

TheObserver

# *Pleasure*

WHAT IT IS AND HOW TO FIND IT



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# WHAT'S JOY GOT TO DO WITH IT?

Scientists have pinpointed the 'hedonic hotspot' in our brains, and are now analysing pleasure in evolutionary terms. But can such intense experiences be reduced to a series of mechanical reactions?

**M**ichel Cabanac has done some strange things in pursuit of pleasure. He has chilled lizards and computer-game players, not necessarily simultaneously. He has caressed frogs and toads and birds and small furry mammals. He has inflicted pain on students (and paid them for it), provoked them into aggression and administered grammar and maths tests.

It's not that he has a particularly sick sense of fun. This physiologist from the University of Laval in Québec, Canada, is trying to prove that pleasure is not just for kicks. Indeed pleasure, like its scientific study, can be a very serious business.

It may seem obvious that we'd rather do things that bring us joy while avoiding things that displease us. But pleasure has a far more fundamental role than that, says Cabanac. Yes, it will encourage us to seek food, water, warmth, rest and sex – the fundamental drives of life. But pleasure is also how we make every decision – even the ones we believe we think about.

There's a very linear relationship between the amount of discomfort people will endure, and the pleasure sought in return, he finds. Cabanac's experiments show that hunger and the nutritional value of food are traded against

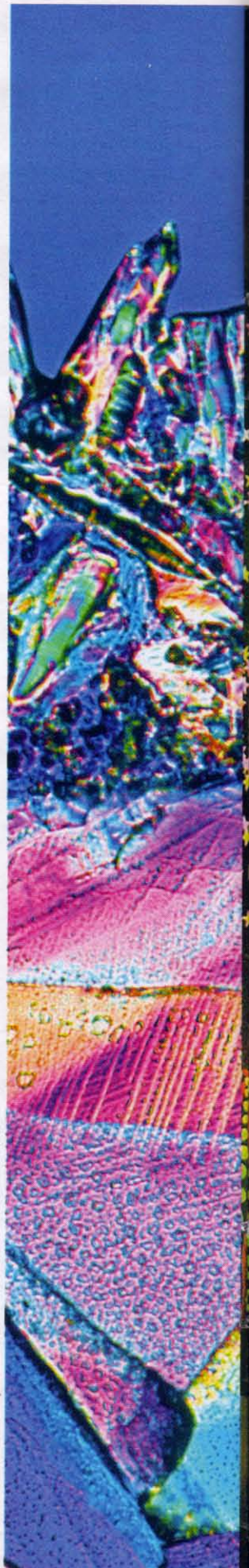
the amount of cold we will withstand to get it, for example. We continually weigh up our needs and choices by comparing them all on one scale – pleasure. 'Pleasure is like a common currency in the brain,' says Cabanac. 'We need some sort of common scale on which to control our conflicting needs and motivations.'

Surprisingly, the relationship holds for more cerebral pursuits too – not just the most basic animal drives. For instance, he finds that his student volunteers will withstand greater and greater pain for larger and larger financial gain.

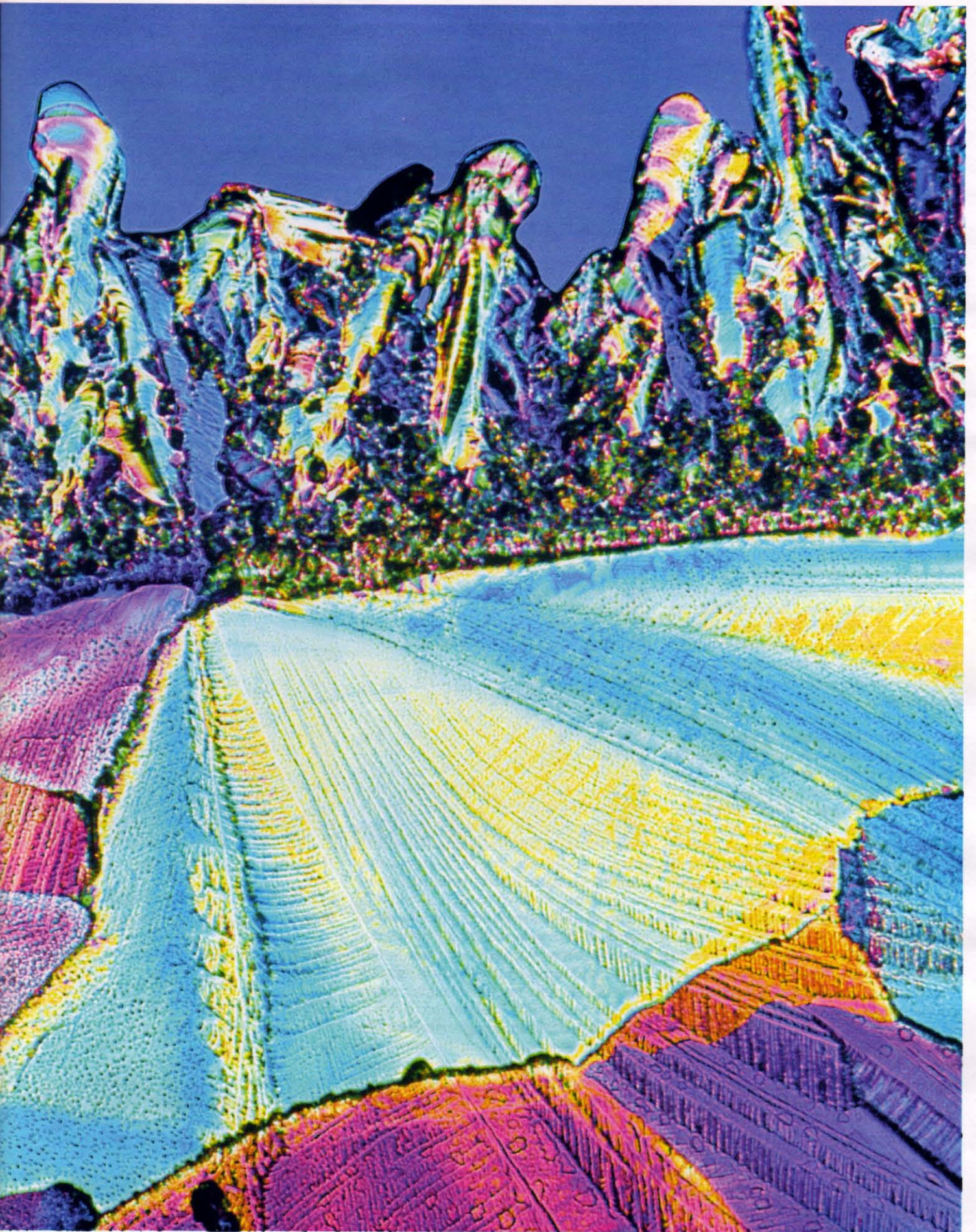
George Stefano, director of the Neuroscience Research Institute at the State University of New York (SUNY) is a pleasure-seeker too. He agrees that emotions play a vital role in our decisions. 'It cuts down on being rational,' he says. Pleasure is a short-cut. It's the reason they'll sell a car by picturing a busty model next to it. As human beings we think we are rational, but we actually do a lot because of gut feelings or emotions.'

And it's not just humans that act on pleasure. Cabanac's experiments have also convinced him that hedonism exists well down the phylogenetic tree. While other animals may not feel pleasure in the same way we do, their behavioural choices are still guided by the same pleasure trade-offs. Even lizards, he finds, seem to make decisions based on levels

**A polarised light micrograph of crystals of beta-endorphin: one of the chemicals produced by the brain thought to determine pain and pleasure**



Alfred Pasieka/Science Photo Library



of discomfort and palatability. 'This means they must experience palatability, which is a form of pleasure,' he says.

But while lizards 'know' about palatability, frogs and toads never quite get it. If food is predictably unpalatable – if, say a certain flavour always causes sickness – they never learn to avoid it. They don't experience sensory pleasure, he says. 'Frogs and toads are robots, whereas reptiles have a mind.' These experiences, which evolved long before humans ever began seeking fun, could be the earliest stages in the evolution of our emotions and sensations – the origin or foundations of our very consciousness.

While some researchers continue to ponder these more philosophical questions of utility and the origins of sensory experience, others are concentrating on the nuts and bolts. What exactly is pleasure, and where in the brain is it based?

It's a question that psychologists thought they had cracked almost half a century ago. In some now classic experiments from the 1950s and 1960s, behavioural psychologists began training rats and pigeons to press levers and all manner of other tricks for food rewards. They became curious about the nature of reward, and began to track down the brain circuits that controlled the animals' motivations.

The key finding came when psychologists James Olds and Peter Milner, working at McGill University in Canada, discovered that rodents would repeatedly press levers or return to a particular spot in their cages, not only for food but for tiny jolts of current injected through electrodes implanted deep within their brains. Rats would do whatever it took to get these shocks up to 2,000 times an hour, at the expense of eating or drinking, ignoring everything around them. The work led to the idea that there was some kind of reward centre in the brain, and that pleasure was the way humans experienced such a reward.

The brain circuits that seem to produce this reward overlap with many of the anatomical regions that go awry in Parkinson's disease – providing a further clue to the nature of reward. In these regions, signals are passed from nerve cell to nerve cell by the chemical dopamine. The Parkinson's drug L-dopa compensates for its loss. Dopamine became dubbed the reward or pleasure chemical. It's a notion that has been reinforced by addiction researchers, who have found that every drug of abuse imaginable stimulates dopamine release in this part of the brain, as do other enjoyable pursuits from eating chocolate, to music, to having sex.

Psychiatrists in the 1960s tried to take advantage of the finding and, in some ethically questionable experiments, began implanting electrodes into the equivalent brain circuits in human patients with conditions such as depression, schizophrenia and – even more controversially – into the brains of gay men. A dose of pleasure, they argued, should overcome or distract people from these 'unwanted' sensations. There were, not surprisingly, no magical cures, and the work was soon halted.

**But a quarter-century on, the findings were** rediscovered by University of Michigan researcher Kent Berridge, currently on sabbatical at the University of Cambridge. He'd been working on the reward system in rodents, particularly their responses to nice and nasty food. He soon learned to spot when a rat was in the throes of pleasure, by watching its facial expression. Sugary food makes them lick their lips contentedly, whereas bitter tastes led to lip-curling expressions of ratty disgust.

He tried different ways of altering their dopamine levels – expecting that this would change the amount of lip licking or curling, but was surprised to see the rats' expressions unchanged. 'It looked like their reaction to pleasure was normal, even when their dopamine was gone,' he says.

When he began reading documents about the old psychiatric experiments, he was struck by the descriptions the patients gave of their electrical stimulation. They claimed it made them alert and aroused, and made them want to drink, eat or masturbate. They reported that they wanted to keep on feeling the sensation, and abused the controls if given the chance, just as Olds and Milner's rats had done. But it struck Berridge that none of the descriptions sounded like satisfaction – more like desire than pleasure or joy.

Berridge has subsequently found a second brain circuit, overlapping the dopamine pathways, but fuelled by opioids – our own natural morphine-like compounds. By probing a little more closely with electrodes and tampering with opioid chemistry, he has shown that there are probably distinct pathways in the brain: the dopamine system, encoding desire, or wanting, and the opioid pathways, producing pleasure or liking.

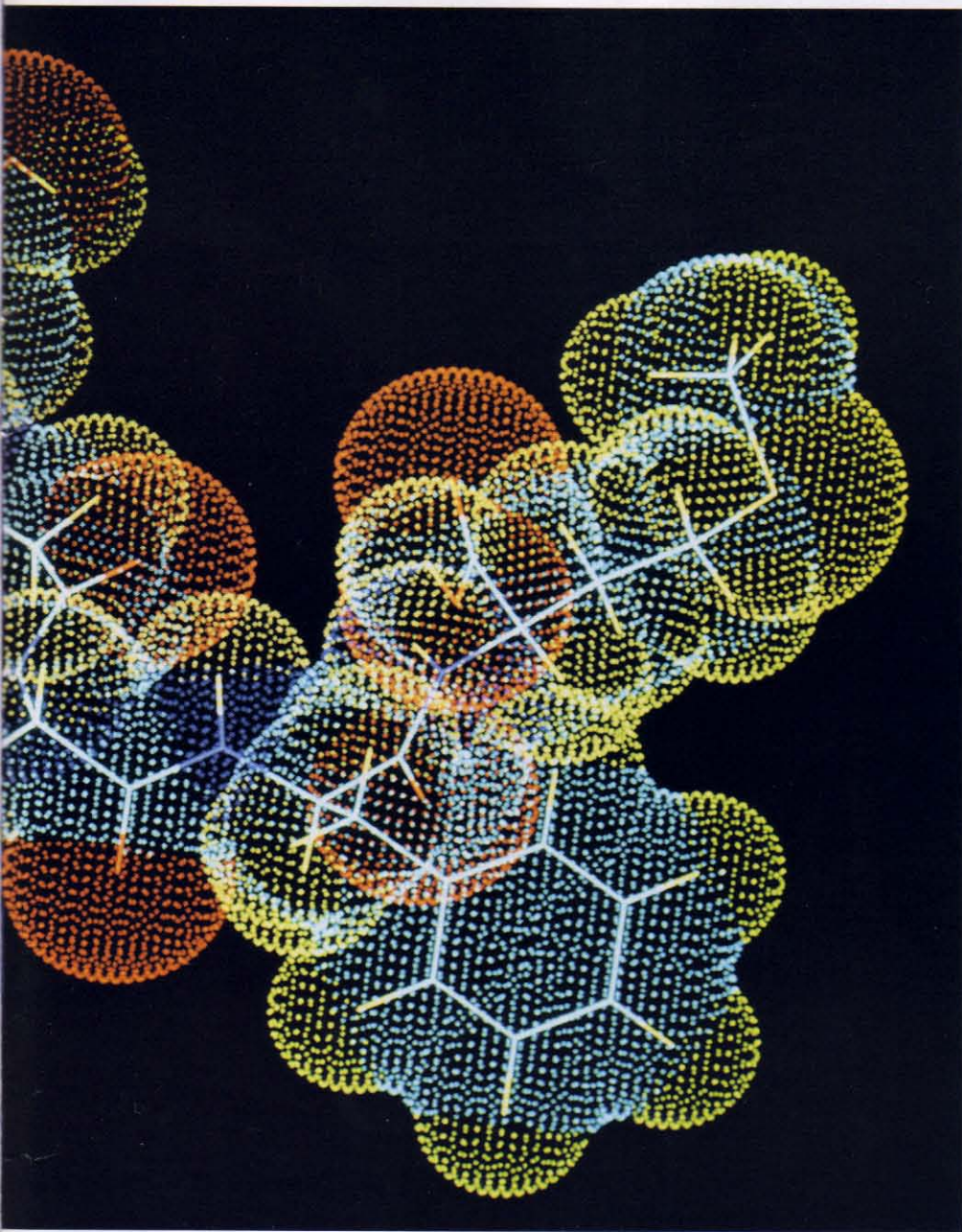
Our search for kicks seems to have at least two elements – wanting and liking, and possibly more chemicals tuning them – which goes some way to explaining why we can desire things we don't actually find pleasurable. There may turn out to be more subtleties, as cannabis-like compounds also seem to be released during pleasure, as does serotonin,



A molecule of enkephalin - a type of endorphin

If a certain food always causes sickness, frogs never learn to avoid it. They don't experience sensory pleasure, whereas reptiles have a mind





perhaps signalling satisfaction.

Just in the past few months Berridge has narrowed down the source of the liking or pleasure signal in the rat brain to a tiny cube of tissue just a millimeter in each dimension, lying in a region called the nucleus accumbens. He calls it the hedonic hotspot. It'll be bigger in humans, he speculates, maybe a centimetre. But a hotspot all the same, of pure sensory pleasure. 'It's very small, but not entirely alone,' says Berridge. 'It's part of a circuit, a little spider web of pleasure.' So if Cabanac is right, all our choices and decisions, and our entire enjoyment of the pleasures of life hail from this tiny web. It's a conclusion far less romantic than centuries of artists and poets would have us believe about the true source of human joy.

However, rats cannot tell us everything about human pleasure, reminds Morten Kringlebach, a neuroscientist from the University of Oxford.

If these wanting and liking circuits are the heart of pleasure, the sensation also has a head. And that, says Kringlebach, seems to reside, in evolutionary terms, in a more recently developed brain region. Itself quite a bit bigger than an entire rat brain, and lying right behind our eyes, it is known to neuroscientists as the orbitofrontal cortex, or OFC.

Kringlebach suggests that pleasure is more complex than the neat division between a wanting circuit and a liking circuit. Dopamine is more a signal to attention, he says. The key to putting a pleasurable tinge on things comes in this OFC.

This brain region has connections to both the opioid and dopamine circuits he says. And it seems to collect all of the sensory information we sample from the outside world. Using sensitive brain-imaging methods, Kringlebach and his colleagues have found regions of the OFC, the activity levels of which correlate per-

fectly with subjective reports of pleasure. These levels can change with time and situation – for example chocolate may be extremely pleasurable at the first bite, but after overeating, it may lose its glow or even become nauseating. These regions seem to be the key to those changing sensations, he suggests.

**The OFC is also more able to deal with the complexities of what we humans enjoy –** allowing us to deal with delayed gratification, for example, or learning that more abstract things like money can bring us pleasurable things indirectly, thus becoming pleasurable in itself. It may allow us to find pleasure in more aesthetic stimuli too, by linking images with more basic drives like attraction, or music to the sounds of bonding with a child.

There's still a huge amount to learn about pleasure, says Kringlebach, such as why play is so pleasurable, despite there being no external reward, and how pain seems to be enjoyable in some cases, such as when people dabble with S&M. 'We still know very little,' he says. 'Understanding pleasure is essential to understanding human nature.'

SUNY's Stefano agrees, but for an entirely different reason. His latest work shows just how good for us fun can be. Just this December he and his colleagues published a study showing for the first time that healthy human tissue produces morphine. It's released in the reward and emotional regions of the brain, he says. 'There is a system that literally makes us feel good,' he says.

In our busy stressful lives, we need this pleasure, he says. Seeking pleasure breaks the cycle of stress. Stress can be good when we need a sudden burst of energy, but not for the long term. For our health, we need things that shut stress off – a pleasure activity, a hobby, falling in love, he says. And not only does pleasure counteract stress, but it also causes cells to release another chemical, enkephalin, which is a natural antibiotic. 'There's a direct link between reward and protection,' he says.

That's certainly good news. But are the scientists actually able to teach us anything about making life more pleasurable? It doesn't look like good news. Pleasure, because of its job in making us seek something we need, can only ever be a fleeting sensation, they say. Pleasure only comes when we need something, says Cabanac. When there is no danger and we need nothing, there can be no pleasure, but there is contentment and indifference. 'Happiness is indifference,' he says. Stefano agrees. 'Pleasure is shortlived,' he concludes. 'It can only ever be so.' **P**

Helen Phillips writes for *New Scientist* magazine