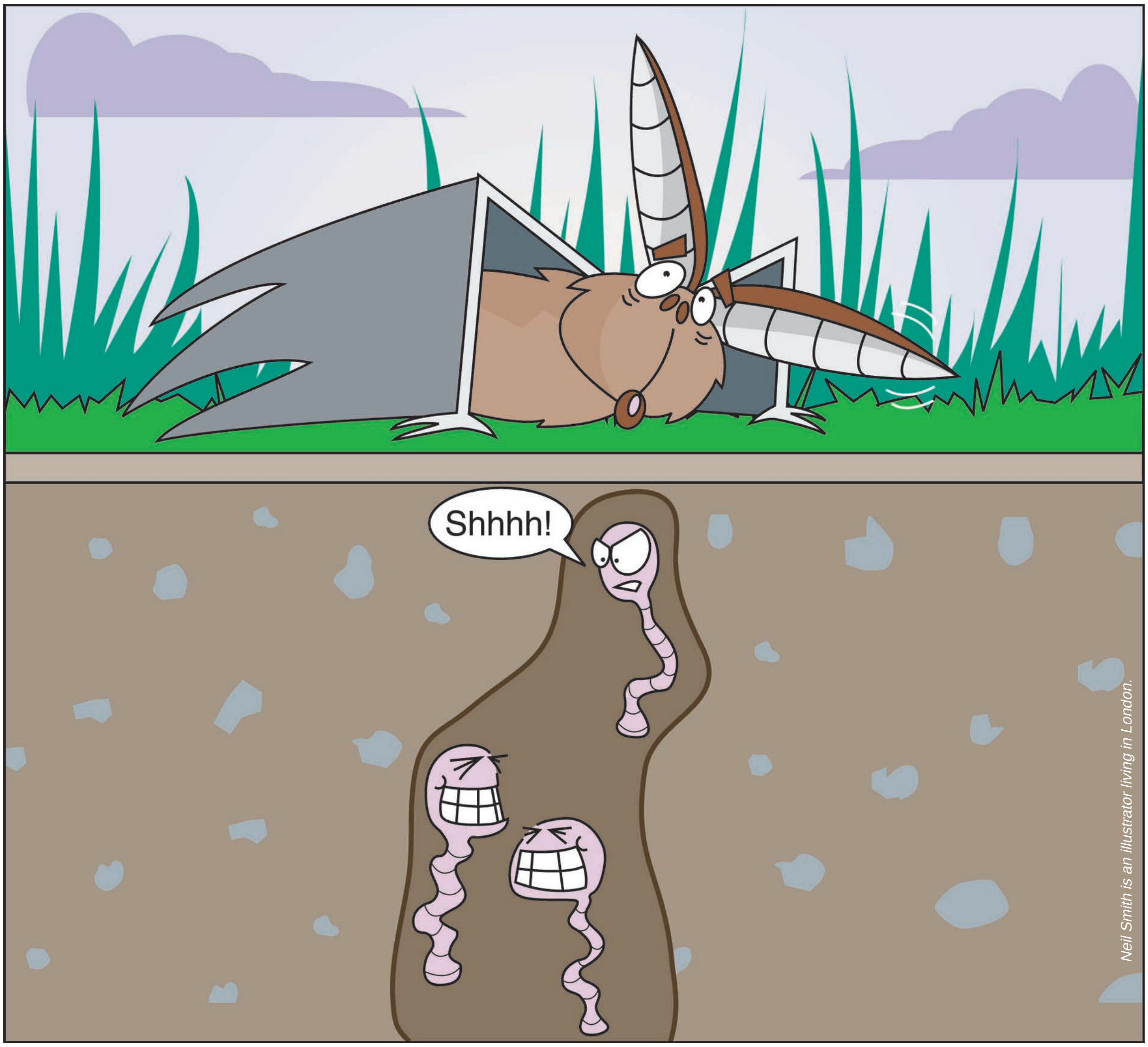
But 'how' and 'why' the python has opted for an endothermic-style heart with an ectothermic life style is a bit of a mystery. Working with Axelsson and Carl Løfmann, Wang has already answered 'how', by inserting an angioscope into a perfused python heart to watch the ridge during a contraction cycle. 'There is no doubt that the muscular ridge provides a complete separation of the two sides of the heart immediately after contraction has commenced' says Wang.

The 'why' question is much more intriguing. Although pythons are well known for their lethargic approach to predation, the reptile's metabolic rate rockets after a feast. Pythons also generate huge amounts of heat by shivering while incubating their eggs. Wang wondered whether these enormous metabolic demands had driven the snake to develop the large pressure-separating ridge? But having failed to find pressure separation in other snakes with high digestive metabolic rates, while identifying pythons that retain high blood pressure even though they abandon their eggs, Wang admits that he isn't sure what is going on. 'God knows what it's all about' he says, but is optimistic that looking at even more distantly related python species could eventually solve why python's have divided hearts.

10.1242/jeb.00729

Wang, T., Altimiras, J., Klein, W. and Axelsson, M. (2003). Ventricular haemodynamics in *Python molurus*: separation of pulmonary and systemic pressures. *J. Exp. Biol.* **206**, 4241-4245.

BATS RUSTLE UP A MEAL



Until humans arrived in New Zealand, only two mammals had taken up residence on the islands; the short and long tailed bats. Without predators to threaten them, hunting for food on the ground was relatively safe, so the short tailed bat developed a taste for ground dwelling arthropods. But how the resourceful bat locates buried morsels wasn't clear. The bat couldn't be using echolocation; it must be doing something else. Gareth Jones and his colleagues began analysing the mammals hunting strategy, on both the wing and ground, and discovered that although echolocation is still the bat's method of choice for trapping airborne prey, the bat tuned its acute hearing to listen out for terrestrial snacks when hunting on the ground (p. 4209).

Working with Peter Webb, Jane Sedgeley and Colin O'Donnell, Jones began recording the bat's hunting calls in their cluttered native forests and in the lab, to see how they used echolocation while hunting on the wing. But next the team wanted to see how the bats located buried fodder.

Hiding live and dead mealworms under leaf litter, the team were astonished at the speed that the bats located the live offerings. Jones says that 'On the ground, [the] bats moved rapidly and adeptly… digging in the leaf litter… sometimes disappearing completely'. The bats had found the live mealworms too quickly to be relying on their sense of smell; the team realised that they must be using their ears to home in on the mealworms' rustling.

10.1242/jeb.00727

Jones, G., Webb, P. I., Sedgeley, J. A. and O'Donnell, C. F. J. (2003). Mysterious *mystacina*: how the New Zealand short-tailed bat (*Mystacina tuberculata*) locates insect prey. *J. Exp. Biol.* **206**, 4209-4216.

Kathryn Phillips
kathryn@biologists.com