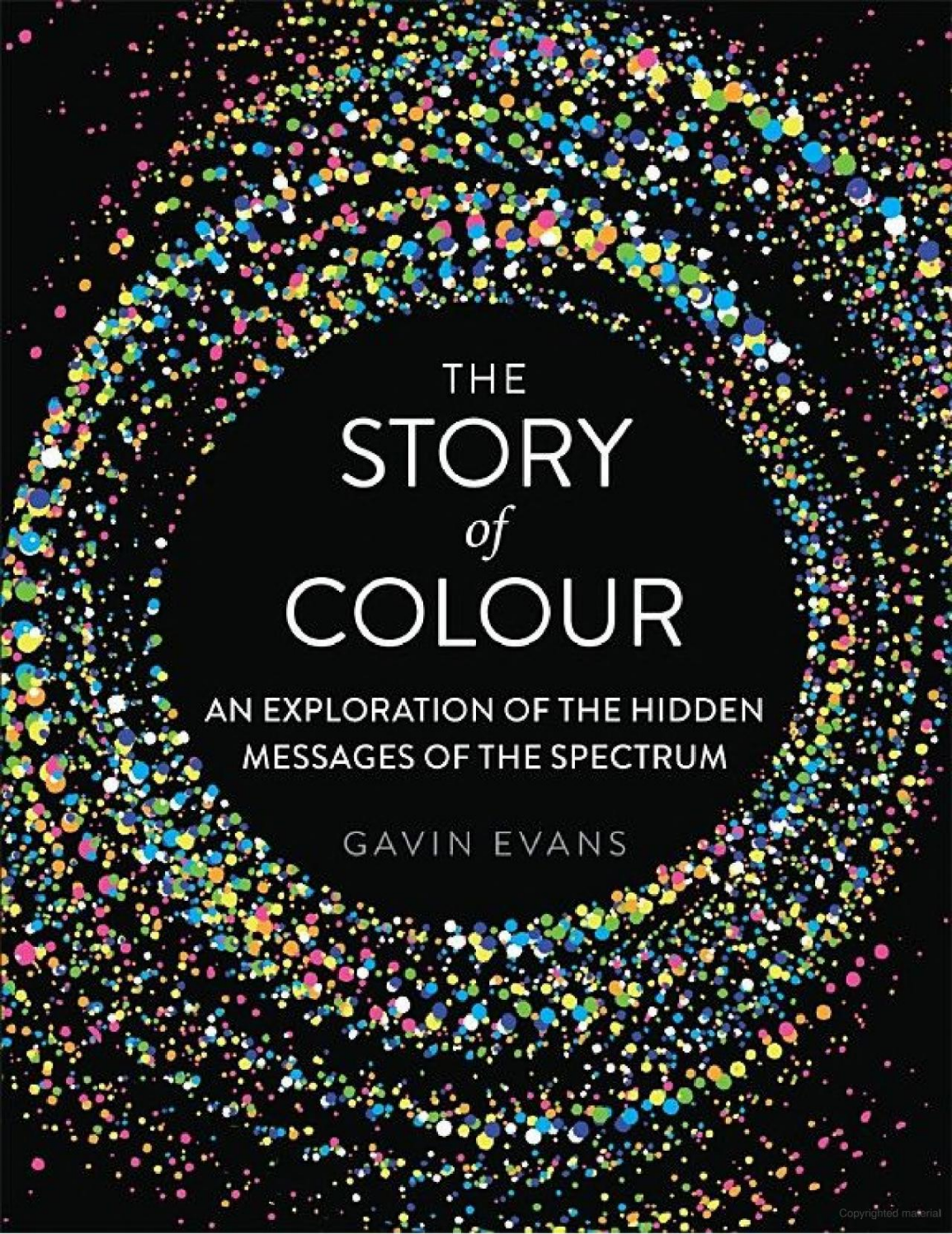

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If pupils were concentrating at school they might have learnt the mnemonic ‘Roy G Biv’, one way of teaching children the usual order of colours of the rainbow – red, orange, yellow, green, blue, indigo, violet – just as some British children learn the alternative ‘Richard of York gave battle in vain’. In India pupils learn VIBGYOR, which is the reverse order of Roy G Biv. Either way round, no purple and most definitely no pink.

And yet, are red, orange, yellow, green, blue, indigo and violet really the ‘correct’ colours of the rainbow? Well, yes, and one can add to the list or subtract, as long as one doesn’t throw in grey or gold or brown, or pink, for that matter. It all depends on where one lives, or when one lived, because the received colours of the rainbow have changed according to culture and over time.

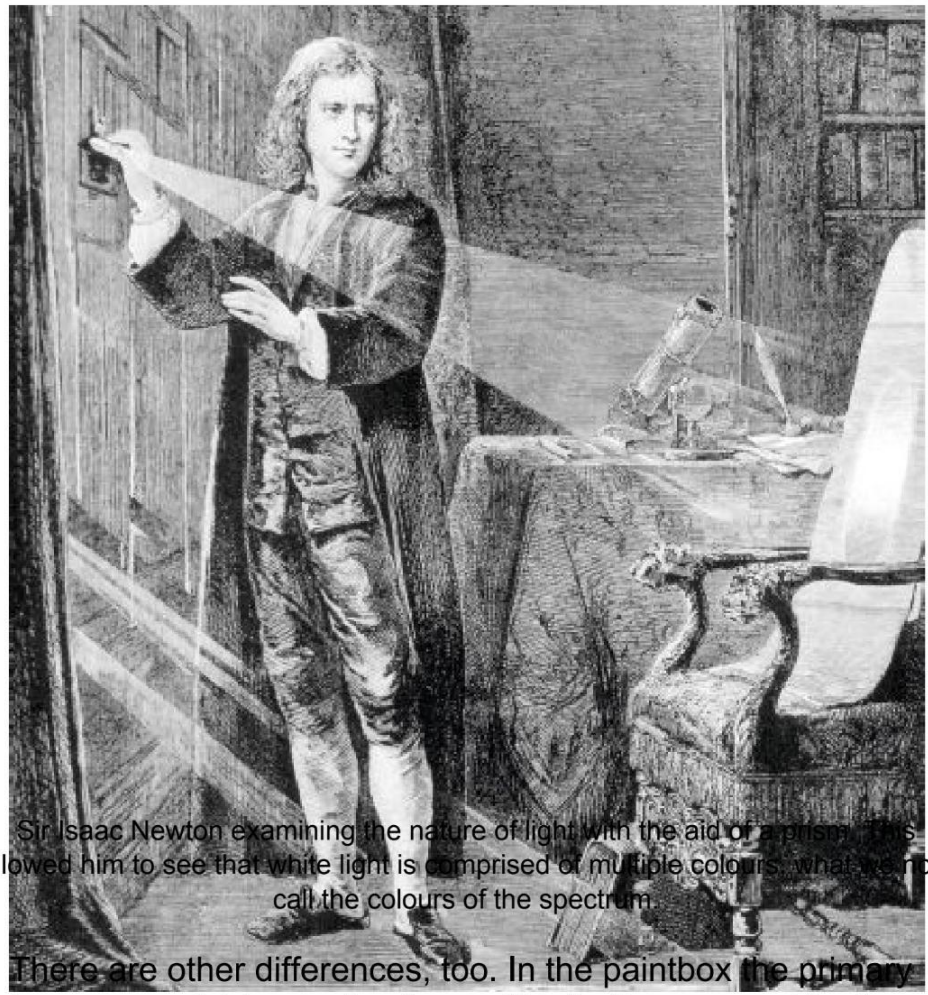
Let us go back to the man who invented what became Roy G Biv: perhaps the most remarkable scientist of them all, Isaac Newton. Along with his discoveries on the laws of planetary motion and of gravity, and his co-discovery of calculus and his huge contribution to developing the scientific method, he was obsessed with light and colour. This prompted one of his most famous experiments (in his rooms, during the Great Plague, when the university was closed). Using a partition board with a pinhole in it and a glass prism, he observed how white light can be broken into the colours of the rainbow.

As Newton explained it: ‘In a very dark chamber, at a round hole, about one-third part of an inch broad, made in the shut of a window, I placed a glass prism, whereby the beam of the sun’s light, which came in that hole, might be refracted upwards toward the opposite wall the chamber, and there form a coloured

image of the sun.'

He showed that white light is the combination of the full colour spectrum. In his book *Opticks* (1704), he explained how these colours comprise light rays that bend, or refract, at different angles when passing through a prism, so the colours separate. The ray that bends the most is violet, with the shortest wavelength, and the least is red, with the longest wavelength. In the middle is green. Crucially, he reversed the experiment too, demonstrating that the spectrum of colours can be reassembled into white light.

A century on, in a book titled *Theory of Colour*, the great German thinker Johann von Goethe described Newton's idea that white light was a combination of all the colours as 'an absurdity' and he moaned about people parroting Newton's idea 'in opposition to the evidence of their senses'. What Newton understood, and Goethe failed to grasp, was the difference between the colours of the paintbox and those of light. Mix the pigments of the artist's palette together and one gets a very dirty grey-brown. But when considering light, it all changes. Spin a colour wheel fast enough and it will appear white.



Sir Isaac Newton examining the nature of light with the aid of a prism. This allowed him to see that white light is comprised of multiple colours, what we now call the colours of the spectrum.

There are other differences, too. In the paintbox the primary colours are red, blue and yellow, with all others a combination of these. With light, the primary colours are green, blue and red. Mix all three equally and one gets white. Mix varying ratios of these and one can get any other colour in the rainbow. Every picture or illustration we see on our televisions or our laptops or smartphones is the product of tiny green, blue and red dots.

Despite his scientific and mathematical genius, Newton was very much a man of his time, one whom John Maynard Keynes

called ‘the last of the magicians’. When taking breaks from advancing science and mathematics, and from hanging counterfeiters and excoriating his scientific rivals, Newton spent his time studying the Holy Trinity, the occult and searching for the philosopher’s stone. He had a mystical fondness for the supposedly magical properties of the number seven, which he also saw as the prime number of nature (the seven notes of the Western musical scale, the seven planets of the solar system, and so on).

After some prevarication, Newton opted for seven colours of the rainbow, rather than the previous five or six (the colours he added were orange and indigo). Really, there are no pure colours in a rainbow, as such, for they all blend into one continuous spectrum. We might see seven but in reality there is not a delineated gradient, which means the boundaries are blurred and the divisions arbitrary. Interestingly, the colour orange did not exist in Europe until the orange fruit was introduced. Prior to its introduction, ‘orange’ objects were described as gold or golden, which is why we have goldfish instead of orangefish. In fact, tomatoes were originally called golden apples, too.

When we see the full range of visible light waves together, our eyes and our brains say ‘white’ but when some of those wavelengths are missing we see them as colours. More accurately, objects absorb different parts of the white light spectrum, so we see those parts that are reflected. But the colours the human eye chooses to see and how it chooses to see them varies from one culture to another and even from one individual to another.

In English indigo is really another word for dark blue and violet is often used as an alternative word for purple. Newton’s blue could also be called turquoise, and so on. We all see the same range of colours when we look at the rainbow, but how we

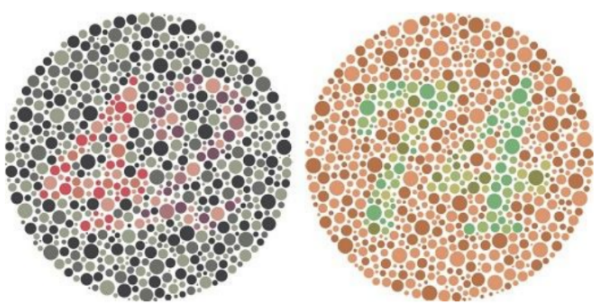
identify them differs. According to the philosopher Xenophon, the Ancient Greeks identified only three colours in the rainbow – red, yellow and purple. Ancient Arab tradition also agreed on three – but they used red, yellow and green.

Part of our colour perception relates to the genes we happen to inherit individually. Yet rather more important are cultural differences, which have been influenced by the way our societies have used colour over time – and the number of colours in our cultural palette has expanded as we have found new ways of capturing the hues of nature in paints, dyes, tints and pigments, and in how we use colours and patterns to adorn ourselves, our homes, our places of work and our possessions.

Language plays a significant role. The colours we see and use find their way into our languages, and the way we see is influenced by language – by the words we use to describe objects. Take blue and green. To Western eyes these are very clearly different colours – alongside each other on the colour wheel, but distinct, as blue is a pure or primary colour and green is a mixed or secondary. However, as we shall see in the chapter on blue (here), several modern and ancient languages have just one word for both. To some that may seem odd. Yet in English the word blue covers both light blue and dark blue, whereas in Russian these colours are as distinct as pink and red. While all shades of green are described as ‘green’ in English, in Korean there are different words for two shades of green – one more yellowish than the other.

MEN, WOMEN AND COLOUR-BLINDNESS

Some people are naturally better at distinguishing colours than others. About 4.5 per cent of Western populations are defined as ‘colour-blind’. This does not mean that they see in black and white, or monochrome; it means that they lack either red or green retinal cone cells, so they can’t tell the difference between red and green, such as on traffic lights. In some cases, they have difficulty distinguishing blue and yellow. Between population groups there are no differences in the genes that relate to mental abilities, but there can be slight differences in the genes that govern physical attributes. One of these relates to the ability to see colour. Among the Pingelap tribe, in Micronesia, it has been estimated that 10 per cent of the population is colour-blind – more than double the international average.



Two colour perception tests, known as ‘Ishihara’ tests, for red-green colour deficiencies.

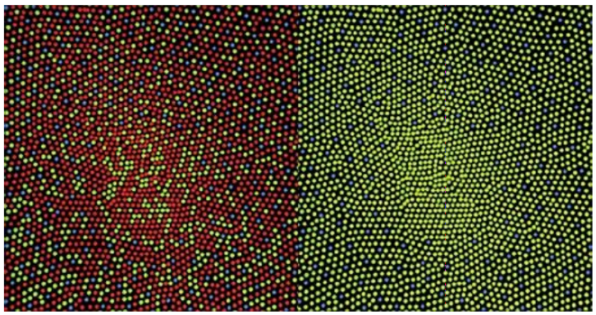


Illustration of the distribution of cone cells in the part of the human eye used for detailed perception; in a person with normal colour vision (left) and a colour-blind retina (right).

In Britain, 8 per cent of men are colour-blind but only 0.5 per cent of women. In addition, more women than men are ‘tetrachromatic’, meaning they have an extra retinal cone, making them super-sensitive to colour distinction.

The normal eye is trichromatic: it has three types of cones that detect colour from three parts of the spectrum. One study found that between 2 and 3 per cent of women had inherited this heightened colour perception. Curiously, colour-blind boys have higher odds of having tetrachromatic mothers and daughters, due to dominant and recessive gene combinations.

RODS, CONES AND ANIMAL EYES

Not all animals are colour-blind. In fact, several see better than humans in terms of distance and colour range. Many

insects can see ultraviolet colour (helping them to find flowers to feed from), while some snakes can detect infrared (helping them detect heat from their mammal prey). Apes have similar colour perception to humans, but most other mammals fall into the same category as colour-blind people (dogs and cats, for example), and some (such as bats and many herbivores) see no colour at all, only shades of grey – they are monochromatic.

What it comes down to is the animal's photoreceptors in the retina of the eye, which consist of rods and cones. Light enters the retina before being interpreted by the rods and cones, which send messages to the primary visual cortex within the brain, prompting the perception of colour and tones. Cones are responsible for colour perception, while rods are responsible for detecting contrast, so that we can sense movement in low-light conditions. The pupil naturally adjusts in size to optimize these perceptions according to light levels.

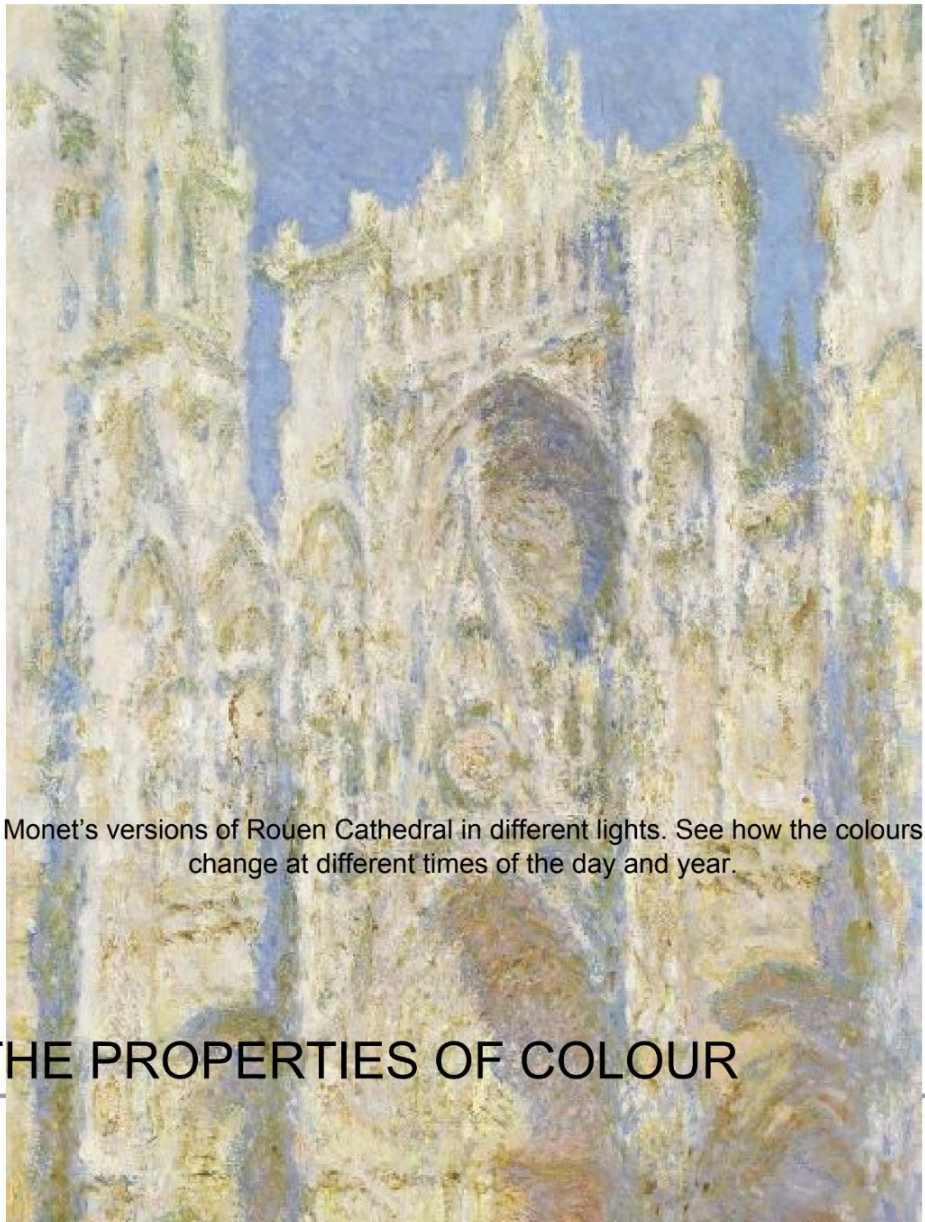
LIGHT AND COLOUR

How we see colour is affected by the way light reflects from the surfaces of objects, so this can vary. When we look at our living room, we might say the couch is green, the curtains are red, the floor is brown and the armchair is blue. These appear to be their colours, but if we change the lighting then the colours change too; switch off the light and red, brown and blue effectively become shades of grey, due to the low light levels.

If we move outside into the bright midday sunlight, we'll see

the full range of colours detectable to the human eye, but as the sun goes down, light levels drop and the atmosphere filters the colours, reducing the range of colour rays. In the 1890s the French impressionist Claude Monet (1840–1926) illustrated this by painting at least thirty pictures of Rouen Cathedral at different times of the day and year, with the colours changing accordingly.

Artificial light exposes our eyes to a narrower colour range than bright sunlight, depending on the kind of light bulb used. For example, fluorescent light highlights cooler colours like blue and green, while incandescent bulbs pick out warm colours like red, orange and yellow. This is most dramatically illustrated by stage lighting. For example, a blue filter will turn blue into a blue-green colour and will turn yellow into black.



Monet's versions of Rouen Cathedral in different lights. See how the colours change at different times of the day and year.

THE PROPERTIES OF COLOUR

We can consider colour from different angles:

- **Luminosity**: This concerns lightness and darkness and is best

illustrated through black and white photographs. A black surface would have no luminosity; a white surface would have maximum luminosity. We also talk of a *shade of colour*, if it contains black, and a *tint* of a colour, if it contains white.

- **Hue:** This term, commonly used by graphic designers, relates to their wavelengths. We shift from one hue to another as their wavelengths change (on the one end of the spectrum violet is in the 390-431 nm range; on the other end, red is in the 658-780 nm range). We call a sunset orange because the light waves bouncing off its molecules are in the 600-658 nm range.
- **Saturation:** Artists and graphic designers note that some colours *appear* 'purer' than others because they have less of their surrounding colours within them – also known as a colour's 'saturation'. This can be influenced by the eye of the viewer. What, for some cultures is pure blue, for other cultures is a muted shade of green.
- **Temperature:** Half of the colours in the spectrum can be defined as 'cool' and the other half as 'warm'. This relates to their cultural associations. Red, yellow and orange – the colours of the sun and fire – are perceived as warm, while blue and green – the colours of sky, sea and leaves – are perceived as cool. But some colours fall somewhere between, such as purple and maroon.

THE MYSTERY DRESS: BLUE AND BLACK OR WHITE AND GOLD?

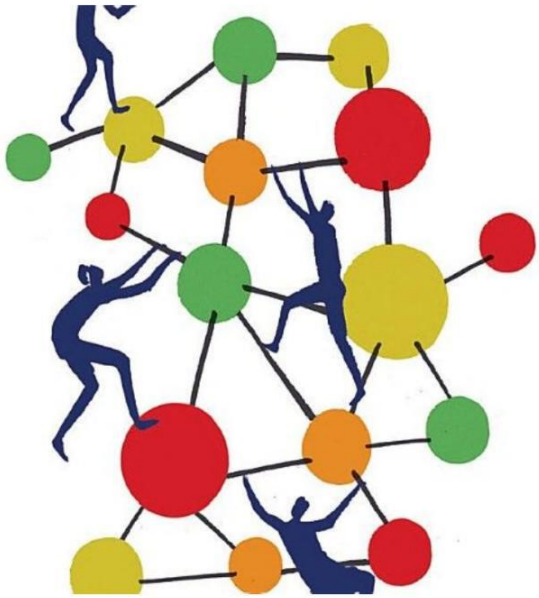
In 2015 a single image polarized opinion on social media. It featured a bodycon dress that appeared to be blue with a black lace fringe to some people, but white with a gold lace fringe to other people. What was going on?

Our brains interpret the light entering the lenses of our eyes, and this is influenced by light in the space we are in, the saturation of colours, the surrounding colours and the clarity of the image. The image of the dress serves to illustrate this. It had little surrounding colour context and it was slightly muted, so people's brains were required to guess. Most people's brains saw the dress as being swathed in light and therefore darkened the colours to see it as blue and black (the 'correct' interpretation, as it turns out). But some brains saw it as being shadowed and therefore compensated by lightening it – and ended up seeing white and gold. Some people can switch from one perception to the other, depending on the light in the room.

USING COLOUR IN ART

Lara Harwood, a London-based artist and illustrator, whose abstract and figurative work is known for its vivid use of colour, reveals how she is influenced by the cultural connotations of colours as she works. She consciously embraces the subtext of their meanings and believes these change when she combines them.

‘When I think about the colours I intend to use in my work, I ask myself what they mean to me, and what they represent for others. Red is bold, happy, dramatic and dangerous; blue is inevitably sad, but also has a richness and light to it – if you have a lighter blue it can be the source of light for a darker blue and lots of blues together can be gorgeous; yellow is such a bright, happy, uplifting colour, but you have to be careful because it can disappear alongside white; orange is also happy and uplifting and it can hold its own as a strong base colour; purple has a very wide range. I love its moodiness and it goes well with most other colours; I use pink a great deal because it is soft and gently happy. Green is obviously such a natural colour but I don’t want to use it in that way, as in, ‘here’s a green tree’. Brown needs brighter colours around it. Black goes with everything but it can have a heavy, flattening effect. Grey, on the other hand, does a wonderful job in showing off other colours. But when thinking about the meaning of colour in art, it is all about the combination of colours and the impact they have on each other.’



Lara Harwood's illustration for the HHMI Annual Report, 2008, shows off her use of colour in her work.

A GROUP OF FISHERMEN on the west coast of South Africa's Cape Province were busy in their workshop. Their aim was to make paint and they went about it with traditional knowledge and skill, carefully blending red ochre (iron oxide) with fat extracted from bone marrow to create a paint compound that was mixed in shell paint pots using bone spatulas.

We can't be sure exactly what they did with their red paint – whether it was daubed on their bodies, their tools and weapons or on the cave walls, because they were making their paint 100,000 years ago. Since then erosion has removed the evidence, but their tool kit and the residues of their red paint remain, and so do their red-stained beads, which show that, at least since that time, humans have had the ability to express and adorn themselves using colour.

THE BEGINNINGS OF EXPRESSION

Perhaps an even more remarkable discovery from the same cave, Blombos, is the oldest known example of symbolic art – some 30,000 years before anything comparable emerged in Europe: two red ochre plaques carved with triangles, diamond-shapes and lines. They have been dated to 75,000 years ago. Again, we don't know for certain what

these engravings meant but finds at other coastal caves in the area have shown that symbols like these were widely used at the time, perhaps to keep a record of something. Murals from later cave dwellers in Southern Africa, Namibia, Europe, the Middle East, Australia and parts of Asia show that red was the colour of choice, as only yellow and black were also available. Images of red animals, red hands and red people have all been recorded. In the Bomvu Ridge area of Swaziland, archaeologists have found 40,000-year-old mines used to dig out red and yellow ochre, thought to be used for body painting.

It may look nondescript, but this red ochre plaque excavated from the Blombos Cave in South Africa is 75,000 years old and is the oldest known piece of artwork created by human hands.

When the modern human brain evolved, at least 100,000 years ago, people started adorning themselves and expressing their thoughts symbolically and artistically. Perhaps not surprisingly, red was the first colour that all cultures shared. In the Hebrew tradition, the first man was moulded from red earth, i.e. earthenware clay. The root of the Hebrew word for Adam actually means ‘red’ and it is also related to the word ‘dam’, which means ‘blood’, so A-dam means ‘of blood’.

To take another example, when the first white colonists sailed into North America they dubbed the native people they encountered as ‘Red Indians’. This wasn’t due to their natural skin colour but rather the

red ochre paste they used to daub their bodies and faces. It was war paint, but might also have been used to repel insects in the summer, or to insulate bare faces in the winter, and to ward off evil spirits.

These ancient cave paintings from Argentina served as an early form of communication, and show how man has desired to record his own existence for thousands of years.

Boys of the Xhosa tribe are wrapped in red striped blankets as they make the passage into manhood.

BIRTH, DEATH, FIRE AND FERTILITY

The appeal of red and its presence in prehistoric art and adornments is not just a product of prehistory and availability. In every continent it seems to have been the first colour (other than black and white) to have been named. It is an elemental shade, the colour of heat and fire. It is also the colour of autumn, due to the colour of changing leaves, the colour of rust (iron oxide) and of the red planet Mars, which is called red due to an abundance of iron oxide.

Red's early appeal had a lot to do with nature – as well as availability. But more than all this, red is the colour of blood – the medium of life, of birth, of the death thrusts of battle and of menstruation. It evokes strength, virility and fertility. In 1850, Alfred Tennyson first referred to nature as 'red in tooth and claw' – and the phrase stuck as a maxim for the bloody violence of the natural world. Blood is also alluded to in the names and symbols of the Red Cross and Red Crescent, the red representing the healing of bleeding wounds. In several languages the name of the colour is drawn from the name for blood.

Blood–birth–death–fertility symbolism appears in most cultural traditions. Young men of the Xhosa tribe in South Africa, having undergone ritual circumcision as part of their passage into manhood, are covered in red-striped blankets as they heal from the procedure, after which they are accepted by the Xhosa as men. In Zambia, Ndembu girls are handed a baby chicken covered with red ochre as a symbol of their entry to the world of menstruation, sexual intercourse and motherhood. This is washed away when they have sex for the first time and the red water is then used to encourage fertility and childbirth. During the Ancient Chinese Han dynasty (206 BC to AD 220) women in the emperor's harem placed a red mark on their foreheads to signal when they were menstruating.

In parts of northern India fathers present their daughters with red

‘blood saris’ on their wedding day – the red symbolizing sexual power. A bride’s hair parting is also painted red, as are the soles of her feet, and she wears a red bindi on her forehead and has red henna hands. If she pre-deceases her husband, then her funeral shroud is also red. Red features prominently in the Indian and Nepalese Hindu spring festivals of *Holi*, also known as the Festival of Colour. This love feast starts with dancing and singing around a bonfire that represents the burning of the devil and the victory of good over evil. In the morning people eat, drink, play and chase each other, throwing coloured powder and spraying each other with water guns and balloons filled with tinted water – including red ochre. Today it is all about uninhibited fun, but it was originally a festival aimed at encouraging sexual activity and boosting the harvest. The red ochre was said to stimulate fertility.

Revellers are covered in coloured powder and water as they celebrate *Holi*, the Festival of Colour.

Newlyweds, wearing traditional Han costumes, attend a group wedding ceremony in China.

The Chinese also elevate red in their colour system, which recognizes five standard colours that correspond with the five elements of traditional Chinese thought: red = fire; black = water; white = metal; yellow = earth; blue/green = wood.

Red is also the colour of celebration, seen everywhere during Chinese New Year. This is because it symbolizes joy, as well as vitality and fertility, and it is the colour of the pomegranate, which is viewed as a revitalizing fruit whose many seeds represent a rich line of descent. Red envelopes are used to offer gifts of money, given on holidays or celebrations, because red symbolizes good luck.

Red has also been thought to hold protective properties. Red clothes were worn in Ancient Roman pagan rituals as protection from evil – and from measles. In New Zealand, Maori warriors would paint their bodies with red ochre to protect them in combat. In several parts of the world, baby clothes are still decorated with red to keep babies from harm. In parts of China, babies have a red mark painted on their foreheads to protect them against evil spirits, and timid children have little red sacks attached to their clothes to give them the courage to withstand evil visions. Chinese brides, as well as their families and guests, wear red to ward off evil.

Red is additionally used to welcome one-month-old Chinese babies into the world – with eggs died in ochre. It also features in some Chinese courting rituals. In the mountainous parts of south China, the Miao people celebrate the Flower Mountain Festival, where children

dance around a pole with long red streamers. The older girls wear red woollen bonnets. In the Sisters Festival girls offer their suitors a knotted scarf. If it holds two red sticks, it means the girl wants a husband. If it contains one red stick, she wants a friend. If it contains a red chilli pepper, then she wants nothing to do with him.

However, in some other cultures, red has been regarded as one of the colours of evil. For instance, medieval European devils are frequently depicted as red, while in the Book of Revelation there is mention of the 'scarlet-coloured beast'.

SEXY RED

In modern Western culture, red can be a feminine sexual statement – rouge 'blusher' makeup has long been used to show fecundity, as have, more recently, red lipstick, red nail varnish and red dresses. Some evolutionary psychologists and socio-biologists have studied the ubiquity of red makeup use among women, and have concluded that its use is 'hard-wired': i.e. an evolved behaviour. The British zoologist and author Desmond Morris has suggested that red lipstick use is an evolutionary adaptation that arose from male apes being turned on by the blood-engorged buttocks of female apes in oestrus. The American evolutionary psychologist Donald Symons hasn't quite gone that far, but has speculated that full red female lips were signals of reproductive fullness and therefore important in sexual signalling, giving red lipstick a kind of evolutionary badge of honour. They call this a 'supernormal' stimulus.

The evidence, however, favours a cultural rather than evolutionary origin, not least because widespread lipstick-wearing only began during the twentieth century, following vigorous advertising campaigns, after tens of thousands of years when most women neglected this

strategy. In contemporary Western culture, the feminine sexual connotations of red appear to have a strong pull. For example, in a 2012 study published in the *Journal of Hospitality & Tourism Research*, it was found that service tips given by male customers to waitresses who wore red were 26 per cent higher than those who didn't wear red. Female customers, however, tipped the same, whether the waitress wore red or not.

When we look at the cultural terminology (and clichés) spawned by the colour red, we find that blood, sex and lust are seldom far away. For example, the kind of man who describes himself as a *red-blooded male* might seek out *red-hot sex* in the *red light district*, after *painting the town red* – a nineteenth-century term relating to debauchery, which emerged from the use of bonfires and firecrackers on US Independence Day. And yet he might get *red-hot* with anger if he finds his wife casting her eyes elsewhere. In English it might be said that someone has turned into a green-eyed monster due to jealousy or envy, but the Chinese would talk instead of the *red-eyed monster* – alluding to the fire-breathing dragons of their mythology.

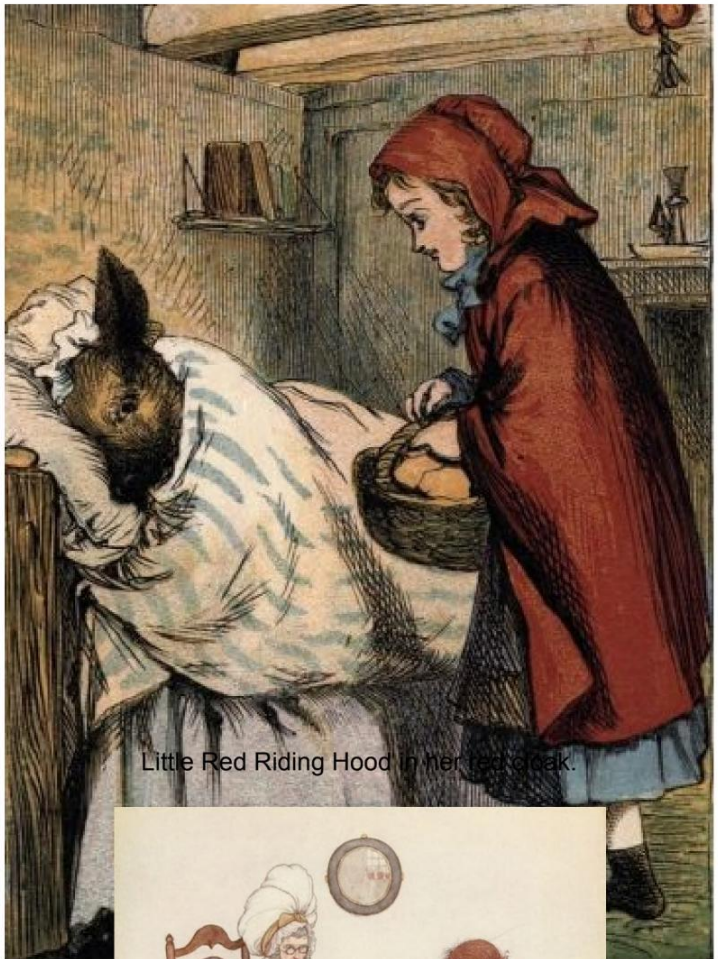
The connotations of red are not always so positive for women. In Nathaniel Hawthorne's 1850 romance *The Scarlet Letter*, set in Puritan seventeenth-century Boston, the beautiful Hester Prynne is accused of adultery and forced to wear a big scarlet letter 'A' (for adulteress) on her way to the gallows. This wasn't fictitious invention. Women convicted of adultery at that time were publicly whipped and had the letter stitched to their clothes. If they removed the letter they were whipped again. Today the term 'scarlet letter' survives, referring to a symbol of something someone has done wrong in the past, perhaps after being *caught red-handed*, which goes back to fifteenth-century Scotland, referring to those caught with blood on their hands from poaching. (This could leave you *red-faced* with embarrassment.)

Sexy in red: The fashion world caught on to the connection between red and sexual allure, demonstrated by the red lipstick and dress of Anita Ekberg and a model from the same era.

The allure of red has changed over time. In *Little Red Riding Hood*, popularized by the Brothers Grimm in 1812, who drew from French and German folklore going back to the 1600s, the red-cloaked girl is conned by the wolf, in granny's clothing, that invites her into bed and then devours her. When Hans Christian Andersen wrote *The Red Shoes* in 1845, his message about their power was brutally cautionary. Karen, the high-spirited peasant girl, defies the sage warnings of the rich old woman, succumbs to vanity and buys the red shoes. As soon as she puts them on, they won't stop dancing. Eventually she persuades a woodsman to chop off her feet with the shoes stuck on, and then she dies. Ninety-four years later, in the film version of *The Wizard of Oz*, Dorothy leaves black-and-white Kansas, puts on the

sparkling and magical red slippers and goes skipping down the yellow brick road to fulfilment and delight.

Hester Prynne was branded as an adulteress in Nathaniel Hawthorne's *The Scarlet Letter*, a punishment that was rooted in reality.



Little Red Riding Hood in her red cloak.

Karen in her red shoes.

WHY DO BULLS SEE RED?

Actually, they don't. Bulls, like dogs and cats, are colour-blind to red – but, back in the day, the bullfighters had no way of knowing this. Tests have since shown that the bull will charge just as ferociously at the blue side of a *toreador*'s muleta cape. It's the waving movement, not the colour, that antagonizes the bull. Red is also convenient for the capes and uniforms of the matador because it doesn't show up the blood – both that of the bull and the matador's.

REVOLUTIONARY RED

One of red's most persistent associations is with the political left – socialism and communism and the blood of revolution. This goes back to the Middle Ages, when fighting ships used red streamer flags to suggest a fight to the death. The first link to protest came in 1293 when a group of English pirates raised a red streamer after disputing the Crown's right to share the bounty of a boat they'd captured. Throughout Europe, red was utilized to show defiance – for example, on castles and cities under siege – but it really came of age during the French Revolution when, in 1789, it was hoisted during the storming of the Bastille, and in 1791, when Lafayette raised a red flag over the Champ-de-Mars after declaring martial law to warn off rioters, fifty of whom were killed. The Jacobins responded by raising their own red flag to commemorate the 'martyrs' blood' and during the reign of terror that ensued, the red flag became their unofficial emblem. After that, its appeal spread rapidly. When British sailors mutinied in 1797, they hoisted red flags on their ships.

It was first used as a symbol of worker power during the Merthyr Rising in 1831, when marchers in South Wales soaked flags in calf blood. The reputation of defiant red soon crossed the Atlantic Ocean, and was used by the Mexicans during their siege of the Alamo in 1836. A variation on the theme came from Garibaldi during his campaign to unify Italy, when his followers wore red shirts. The banners of the 1848 French revolution, and of the Paris Commune of 1871, were red, after which it became the colour of communism, later to be adopted as the flag of the Soviet Union (with the yellow hammer, sickle and star in the top left corner) and of China (where the rival nationalist party of Chiang Kai-shek also used red to shore up its revolutionary credentials in their losing fight against Mao's Red Army).

By the time the British Labour Party was founded in 1906, the reputation of red as the colour of the left was well on its way to being entrenched, so they adopted the red flag as their emblem, but eighty years later, a switch was made to the red rose. However, delegates at Labour Party conferences continue to sing 'The Red Flag', a song written in 1889. In 1976, Labour Party MPs burst into a hearty rendition, prompting the Tory notable, Michael Heseltine, to swing the parliamentary mace above his head in exasperation. With the decline of communism it lost its power to shock, but its lyrics still give a neat illustration of the links between flag, colour and blood:

French revolutionaries storming the Bastille

Garibaldi with his men.

GARIBALDI.

Entrée à Naples.

A mass demonstration on National Day outside the Gate of Heavenly Peace, Tiananmen, China, during the Cultural Revolution of the late 1960s.

A parade celebrating the fifty-ninth anniversary of the Russian Bolshevik Revolution, Moscow, 1976.

Communist red combined with the hammer, sickle and star of the Soviet Union, which Lenin stands in front of proudly.

The people's flag is deepest red,
It shrouded oft our martyred dead,
And ere their limbs grew stiff and cold,
Their hearts' blood dyed its every fold.
So raise the scarlet standard high,
Beneath its shade we'll live and die,
Though cowards flinch and traitors sneer,
We'll keep the red flag flying here.

Beyond the UK, red retains a vestige of its former power. In 2016, after Brazil's left-of-centre president Dilma Rousseff was unseated, in what some called a constitutional coup, there were several news reports of children riding red bicycles or wearing red shirts, being chased and

assaulted by anti-left thugs.

Red has a special place in the politics of the United States. 'The Red Flag' song found its way there a decade after it was composed, and in 1909 was featured in the *Little Red Songbook* of the 'Wobblies' (the Industrial Workers of the World), a collection of their tunes, songs and hymns. But far more potent was the American backlash against all things red, which picked up momentum after the First World War, with several states banning the display of red flags, only to have these actions declared unconstitutional by the Supreme Court. In the 1950s, McCarthyite America lived in fear of the 'Red Peril' and 'Reds under the Bed' – terms drawn from the fear of 'red' communism.

There's an odd anomaly in the colours of US political parties: the usually right-of-centre Republican Party has red as its colour, while the occasionally left-of-centre Democrat Party has blue. In Britain, Germany, Austria, Ireland, Romania, Taiwan and Canada, however, blue is the colour of conservatism.

This is a recent thing – in fact, until the late 1990s it tended to go in the opposite direction. But in the 2000 presidential election that brought George W. Bush to power, the NBC television pundit Tim Russert used red for Republican states and blue for Democratic states and it just stuck. Blue had been used for Democrats in Texas in the late nineteenth century, and early in the twentieth century *The New York Times* and the *Washington Post* used blue for Democratic states. But it was only after 2000 that media outlets began to conform, leading pundits to talk of 'red states' (Republican), 'blue states' (Democrat) and sometimes 'purple states' (hard to call). When *The New York Times* graphics editor explained their choice he said it was because both *Republican* and *red* begin with the letter R.

WHY RED-LETTER DAYS?

It originated in 509 BC when Roman calendars marked important days in red. This practice was revived in medieval Europe with capital letters and important words highlighted in red, and continued after the invention of the printing press. Later, holidays

were marked in calendars in red, and the term red-letter day became associated with any day that was significant.

ARISTOCRATIC RED

Not all historical references to the colour red are drawn from the elements of blood, fire and sex. The origin of aristocratic red has a very different story, relating to money, status and power.

For much of human history people did not wear coloured clothes. The transition from hunter-gatherer lifestyles to agriculture, which started around 10,000 years ago, prompted a transition from skins and furs to fabrics, although this shift was gradual and took thousands of years. The business of dyeing these clothes was exceedingly tricky and took thousands more years to take root. With some colours the dyes washed out with the first drop of rain, and those that didn't were expensive to produce. Red dye was a case in point. The best red dye was produced by extracting carmine dye from the cochineal scale insect, which is native to the Americas and feeds on the leaves of the prickly pear cactus.

The founders of this dyeing technique were the Aztecs, Incas and Maya, who also used cochineal for medicine, adornment and painting. Cochineal also had religious significance. For example, the Inca believed that their goddess Mama Huaco emerged from the Paqariq Tampu cave in Peru wearing red. The Spanish conquistadors, under the command of Hernán Cortés (1485–1547), were dazzled by the brilliant red of Aztec clothing and, after acquiring the recipes from their colonial subjects, they set them to work on producing huge quantities of this wonderful, colourfast red dye, earning a fortune for king and country.

For two centuries the Spanish kept the process secret, partly by spreading charming rumours about the existence of a versatile little animal that was part-fruit, part-worm, which they called a wormberry. Their export of cochineal dye from Mexico rose from 50 tons a year at the beginning of the sixteenth century to 160 tons at the end. But eventually, in 1777, the secret got out when one Thierry de Mononville, a twenty-five-year-old Frenchman, smuggled out a cactus covered with cochineal insects, took it to Port au Prince, in Haiti, and set to work farming them.

Still, the dye remained prohibitively expensive because it took 150,000 of the tiny insects to produce a single kilogram of dye. They had to be dried and crushed to obtain the pigment, which was then mixed with alum. So it was hardly surprising that only the aristocracy and the super-rich could afford red clothes, carpets and wall hangings. But it wasn't just about cost. All over the world, from at least the time of the Ancient Greeks, Romans and Chinese, powers and principalities introduced sumptuary laws that placed restrictions on the clothes, colours and jewellery people could wear, depending on status, class and gender. It was one of the ways they enforced their hierarchies.

The last Aztec ruler, Moctezuma II, standing on the left in his cochineal red cloak, before being imprisoned by Spanish conquistador Hernán Cortés.

Post-Roman European sumptuary laws were applied in Italy and France from the 1500s, but they were most vigorous in England, starting with Richard I – also known as Richard the Lionheart. He introduced a ruling, in 1197, that restricted the masses to wearing only grey clothing which, for most, was not much of a restriction because the only clothes they possessed were made from rough, undyed grey cloth.

In later centuries, as dyes became more available, commoners were restricted to a narrow range of their own earthy colours. Although

these laws were not always rigorously enforced, there were periodic calls for implementation – particularly during the Elizabethan era. In some cases, failure to comply could lead to fines, loss of property and title, imprisonment and even death – although there are no reports of executions for wearing the wrong colour clothes.

There were also laws in some European countries against mixing colours, which, in the Middle Ages, was seen as part of the dark art of alchemy. So, for example, mixing blue and yellow dye to create green was strictly forbidden, and those working in black and blue were restricted, by their guilds, from working in red and yellow.

The main purpose of the sumptuary laws was to indicate status in those wearing one colour or another, and to keep the newly wealthy merchants separate from the land-owning nobility. These laws were publicly motivated by a call to prevent excess, waste, vanity and moral decay among common people. They had the secondary purpose of encouraging commoners to spend their money in certain ways. For example, in order to stimulate English wool production, a new sumptuary law was introduced in 1571 compelling all non-noble males over the age of six to wear woollen caps on Sundays and holidays. Failure to comply invited a stiff fine.

Under these laws, red colours were solely for the highest nobility, along with gold, silver, dark blue, black and pure white. Only royalty were allowed to wear purple. Commoners were restricted to earthy colours, such as greys, browns, yellows, greens and oranges, and also pale blue and pale red (which centuries later would be called pink).

By the end of the seventeenth century sumptuary laws all over Europe had been repealed or had fallen into disuse. Red, however, remained the preserve of the noblemen, cardinals and wealthy merchants simply because of the cost of the cochineal dyeing process.

It took until the 1870s before a cheap, colourfast substitute was found: a new synthetic dye called alizarin. In no time, red lost its aristocratic status and came to be seen as flash, vulgar and erotic. But one aspect of its past splendour survives: the red carpet. The first reference to its use comes in the Greek play *Agamemnon* by Aeschylus. The eponymous Agamemnon returns from Troy and his wife invites him to step on to the crimson carpet she has laid. It has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By the twentieth century, colourfast synthetic red dyes were a dime-a-dozen, but safe red food and cosmetic dyes remained a problem. Many of the dyes used turned out to be carcinogenic, so the search for a safe red food colouring led back to the cochineal insect. Under the code number E120, it began to appear in lipsticks, rouge, face powders, blusher and eye-shadows, as well as in jams, maraschino cherries, sausage skins, some alcoholic drinks and also in the 'Strawberries and Crème Frappuccino' made by Starbucks.

This might be fine for anyone worried about carcinogenic 'e-numbers', but not so much for people more worried about purity in their vegetarianism or veganism, or for those a bit squeamish about ingesting insects. In 2012 some bloggers were outraged to discover that E120 was really cochineal pigment and set up an online petition against Starbucks. It took a mere 6,500 signatures before the Seattle-based company capitulated and announced that cochineal would be replaced by a tomato extract. Cochineal is still widely used in lipstick and other cosmetics and in some food products. It has since been found that although the cochineal pigment is indeed non-carcinogenic, it can cause allergic reactions.

SANTA CLAUS AND RED

A red Santa is often said to be the work of the Coca-Cola Company, but this is not quite true – or not the full truth. The original Saint Nicholas, the kindly fourth-century bishop who gave rise to Santa Claus, is said to have dressed in ecclesiastical red, though there is some debate about this. So when Saint Nicholas made his first appearance in the Middle Ages, he was frequently depicted dressed in

red, but quite often in green too. Over the years, across Europe there were also Santas shown clad in brown and several other colours, but by the nineteenth century red had become commonplace. The current image of Santa is the work of the Swedish illustrator Haddon Sundblom, who was hired by Coca-Cola for a series of advertisements. He chose a fat, jolly Santa, with a red coat trimmed with white ermine, which just happened to fit with the branding colours of Coke. Red and white were taken from the red and white flag of Peru, the source of its coca leaves, which were part of the recipe until the 1920s.


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Saint Nicholas in ecclesiastical red, and the various alternatively coloured representations of Santa. It wasn't until the nineteenth century that red became the favoured colour, and this was cemented in the twentieth century thanks to Coca-Cola.


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A CHRISTINA ROSSETTI POEM tells of the rich natural associations of all the colours bar one: orange. ‘What is Pink’ ends with: ‘What is orange? Why an orange / Just an orange!’ In fact, the colour orange is about much more than orange the fruit. Nature often displays the colour orange, from sunsets and flowers and spices to a wonderful range of fruits and vegetables, and yet Rossetti was right in one respect: it is the only colour in the English language where the name comes from a fruit. There are other languages where the name of colour and fruit are separated: for example, in Afrikaans, the word for the fruit is *lemoen*, but the name for the colour is *oranje*.

In the paint mixing tray orange is, of course, formed by blending red with yellow, but as a unique pigment, it is a relatively recent addition to the paintbox: cadmium red and chrome orange were only discovered about 200 years ago. The word ‘orange’ is also a relatively recent addition to English. There are still several languages that have no word for the colour, including Himba, Nafana and Piraha. This is perhaps part of the reason why its connotations are more confined than its companions – to the sunny optimism of its warmth, a disparate range of political identities and as a colour of high visibility, used for traffic cones, life vests, dangerous machinery and the ‘black boxes’ of aeroplanes.

THE JOURNEY OF ORANGE

Oranges were first cultivated in China around 4,500 years ago and they slowly travelled west, via the Silk Road. The word ‘orange’ has its origins in an ancient Dravidian language, from southern India, from a word meaning ‘fragrant’.

Oranges have been cultivated for thousands of years, and their slow journey west meant many languages along their path have similar-sounding words for the fruit.

From there it went to Sanskrit, where the term for an orange tree – *narangah* – served as the root for many languages' translations of the


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