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The Sucker, the Sucker!

Amia Srinivasan

Other Minds: The Octopus and the Evolution of Intelligent Life by Peter Godfrey-Smith
Collins, 255 pp, £20.00, March 2017, ISBN 978 0 00 822627 5
The Soul of an Octopus: A Surprising Exploration into the Wonder of Consciousness by Sy Montgomery
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In 1815, 15 years before he made his most famous print, The Great Wave, Hokusai published three volumes of erotic art. In one of them there is a woodcut print known in English as ‘The Dream of the Fisherman’s Wife’ and in Japanese as ‘Tako to ama’, ‘Octopus and Shell Diver’. It depicts a naked woman lying on her back, legs spread and eyes closed, while a huge red octopus performs cunnilingus on her. The octopus’s slit eyes bulge between the woman’s legs and its suckered limbs wrap around her writhing body. A second, smaller octopus inserts its beak into the woman’s mouth while curling the thin tip of an arm around her left nipple. In Europe, the print was interpreted as a scene of rape, but the critics didn’t read Japanese. In the text arranged in the space around the three entwined bodies, the shell diver exclaims: ‘You hateful octopus! Your sucking at the mouth of my womb makes me gasp for breath! Ah! Yes … it’s … there! With the sucker, the sucker! … There, there! … Until now it was I that men called an octopus! An octopus! … How are you able? … Oh! Boundaries and borders gone! I’ve vanished!’

A Giant Pacific octopus

The octopus threatens boundaries. Its body, a boneless mass of soft tissue, has no fixed shape. Even large octopuses – the largest species, the Giant Pacific, has an arm span of more than six metres and weighs a hundred pounds – can fit through an opening an inch wide, or about the size of its eye. This, combined with their

considerable strength – a mature male Giant Pacific can lift thirty pounds with each of its 1600 suckers – means that octopuses are difficult to keep in captivity. Many octopuses have escaped their aquarium tanks through small holes; some have been known to lift the lid of their tank, making their way, sometimes across stretches of dry floor, to a neighbouring tank for a snack, or to the nearest drain, and maybe from there back home to the sea.

Octopuses do not have any stable colour or texture, changing at will to match their surroundings: a camouflaged octopus can be invisible from just a few feet away. Like humans, they have centralised nervous systems, but in their case there is no clear distinction between brain and body. An octopus's neurons are dispersed throughout its body, and two-thirds of them are in its arms: each arm can act intelligently on its own, grasping, manipulating and hunting. (Octopuses have arms, not tentacles: tentacles have suckers only at their tips. Squid and cuttlefish have a combination of arms and tentacles.) In evolutionary terms, the intelligence of octopuses is an anomaly. The last common ancestor between octopuses on the one hand, and humans and other intelligent animals (monkeys, dolphins, dogs, crows) on the other, was probably a primitive, blind worm-like creature that existed six hundred million years ago. Other creatures that are so evolutionarily distant from humans – lobsters, snails, slugs, clams – rate pretty low on the cognitive scale. But octopuses – and to some extent their cephalopod cousins, cuttlefish and squid – frustrate the neat evolutionary division between clever vertebrates and simple-minded invertebrates. They are sophisticated problem solvers; they learn, and can use tools; and they show a capacity for mimicry, deception and, some think, humour. Just how refined their abilities are is a matter of scientific debate: their very strangeness makes octopuses hard to study. Their intelligence is like ours, and utterly unlike ours. Octopuses are the closest we can come, on earth, to knowing what it might be like to encounter intelligent aliens.

Peter Godfrey-Smith is a philosopher and diver who has been studying octopuses and other cephalopods in the wild, mostly off the coast of his native Sydney, for years. The alienness of octopuses, in his view, provides an opportunity to reflect on the nature of cognition and consciousness without simply projecting from the human example. Because of their evolutionary distance from us, octopuses are an 'independent experiment in the evolution of large brains and complex behaviour'. Insofar as we are able to make intelligent contact with them – to understand octopuses and have them understand us – it is 'not because of a shared history, not because of kinship, but because evolution built minds twice over'. The potential worry is that the evolutionary chasm between us and the octopus is too great to

make mutual intelligibility possible. In that case the octopus will have something to teach us about the limits of our own understanding.

An octopus is an eight-armed, soft-bodied mollusc. Its arms are covered in suckers and arranged radially around a sharp-beaked mouth. It eats by catching prey with one of its arms and moving it through a conveyer belt of undulating suckers to its mouth – in that sense an octopus's arms can also be thought of as its lips. On top of its arms rests its head, which contains its brain and features two large eyes with horizontal, dash-shaped pupils, like a cat's eyes turned on their side. Behind the head is the octopus's mantle, a large bulbous structure that contains its vital organs, including three hearts which pump blue-green blood. A tubular siphon is attached to the mantle, which the octopus uses variously for jet propulsion, respiration, excretion and inking predators. A full-grown octopus can range in size from the Giant Pacific, with its six-metre arm span, to the 2.5 centimetre-long Octopus wolfi, which weighs less than a gram.

Linnaeus called the octopus singulare monstrum, 'a unique monster'. Erik Pontoppidan, bishop of Bergen, in his Natural History of Norway (1752), wrote about the Kraken, a giant octopus-like sea monster capable of dragging down 'the largest man of war' in its arms, or sucking it down in the whirlpool of its wake. A similar creature, the Akkorokamui, with huge eyes and the ability to amputate and regenerate its limbs, features in Ainu folklore, and is worshipped in Shinto shrines throughout Japan. Victor Hugo's Toilers of the Sea includes a long description of the octopus or 'devil-fish':

If terror were the object of … creation, nothing could be imagined more perfect than the devil-fish … This irregular mass advances slowly towards you. Suddenly it opens, and eight radii issue abruptly from around a face with two eyes. These radii are alive: their undulation is like lambent flames … A terrible expansion! … Its folds strangle, its contact paralyses. It has an aspect like gangrened or scabrous flesh. It is a monstrous embodiment of disease … Underneath each of [its] feelers range two rows of pustules, decreasing in size … They are cartilaginous substances, cylindrical, horny and livid … A glutinous mass, endowed with a malignant will, what can be more horrible?

Octopuses are indeed glutinous; according to Sy Montgomery, author of the splendid Soul of an Octopus, the slime on an octopus's skin feels like a cross between drool and snot. But the octopus's will is far from malignant, at least when it comes to humans. Octopuses do occasionally attack people, giving a venomous nip or stealing an underwater camera when threatened or annoyed, but in general

they are gentle, inquisitive creatures. (Fishermen, by contrast, often kill octopuses by biting out their brains, and in many countries they are eaten alive.) Octopuses encountering divers in the wild will frequently meet them with a probing arm or two, and sometimes lead them by the hand on a tour of the neighbourhood. Aristotle, mistaking curiosity for a lack of intelligence, called the octopus a ‘stupid creature’ because of its willingness to approach an extended human hand. Octopuses can recognise individual humans, and will respond differently to different people, greeting some with a caress of the arms, spraying others with their siphons. This is striking behaviour in an animal whose natural life cycle is deeply antisocial. Octopuses live solitary lives in single dens and die soon after their young hatch. Many male octopuses, to avoid being eaten during mating, will keep their bodies as far removed from the female as possible, extending a single arm with a sperm packet towards her siphon, a manoeuvre known as ‘the reach’.

Just how clever are octopuses? An octopus has half a billion neurons, about as many as a dog. (A human has a hundred billion neurons.) Octopuses also have a high ratio of brain to body size, a sign of the ‘investment’ the animal makes in its own cognition. But these metrics are only a very rough guide to animal intelligence; the number and complexity of synaptic connections between neurons are also a factor. (Crows and parrots have small brains, but have recently been shown to be highly intelligent.) And the brain-to-body ratio does not take into account the majority of the octopus’s neurons that exist outside its brain. What’s more, the octopus’s brain has a structure completely distinct from that of our own. Even birds and fish have brains which exhibit a one-to-one correspondence with parts of the human brain. But the octopus’s brain is built on a different model entirely.

Since a comparison with the human brain tells us so little, scientists turn to the octopus’s behaviour as the best indicator of its cognitive power. But here researchers are often frustrated by what Godfrey-Smith describes as a ‘mismatch’ between anecdotal reports and experimental studies. In the lab, octopuses do fairly well: they can navigate mazes, use memory to solve simple puzzles and unscrew jars and child-proof bottles to get food (octopuses have also been filmed opening jam jars from the inside). Yet it can take octopuses a surprisingly long time to be trained in new behaviours, which some researchers have taken as a sign of their cognitive limitations. Much of the early work on octopus intelligence was done at the Naples Zoological Station. In 1959, Peter Dews, a Harvard scientist, trained three octopuses there to pull a lever to obtain a chunk of sardine. Two of the octopuses, Albert and Bertram, pulled the lever in a ‘reasonably consistent’ manner. But the third, Charles, would anchor his arms on the side of the tank and apply great force to the lever, eventually breaking it and bringing the experiment to a

premature end. Dews also reported that Charles repeatedly pulled a lamp into his tank, and that he 'had a high tendency to direct jets of water out of the tank; specifically … in the direction of the experimenter'. 'This behaviour,' Dews wrote, 'interfered materially with the smooth conduct of the experiments, and is … clearly incompatible with lever-pulling.' He concluded that his experiment was a partial failure. Godfrey-Smith says this 'encapsulates much of the story with octopus behaviour'. Octopuses have a high curiosity drive, and a knack for repurposing things around them for their own ends. Perhaps there are tasks that octopuses find it hard to learn. Or perhaps they just have better things to do.

Captive octopuses appear to be aware of their captivity; they adapt to it but also resist it. When they try to escape, which is often, they tend to wait for a moment they aren't being watched. Octopuses have flooded laboratories by deliberately plugging valves in their tanks with their arms. At the University of Otago, an octopus short-circuited the electricity supply – by shooting jets of water at the aquarium lightbulbs – so often that it had to be released back into the wild. Jean Boal, a cephalopod researcher at Millersville University in Pennsylvania, reported feeding octopuses in a row of tanks with thawed squid, not an octopus's favourite food. Returning to the first tank, Boal found that the octopus in it hadn't eaten the squid, but was instead holding it out in its arm; watching Boal, it slowly made its way across the tank and shoved the squid down the drain. (The third-century Roman rhetorician Claudius Aelianus, a more sympathetic observer than Aristotle, identified the octopus's main characteristic as 'mischief and craft'.)

What does it feel like to be an octopus? Does it feel like anything at all? Or are octopuses, as Godfrey-Smith puts it, 'just biochemical machines for which all is dark inside'? This form of question – 'what is it like to be a bat?' Thomas Nagel asked in a hugely influential paper in 1974 – is philosophical shorthand for asking whether a creature is conscious. Many philosophers think consciousness is an all or nothing phenomenon: you either have it or you don't. Humans have it, as do perhaps chimps and dolphins. Mice, ants and amoebas presumably do not. Part of the motivation for the all or nothing view is that it is difficult to imagine consciousness being possessed in degrees. Other cognitive attributes – like memory, linguistic capacity and problem-solving ability – are the sorts of thing that can and do vary in degree from creature to creature, and species to species. But it is harder to see how consciousness can vary in that way. As Godfrey-Smith puts it, 'how can an animal be halfway to having it feel like something to be that animal?' Yet, if consciousness is a natural thing, something that evolved over time, it seems unlikely that it just popped up at some point in evolutionary history, fully formed.

Godfrey-Smith starts with the conviction that consciousness is an evolved thing, and accepts the conclusion that it has more primitive precursors: that it comes in degrees after all. Consciousness – the possession of an 'inner' model of the 'outer' world, or the sense of having an integrated, subjective perspective on the world – is, on his view, just a highly evolved form of what he calls 'subjective experience'. Many animals, Godfrey-Smith thinks, have some degree of subjective experience, even if it falls short of full-blown consciousness. He points to what the physiologist Derek Denton called the 'primordial emotions': thirst, lack of air, physical pain. These sensations intrude on our more complex mental processes, refusing to be dismissed. They hark back to a more rudimentary form of experiencing the world – a form, Godfrey-Smith thinks, that does not require a sophisticated inner model of the world. 'Do you think,' he asks, that pain, thirst or shortness of breath 'only feel like something because of sophisticated cognitive processing in mammals that has arisen late in evolution? I doubt it.'

The case of animal pain underscores Godfrey-Smith's point. Simple animals respond to physical harm with what appears to be distress, and there is experimental evidence that suggests that they feel pain, that physical harm feels bad for them. Zebrafish, injected with what is assumed to be a painful chemical, will prefer an otherwise less desirable environment if a painkiller is dissolved in the water. Similarly, chickens with leg injuries will choose a feed they don't normally favour if it is laced with a painkiller. Insects do not appear to feel pain, carrying on as usual even after major injuries. But shrimp and crabs groom their injured parts, and do so less when they are given an anaesthetic. None of this is dispositive evidence that animals feel pain – but then it isn't clear what would be. As Godfrey-Smith puts it, 'you can still doubt that these animals feel anything, yes. But you can doubt that about your next-door neighbour.' If even simple animals have rudimentary forms of consciousness or subjective experience, what might that feel like? What does it feel like to be an injured crab? Here Godfrey-Smith reaches for a metaphor proposed by the evolutionary theorists Simona Ginsburg and Eva Jablonka: white noise. Primitive consciousness, he writes, might be like 'a crackle of metabolic electricity', an 'inchoate buzz' that grows, with evolutionary time, in complexity and clarity.

If consciousness comes in degrees, then where on the spectrum is the octopus? Octopuses almost certainly feel pain. They nurse and protect injured body parts, and don't like to be touched near wounds. (Until recently, researchers operated on octopuses without anaesthetic, and much early work on them involved electric shocks. A 2010 EU directive on animal testing classifies cephalopods together with

vertebrates because of their ‘ability to experience pain, suffering, distress and lasting harm’.) As well as feeling pain, octopuses have sophisticated sensory capacities: excellent eyesight, and acute senses of taste and smell. This, together with their large nervous systems and complex behaviour, makes it all but certain, in Godfrey-Smith’s view, that octopuses have rich subjective experience. But they may have even more than this. According to some theorists, notably Stanislas Dehaene, a particular kind of mental processing, the sort that involves completing novel tasks extended over time, not only goes hand in hand with human consciousness, but helps explain why humans are conscious. The octopus’s curiosity and adaptability to novel circumstances are, Godfrey-Smith suggests, ‘reminiscent’ of these paradigmatically human forms of cognition. If so, then being an octopus might be more like being a human than we have tended to think.

The question of what subjective experience might be like for an octopus is complicated by the odd relationship between its brain and its body. An octopus’s arms have more neurons than its brain, about ten thousand neurons per sucker; the arms can taste and smell, and exhibit short-term memory. Each arm acts with considerable independence from the brain; even a surgically detached arm can reach and grasp, avoid painful stimuli, and change colour. (In The Soul of an Octopus, Montgomery imagines an octopus testing human intelligence by seeing how many colour patterns our severed arms can produce in one second.) Yet an octopus’s brain can exert executive control, ‘pulling itself together’ when it needs to, for example when an octopus puts out only a single inquisitive arm to inspect a stranger.

Godfrey-Smith suggests that the octopus is, phenomenologically speaking, in a hybrid situation: its arms are partly self, and partly other. Because of this, the octopus is sometimes held up as a mascot for the ‘embodied cognition’ movement in psychology, according to which the physical body, by constraining and making possible certain actions, is itself ‘intelligent’. The human ability to walk, for example, is not simply a matter of top-down brain control, but also a function of the angles of our joints; in this sense, our bodies encode information vital for intelligent action. There can be little doubt that an octopus’s embodiment is radically different from our own, and that understanding an octopus’s mind requires us to grasp its particular form of embodiment. But thinking about the octopus in terms of embodied cognition may undersell its strangeness. While it makes sense to think of our own bodies in terms of the constraints and opportunities they afford, the octopus’s body, as Godfrey-Smith says, is ‘protean, all possibility’. Even asking how much the body contributes to intelligent action presupposes a division between brain and body that seems not to apply to the

octopus. The octopus's body is pervaded by nervousness: it is not a thing controlled by the animal's thinking part, but itself a thinking thing.

A further oddity in thinking about octopus experience has to do with the creature's relationship to colour. An octopus's skin is a layered screen of pixel-like sacs of colour called chromatophores, which make it possible for an octopus to change its colour at will to match its surroundings or threaten an aggressor. The so-called mimic octopus can impersonate more than 15 different animals, including flounder, lionfish and sea snakes, by changing its colour and shape. An octopus's colour also seems to indicate its mood – some octopuses turn white after being caressed for a long time by humans, as well as after mating. The chromatic displays produced by octopuses can include elaborate patterns of stripes and spots, flashing rings and waves of rippling colour. Yet octopuses – like most cephalopods – appear to be colour-blind. Their eyes lack the variety of photoreceptors required to see colour, and octopuses are unable to distinguish between differently coloured objects in experimental tests. Researchers have recently discovered that octopuses have photoreceptors not only in their eyes but also in their skin, which suggests that the skin can see (as well as taste and smell), either by sending the visual information it receives to the octopus's brain, or by processing the information itself. Both options are weird: either the skin as a whole becomes an eye, or the octopus's body sees independently of the octopus's brain. Even this isn't the whole story, since the photoreceptors found in an octopus's skin are, like those in its eyes, insufficient to detect colour. The best working hypothesis is that some complex interaction between the skin's photoreceptors and chromatophores allows the octopus to adopt colours it cannot see.

Octopuses use their colour displays mainly for camouflage and signalling. But sometimes they produce elaborate colour displays for no apparent reason, in the absence of predators or other octopuses. Godfrey-Smith calls such purposeless displays 'chromatic chatter', suggesting they may just be an involuntary, metabolic effect. Could they be more intentionally expressive? Do octopuses talk to themselves? The problem with this thought is that octopuses appear not to have any language at all, and so presumably can no more talk to themselves than to others. (Wittgenstein famously argued for the conceptual impossibility of a 'purely private language', meaningful only to one person. Whether or not a private language is conceptually possible, it is evolutionarily unlikely, since the ability to talk to oneself appears to be a later internalisation of the ability to talk to others.) The megapixel screen of the octopus's body means that theoretically it could telegraph information of almost infinite complexity – the sort of expressive bandwidth of which a chimp or baboon can only dream. Yet most of the chromatic

signals produced by an octopus appear not to have any consistent effect on other octopuses, suggesting that they are signs without meaning, words with no sense.

Most species of octopus live for only a year or two; the Giant Pacific, the species that lives longest, dies after four years at most. Both female and male octopuses mate only once, and enter a swift and sudden decline into senescence soon after, developing white lesions on their skin, losing interest in food, and becoming uncoordinated and confused. The females die from starvation while they tend their eggs, and the males are typically preyed on as they wander the ocean aimlessly. Most highly intelligent animals live significantly longer than octopuses, as do some other molluscs. Why is the octopus's life so short? Ageing in general is explained by evolutionary theorists in terms of what is known as the Medawar effect: natural selection tends to weed out mutations whose harmful effects appear early in an animal's life, but it is less likely to weed out mutations whose harmful effects manifest later on. This is because most animals succumb to death by predation, disease or accident before they reach the age where late-acting mutations could take effect. Late-acting mutations therefore accumulate in animal populations, eventually producing the appearance of a preprogrammed lifespan. In the octopus, the Medawar effect, coupled with an unusual body plan, has resulted in its uncommonly short lifespan. In its early evolutionary history, the octopus gave up its protective, molluscan shell in order to embrace a life of unboundaried potential. But the cost was an increased vulnerability to toothy and bony predators. An animal with a soft body and no shell cannot expect to live long, and so harmful mutations that take effect only once it has been alive for a couple of years will soon spread through the population. The result is a life that is experientially rich but conspicuously brief.

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Earlier this summer, on a drive from San Francisco to Los Angeles, I went to see the octopuses at Monterey Bay Aquarium. At the time Monterey's permanent octopus exhibit housed two Giant Pacifics, though there were more octopuses in its temporary show Tentacles, the largest ever exhibition of cephalopods. This was my second encounter with a live octopus. (I have had more encounters with dead octopuses at the dinner table than I care to recall. They make excellent carpaccio. Never again.) The first was off a beach in Mykonos, where I was snorkelling. There wasn't much on the sea floor, just small crustaceans and darting silver fish, until I saw a red mass a few feet away, about the size of a cat, watching me with a single eye. I stayed still, watching it back. The octopus made small, unhurried movements, curling and uncurling its arms, snuffling along the floor. Eventually it

crawled to a sunken rope some feet away and wrapped itself around it. Its body became a brown, barnacled coil, and then there was only a single white eye with a black dash of pupil. The eye closed, and the octopus vanished.

At Monterey the two Giant Pacifics were in adjacent tanks, each a few metres wide. The first octopus was energetic, unfurling its huge body and then compressing it, uncoiling its arms and pushing its suckers against the tank walls, boiling and jetting its way back and forth through the water. Tourists took flash photographs despite the sign warning that octopuses dislike bright lights. Children expressed admiration and disgust. When you're looking at an octopus, your attention is naturally drawn to its rows of suckers, coiling arms and bulging body. Its eyes look sleepy, half-closed. You have to know what you're looking for to see that they are open, and staring straight at you. I looked the octopus in the eyes and found it looking back at me, fixedly, as its body ballooned and hollowed behind it. The second octopus was quieter, bundled up at the top of her tank. A few thin strands of translucent, pearl-shaped eggs – laid and then painstakingly braided together with the thin tips of her arms – hung nearby, remnants of the clutch that had been removed by the aquarium keepers. Her skin was dull and white. She was dying.

The logic of aquariums, as with zoos, is the logic of conservation: individual animals must sacrifice their freedom so that the species as a whole can be protected. (As the philosopher Robert Nozick put it, 'utilitarianism for animals, Kantianism for humans.') The conservationist logic is at its most compelling at an aquarium like Monterey, with its state of the art research centre, environmental policy unit, and public education programmes. Plenty of its creatures seem delighted to be there, as far as one can tell, and others seem perfectly unaware of where they are. No doubt many of these animals live longer and healthier lives than they would in the ocean. Yet ethical questions remain, raised by creatures, like the octopus, which so clearly yearn for freedom. Perhaps from our perspective the life of a wild octopus is already a tragic thing: sociality without society, speaking without being heard, a life-world without longevity. An alien. If only the octopus were more like us, we might be better at leaving it alone.

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Letters
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‘Never again’, Amia Srinivasen promises, will she indulge in octopus carpaccio, or order any dish of octopus, after her fascinating investigation of these eight-armed ‘sophisticated problem-solvers’ whose complex behaviours have an eerie resemblance to our own, while they remain utterly unlike us (LRB, 7 September). ‘Octopuses,’ she says, ‘are the closest we can come, on earth, to knowing what it might be like to encounter intelligent aliens.’ Her description of the octopus extending an arm to a human, or leading it by the hand, has a touch of Spielberg’s ET. The octopus, like us, is keen on food, and when it reaches into submarine outcrops of rock to extricate a shrimp or a baby crab, it performs a gesture I see a lot at home, whenever my husband rummages with his fingers in a jar of pickles. The octopus, itself a soft-bodied mollusc, has a penchant for … molluscs. So I believe it’s okay – without wishing to egg her on – for Srinivasan to enjoy a plate of octopus now and then, on the grounds that like may as well eat like as unlike. Apparently there’s no stopping us.

Diogenes Laertius, in his life of Diogenes the Cynic (no relation), tells that the philosopher met his end in Corinth while distributing raw octopus to his dogs, one of whom bit him in the tendon. In Appetites for Thought: Philosophers and Food (2015), Michel Onfray gives another version, in which Diogenes fought over the octopus with the dog in question, won the day, ate the prize morsel and promptly died of indigestion. So perhaps we’re at physical as well as moral risk when we eat these complicated creatures.

The terrifying vastness of Erik Pontoppidan’s Kraken, of which Srinivasan writes, struck Kant very forcibly. In his writings on physical geography he calls the octopus ‘the world’s largest animal’. When it rises to the surface of the sea, ‘it is said to have great tines that protrude above it like trees’ and ‘innumerable fish are said to roll down off it.’ He adds judiciously: ‘Its shape is unknown’ – a remark designed to give us the impression that we know a lot more than he did.

Marisol Hutchison
Bruges

Amia Srinivasan’s tentacular essay on octopuses was a treat. She mentions the 2010 EU directive on animal testing, which classified cephalopods with vertebrates, because of their ‘ability to experience pain’. That was 17 years after the UK recognised the sentience of these remarkable animals: in 1993, the then home secretary, Michael Howard, gave the common octopus, Octopus vulgaris, the status of a ‘protected animal’.

Gavin Francis
Edinburgh

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Amia Srinivasan writes about laboratory studies of octopuses' behaviour (LRB, 7 September). You can learn just as much watching animals at work in their own homes. Last summer we had an orbweb spider roost in our garden trellis. From there she threw a silk thread to the lemon tree, a distance of some 1.2 metres. She then spun a web down at the trellis end, but over time moved it across to the lemon. This seemed sensible: there was more insect traffic around the tree. Her web would be destroyed every two or three days, and she would patiently remake it during the night. Sitting near the top of the trellis with her backside pointing at the lemon, she would wait for the breeze to dissipate, then jet out another thread. Once she miscued, hitting the bottlebrush next door, 1.35 metres away, but she spun a new web along this line anyway. A bottlebrush isn't as stable an anchor as a lemon, however, so she relocated the web to the trellis end where she didn't wave around so much. When this web was destroyed, she moved back to the lemon. Here's the surprise. Two weeks later she hit the bottlebrush again, but this time she ignored that line and continued to shoot threads at the lemon until one caught. This tiny creature toils in near blackout conditions, and we aren't anywhere close to understanding what is going on in her mind – for this is surely mindful behaviour.

Derek Schulz
Raumati Beach, New Zealand