Why Don't Penguins' Feet Freeze?

And 114 Other Questions

Edited by Mick O' Hare

Published by Profile Books

Extract

Introduction

This book's predecessor, *Does Anything Eat Wasps?*, was the surprise publishing phenomenon of the 2005 Christmas season. The quirky collection of science questions and answers from *New Scientist*'s Last Word column took the bestseller lists by storm, leaving those associated with the column's 13-year history a little shell-shocked and breathless. This sense of surprise was reinforced by the fact that *Does Anything Eat Wasps?* was actually the third collection of Last Word questions and answers in book form. The first two had modestly paid their way without ever troubling the bestseller charts. Which, on reflection, seems a pity, for those first two volumes contain some of the questions that have come to define exactly what The Last Word represents: the pursuit of the offbeat and the trivial. Why is snot green? Why does grilled cheese go stringy? Why does silver foil make tooth fillings painful? And, of course, why don't penguins' feet freeze?

Perhaps more importantly, those first two books also contain answers to questions that are asked every week by readers who newly discover The Last Word. It seems everybody wants to know why hair turns grey or the sky is blue. And you can find the answers on pages 3 and 153.

Interestingly, the most popular question when the first two Last Word books were translated into German was 'Why don't sleeping birds fall out of trees?' This led to the longest title of any *New Scientist* book published anywhere in the world – *Warum fallen schlafende Vögel nicht vom Baum?* And although the title *Why Don't Penguins' Feet Freeze?* does not match this for length, this book is by far the thickest and best-value collection of Last Word questions yet published. Since we feel the first two books deserved a wider audience, we've combined the best questions and answers from those volumes with some wholly new material from the weekly magazine column to create this bumper edition. Added together, we hope they will keep you entertained for weeks to come.

Does Anything Eat Wasps? generated a vast amount of media coverage, during which I was constantly asked why my book had sold so well. The truth was, of course, that it wasn't my book at all; it belonged to the readers of *New Scientist*. Remember, everything you see here is provided by contributors to The Last Word, both in the weekly print edition of *New Scientist* and online. Thousands of questions are posed every year and just as many answers are received. So if you have something to ask *New Scientist*'s readers visit www.newscientist.com/lastword or buy the weekly magazine. Even better, if your friends routinely describe you as a complete know-all – or, like me, the pub bore – you are just the kind of person we are looking for. The Last Word is your natural home, so why not help us answer our endless supply of questions? Without readers' input The Last Word would not survive and, as you'll read here, none of us would know how to toughen up our conkers.

Enjoy this fascinating compilation and keep those questions flooding in.

Mick O'Hare

Again, special thanks are due to Jeremy Webb, Lucy Middleton, Alun Anderson, the production and subbing teams of *New Scientist* and the people at Profile Books for making this book far better than it might have been.

1 Our bodies

Grey matters

Why does hair turn grey?

Keren Bagon
Radlett, Hertfordshire, UK

Grey (or white) is merely the base 'colour' of hair. Pigment cells located at the base of each hair follicle produce the natural dominant colour of our youth. However, as a person grows older and reaches middle age, more and more of these pigment cells die and colour is lost from individual hairs. The result is that a person's hair gradually begins to show more and more grey.

The whole process may take between 10 and 20 years – rarely does a person's entire collection of individual hairs (which, depending on hair loss, can number in the hundreds of thousands) go grey overnight. Interestingly, the colour-enhancing cells often speed up pigment production as we age, so hair sometimes darkens temporarily before the pigment cells die.

Bob Barnhurst
Pointe-Claire, Quebec, Canada

Light sneeze

I have noticed that many people tend to sneeze when they go from dark conditions into very bright light. What is the reason for this?

D. Boothroyd
Harpenden, Hertfordshire, UK

Photons get up your nose!

Steve Joseph
Sussex, UK

I think that the answer may be fairly simple: when the sun hits a given area, particularly one shielded or enclosed in glass, there is a marked rise in local temperature. This results in warming of the air and a subsequent upward movement of the air and, with it, many millions of particles of dust and hair fibres. These particles quite literally get up one's nose within seconds of being elevated, hence the sneezing.

Alan Beswick
Birkenhead, Merseyside, UK

My mother, one of my sisters and I all experience this. I feel the behaviour is genetic and confers an unrecognised evolutionary advantage. I have questioned many people, and we sun-sneezers seem to be in the minority. However, as the ozone thins and more ultraviolet light penetrates the Earth's atmosphere, it will become increasingly dangerous to allow direct sunlight into the eye. Those of us with the sun-sneeze gene will not be exposed to this, as our eyes automatically close as we sneeze! The rest of the population will gradually go blind, something not usually favoured by natural selection.

Alex Hallatt
Newbury, Berkshire, UK

The tendency to sneeze on exposure to bright light is termed the 'photic sneeze'. It is a genetic character transmitted from one generation to the next and which affects between 18 and 35 per cent of the population. The sneeze occurs because the protective reflexes of the eyes (in this case on encountering bright light) and nose are closely linked. Likewise, when we sneeze our eyes close and also water. The photic sneeze is well known as a hazard to pilots of combat planes, especially when they turn towards the sun or are exposed to flares from anti-aircraft fire at night.

R. Eccles
Common Cold and Nasal Research Centre
Cardiff, UK

Here are some early thoughts on the subject of light sneezing from Francis Bacon's *Sylva Sylvarum* (London: John Haviland for William Lee, 1635, page 170): 'Looking against the Sunne, doth induce Sneezing. The Cause is, not the Heating of the Nosthrils; For then the Holding up of the Nostrills against the Sunne, though one Winke, would doe it; But the Drawing downe of the Moisture of the Braine. For it will make the Eyes run with Water; And the Drawing of Moisture to the Eyes, doth draw it to the Nosthrills, by Motion of Consent; And so followeth Sneezing; As contrariwise, the Tickling of the Nosthrills within, doth draw the Moisture to the Nosthrills, and to the Eyes by Consent; For they also will Water. But yet, it hath been observed, that if one be about to Sneeze, the Rubbing of the Eyes, till they run with Water, will prevent it. Whereof the Cause is, for that the Humour, which was descending to the Nosthrills, is diverted to the Eyes.'

C. W. Hart
Smithsonian Institution
Washington DC, US

Comes in handy

Why do we have fingerprints? What beneficial purpose could they have evolved to serve?

Mary Newsham
London, UK

Fingerprints help us in gripping and handling objects in a variety of conditions. They work on the same principle as the tyres of a car. While smooth surfaces are fine for gripping in a dry environment, they are useless in a wet one. So we have evolved a system of troughs and ridges, to help channel the water away from the fingertips, leaving a dry surface which allows a better grip. The unique pattern is merely a useful phenomenon that is used by the police to identify individuals.

James Curtis
Bradford, West Yorkshire, UK

Fingerprints are the visible parts of rete ridges, where the epidermis of the skin dips down into the dermis, forming an interlocking structure (similar to interlaced fingers). These protect against shearing (sideways) stress, which would otherwise separate the two layers of skin and allow fluid to accumulate in the space (a blister). They appear on skin surfaces which are subject to constant shearing stress, such as fingers, palms, toes and heels. The unique patterns are simply due to the semi-random way in which the ridges and the structures in the dermis grow.

Keith Lawrence
Staines, Middlesex, UK

Crinkle tips

Why does skin – especially of the fingers and toes – become wrinkled after prolonged immersion in water?

Lloyd Unverfirth
Wahroonga, New South Wales, Australia

The tips of fingers and toes are covered by a tough, thick layer of skin which, when soaked for a prolonged period, absorbs water and expands. However, there is no room for this expansion on fingers and toes, so the skin buckles.

Steven Frith
Rushden, Northamptonshire, UK

Your whole body does not become crinkled as the skin has a layer of waterproof keratin on the surface, preventing both water loss and uptake. On the hands and feet, especially at the toes and fingers, this layer of keratin is continually worn away by friction. Water can then penetrate these cells by osmosis and cause them to become turgid.

Robert Harrison
Leeds, West Yorkshire, UK

Take the pils

Why is it that when I walk home from the pub after a few beers, I always stumble to the left more than to the right?

Chris Wood
Liverpool, UK

A similar situation arises when people wander in the forest or desert. Although they may intend to walk in a straight line, if they are lost and have no landmarks to guide them, most people will unconsciously walk slightly towards the left, making a big anticlockwise circle which brings them back to their starting point.

The reason for this is that most people have a slightly stronger and more flexible right leg. This is common knowledge among sports scientists, and most people who have undergone strength tests in their legs can confirm it.

Most people also find they can lift their right leg slightly higher than their left. The right leg has a longer stride than the left one and so when there are no guiding landmarks a circular walking route is the result.

Also, the slightly greater strength of the right leg means that when you push on the ground with your right foot, the push to the left is slightly greater than the push to the right produced by the left foot. The longer stride and greater push combine to cause most people to move in an anticlockwise manner in the course of a long walk.

Han Ying Loke
Edinburgh, UK

The human body is never perfectly symmetrical. In this case, the right leg seems to be longer than the left. A beer mat placed in the left shoe underneath the foot should remedy the problem quite easily.

J. Jamieson
Marlow, Buckinghamshire, UK

Everyone has a dominant eye which they rely on more than the other, weaker eye. Instinctively, we try to walk where we can see best (although we normally correct this to allow us to walk forwards). So when we stumble, it is more likely that we will stumble in the direction of our dominant eye.

This is because the brain, in trying to recover the situation, has to react fast and gives more weight to the information coming from the dominant eye to work out where to put the feet in order to regain balance. Hence the feet tend to be aimed at a position towards the side of your body on which the dominant eye lies, resulting in a stumble in that direction. In this case the questioner's dominant eye is obviously his left.

This phenomenon can be used to steer riding animals – simply cover up one of their eyes and they will tend to move in the direction of their remaining eye.

Adrian Baugh
Shrewsbury, Shropshire, UK

The questioner obviously walks to the pub with his change in his right pocket and his keys in his left. After spending all his money on beer the weight of his keys pulls him to the left as he walks home.

Simon Thorn
Perth, Tayside, UK

Members of the Department of Physics at Auckland University have held consultations regarding this issue and our most popular theory derives from an application of the simple principles of gravity gathered from our common experience in returning from pubs in Auckland.

Currency in denominations lower than NZ$10 is mostly in coins, some of them quite large in size. During an evening in the pub, the drinker accumulates a large number of such coins in his or her pocket. Assuming that English coinage is similar and that your questioner habitually carries his coins in his left pocket, elementary laws of gravity dictate that his gait will incline to the left. It is not uncommon for some New Zealanders in similar circumstances to actually walk in a circle.

Nelson Christenson
University of Auckland, New Zealand

After standing for endless hours in a pub with your beer glass in your right hand, it is inevitable that you are still subconsciously counterbalancing the glass's weight, and thus stumbling more to the left. The opposite can be demonstrated in left-handed beer drinkers.
By email, no name or address supplied

? By the left

Why is it that when two people walk together they often subconsciously start to walk in a synchronised manner. Is this some natural instinct?

Simon Apperley
Cheltenham, Gloucestershire, UK

The zoologist and specialist in human behaviour, Desmond Morris, says that the reason that people start to walk like each other is that they have a subconscious need to show their companion that they agree with them and so fit in with them. This is also a signal to other people that 'we are together, we are synchronised'.

Other studies suggest that we adopt the mannerisms of our companions as well, especially our superiors, such as crossing our legs in the same directions as others. An example often given is when, in a meeting, the boss scratches his nose and others at the table then follow him without realising it.

Adithi
Hong Kong

While it is purely unsubstantiated opinion, I do have an answer to why people tend to synchronise their steps. Observing a group of children walking in a park recently, supervised by two adults, I noted that the adults synchronised their steps and direction, while the children walked, ran and skipped apparently at random, running ahead, lagging behind, and deviating from the common course.

Perhaps these children, unpolluted by society's emphasis on conformity, have not yet learned that it is unacceptable to march to your own drum.

Todd Collins
Wagga Wagga, New South Wales, Australia

The next time you walk alongside somebody, walk out of step. Then try to follow the conversation you are having. You will soon fall back into step, because once you are in step with the other person, it is easier to watch where you are walking and then turn to look at them.

Communication is easier with another person when you are in close proximity and when both faces are relatively stable and not bobbing all over the place.

Hamish
By email, no address supplied

Here is a more prosaic (less sociologically inclined) explanation. When people walk they have a slight side-to-side sway. Two people walking together and out of step would bump shoulders every second step.

Peter Verstappen
Kaleen, ACT, Australia

Helpless laughter

Why is it that if you tickle yourself it doesn't tickle, but if someone else tickles you, you cannot stand it?

Daniel (aged 7) and Nicolas (aged 9) Takken
Wageningen, The Netherlands

If someone was tickling you and you managed to remain relaxed, it would not affect you at all. Of course, it would be difficult to stay relaxed, because tickling causes tension for most of us, such as feelings of unease due to physical contact, the lack of control and the fear of whether it will tickle or hurt. However, some people are not ticklish – those who for some reason do not get tense.

When you try to tickle yourself you are in complete control of the situation. There is no need to get tense and therefore, no reaction. You will notice the same effect if you close your eyes, breathe calmly and manage to relax the next time someone tickles you.

The laughter is the result of the mild state of panic you are in. This may be inconsistent with 'survival of the fittest' theories, because panic makes you more vulnerable. But as in many cases, nature is not necessarily logical.

Sigurd Hermansson
Stockholm, Sweden

Live wire

Where does the force come from when you are thrown horizontally across a room after touching a live electrical connection? I thought there was a reaction to every action, but there is no obvious push from the electricity.

John Davies
Ahmadi, Kuwait

The force comes from your own muscles. When a large electrical current runs through your body, your muscles are stimulated to contract powerfully – often much harder than they can be made to contract voluntarily.

Normally the body sets limits on the proportion of muscle fibres that can voluntarily contract at once. Extreme stress can cause the body to raise these limits, allowing greater exertion at the cost of possible injury. This is the basis of the 'hysterical strength' effect that notoriously allows mothers to lift cars if their child is trapped underneath, or allows psychotics the strength to overcome several nursing attendants.

When muscles are stimulated by an electric current, these built-in limits don't apply, so the contractions can be violent. The electric current typically flows into one arm, through the abdomen, and out of one or both legs, which can cause most of the muscles in the body to contract at once. The results are unpredictable, but given the strength of the leg and back muscles, can often send the victim flying across the room with no voluntary action on their part. Combined with the unexpected shock of an electrocution this feels as if you are being flung, rather than flinging yourself.

The distance people can involuntarily fling themselves can be astonishing. In one case a woman in a wet car park was hit by lightning. When she recovered she found herself some 12 metres from where she was struck. However, in this case there may also have been some physical force involved from a steam explosion, as water on her and the area in which she was standing was flash-boiled by the lightning. She survived, though she was partially disabled by nerve damage and other injuries.

A common side effect of being thrown across the room by an electric shock, apart from bruising and other injuries, is muscle sprain caused by the extreme muscle contractions. This can also damage joint and connective tissue. Physiotherapists, chiropractors and osteopaths might consider asking new patients if they have ever been electrocuted.

Being thrown across the room can save your life by breaking the electrical contact. In other cases, particularly where the source of the current is something they are holding, the victim's arms and hand muscles may lock on to it. They are unable to let go and, if nothing else intervenes, they may die through heart fibrillation or electrocution.

I recall what may be an apocryphal account of a poorly earthed metal microphone causing a rock singer to be involuntarily locked on to it. Unfortunately, writhing on floor while screaming incoherently was not entirely unusual during his shows, and it was a while before one of his road crew figured out that something was amiss and killed the power.

Roger Dearnaley
Abingdon, Oxfordshire, UK

It is interesting to consider why the subject is thrown across the room rather than freezing in a tetanic posture. It is because some muscle groups dominate others. Compare this with the muscle effects seen in a stroke victim, where, if the stroke is severe enough so that no cerebral control is present over one side of the body, the arm is held flexed (that is wrist bent with fingers pointing to the wrist, elbow bent so that the forearm meets the upper arm) and the leg extended (knee straight, ankle extended so that the toes point to the ground).

This is because without cerebral control, the spinal cord reflexes cause all muscle groups to be active, including both components of any bending and straightening muscle pairs. The dominance of one muscle group over another produces the effect described.

Therefore, if any electrical charge triggers all muscle groups the imbalance in 'bending and straightening' muscle pairs produces the force that is required to throw the person across the room.

It's not at all recommended, but I have heard that if you touch a conductor carrying a current using the back of your hand it is safer than the palm because the resultant muscle spasm does not force you to grip the conductor, producing a continuing electrocution.

There is always the effect on the heart to consider too, but that is another matter.

John Parry
Cowling, North Yorkshire, UK

Left in doubt

As a left-handed person I was both amused and annoyed by an article in New Scientist *which suggested that left-handed people are at greater risk of accidental death. How can this be? Surely a right-handed person has just as much chance of dying accidentally as I do. Or is there some unknown factor involved?*

Alan Parker
London, UK

Approaching obstacles, right-handed people will, in general, circumvent them by going to the right, while left-handed people will go to the left. If two same-handed people approach an obstacle from the opposite direction they will walk safely around it without bumping into one another en route. If two people of different handedness approach an obstacle from the opposite direction, they will pass on the same side leading, potentially, to a bump. Because most people are right-handed, it is left-handed people that most frequently find themselves bumped in these situations. This is a simple example, but taken to extreme and multiplied by a lifetime of bumps, the result is a shorter life expectancy for left-handed people.

Hannah Ben-Zvi
New York, US

We left-handers are at greater risk of accidental death because industrial tools and machinery are designed for the right-handed. Left-handers are, therefore, more likely to chop off parts of themselves in all manner of mechanical devices. An interesting example is the SA-80 assault rifle. When fired from the left shoulder, it ejects spent cartridges, at great velocity, into the user's right eye.

Daniel Bristow
Kew, Surrey, UK

No flakes

How does antidandruff shampoo work?

Eugene
By email, no address supplied

Dandruff is thought to be caused by overgrowth of yeasts such as *Pityrosporum ovale* which live on normal skin. This overgrowth causes local irritation resulting in hyperproliferation of the cells (keratinocytes) which form the outer layer of the skin. These form scales which accumulate and are shed as dandruff flakes.

Antidandruff shampoos work by three mechanisms. Ingredients such as coal tar are antikeratostatic and they inhibit keratinocyte cell division. Detergents in the shampoo are keratolytic – they break up accumulation of scale. Finally, antifungal agents such as ketoconazole inhibit growth of the yeast itself. Other components such as selenium sulphide also inhibit yeast growth and therefore scaling.

Roddie McKenzie
University of Edinburgh, UK

Gas gassing

Why does speaking through helium raise the frequency of the sounds emitted, even when the final transmission to the hearer is through air?

David Bolton
Mosgiel, New Zealand

Sound travels faster in helium than in air because helium atoms (atomic mass 4) are lighter than nitrogen and oxygen molecules (molecular mass 14 and 16 respectively). In the voice, as in all wind instruments, the sound is produced as a standing wave in a column of gas, normally air. A sound wave's frequency multiplied by its wavelength is equal to the speed of sound. The wavelength is fixed by the shape of the mouth, nose and throat so, if the speed of sound increases, the frequency must do the same. Once sound leaves the mouth its frequency is fixed, so the sound arrives to you at the same pitch as it left the speaker. Imagine a rollercoaster ride. The car speeds up and slows down as it goes around the track, but all cars follow exactly the same pattern. If one sets out every 30 seconds, they will reach the end at the same rate, whatever happens in between.

In stringed instruments, the pitch depends on the length, thickness and tension of the string, so the instrument is unaffected by the composition of the air. Releasing helium in the middle of an orchestra would therefore create havoc. The wind and brass would rise in pitch, while the pitch of the strings and percussion would remain more or less the same. In the *Song of the White Horse* by David Bedford, the lead soprano is required to breathe in helium to reach the extremely high top note.

Eoin McAuley
Dublin, Ireland

Brain waves

Why are there fissures or folds in the surface of the brain?

Brian Lassen
Canberra, Australia

The brain has fissures to increase the surface area for the cortex. Dimmer animals such as rats have smooth brains.
Much of the work carried out in the brain is performed by the top few layers of cells – a lot of the brain's volume is, in effect, point-to-point wiring.

So, if you need to do lots of processing, it is much more efficient to grow fissures than it is to expand the surface area of the brain by increasing the skull diameter.

Anthony Staines
By email, no address supplied

Evidently they are there to maximise the surface area of the brain cortex. The real question is why this is necessary.
The answer probably lies in the relative number of short-range and long-range connections needed.

If many short-range connections are required, it makes more sense to pack the processing units into thin, almost two-dimensional, plates and reserve a third dimension for long-range connections.

If the neurons were distributed homogeneously over the whole volume of the brain, long-range connections would possibly be shorter, but they would take up the space between the computational units of the brain and thus lengthen the short-range connections, increasing the overall brain volume.

Janne Sinkkonen
Finland