the stuff that stuff is made of

Things We Make with Plants

Jonathan Drori

MAGIC CAT PUBLISHING

What can you see right now that was made with plants? The wood for your bookshelf or your pencil, of course. The chocolate, or nuts in your snack – they're obvious too. But what about the fibre for your t-shirt, or the rubber for the car tyres outside? And here's a challenge: what can you see right now that *wasn't* made using plants? A lot less than you think!

When I was about twelve years old, I remember visiting a botanic garden bursting with plants of every shape, size and colour, from minuscule mosses to towering trees. Some of them had colossal leaves or gaudy flowers; others had sharp spikes or the feel of velvet. Some smelled sweet while others were so poisonous I wasn't even allowed to touch them. Later, I discovered that plants are not just weird and wonderful, but we literally can't live without them.

Plants are very special. Imagine being a plant: having to grow up, defend yourself from critters that come to eat you, make new seeds and disperse them... all while rooted to the ground! I find it even more incredible that plants are made from just two main ingredients. The first is carbon dioxide, an invisible gas in the air around us, that enters through the leaves. The second is water, which comes up through the roots. The way that plants use the energy from sunshine to turn these into more complex, solid stuff has a fancy name – photosynthesis. With just a smattering of other nutrients from the soil, plants make roots, leaves, stems, flowers, fruit, bark and seeds.

Of course, we depend on plants for our food but I'm fascinated by the countless ways plants have evolved for their own purposes that have made them so important to us. For example, the fibres that keep a stem sturdy or help seeds to fly on the wind can be spun into thread to make our clothes. And we use wood for building, for fuel, for making musical instruments and cricket bats and in countless other ways. Once you look, the things people have made with plants are everywhere... in food and clothing, perfumes and dyes, from towering scaffolding and the heatshield of the Space Shuttle, to popcorn, chocolate bars and ice cream. And even the book that you're holding right now!

Some of the plants in this book have very sad histories. Just a few generations ago, extremely valuable crops – sugarcane and cotton, for example – depended on people who had been kidnapped and enslaved. Mostly from West Africa, enslaved people were transported and forced to work in terrible conditions on plantations in the Caribbean and the United States. I remember my father explaining to me how landowners, companies and whole countries became wealthy, buying and selling people and the things they produced. It wasn't until the 19th century that slavery was abolished.

Other plant stories – peppercorns as money, dandelion clocks or henna designs on the skin of brides-to-be – make me smile. Be amazed, as I was, by the people who bred measly wild plants into sturdy food crops. Discover ingenious uses for plants and the incredible things people have made from them. Especially, let's celebrate the plants themselves: the most intricate and beautiful chemical factories you could possibly imagine. Three cheers for each and every plant... **the stuff that stuff is made of!**

– Jonathan Drori

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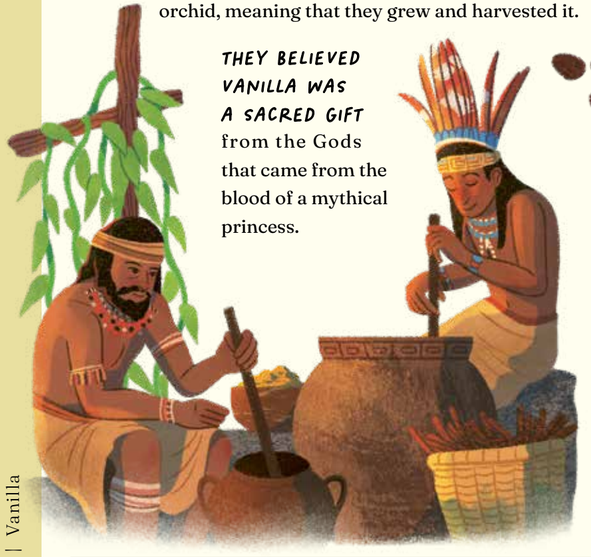
Vanilla. Sometimes belittled as boring or plain, vanilla is anything but! True vanilla is one of the most valuable and delicious spices in the world.



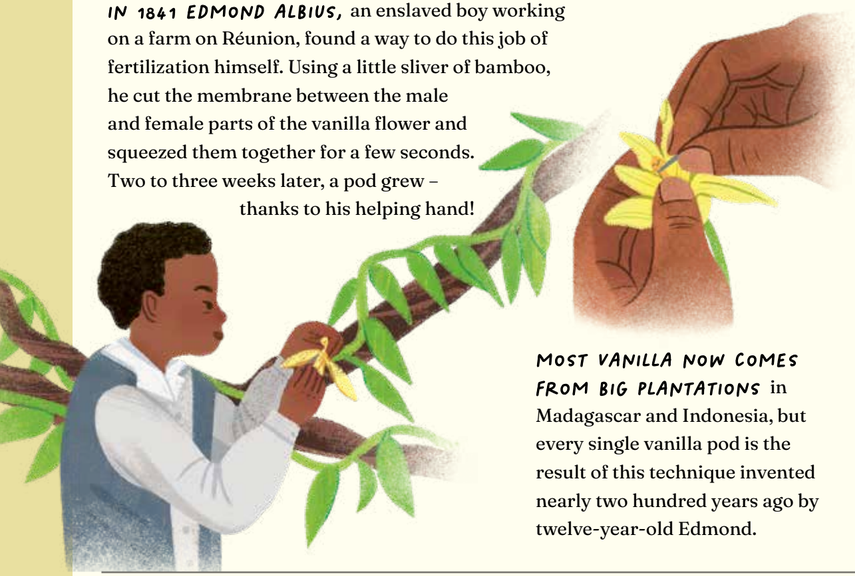
PROBABLY A THOUSAND YEARS AGO, the indigenous Totonac people of Mexico began to cultivate the vanilla orchid, meaning that they grew and harvested it.

THEY BELIEVED VANILLA WAS A SACRED GIFT from the Gods that came from the blood of a mythical princess.

IT WAS SO VALUABLE that the invading Aztecs forced the Totonacs to pay taxes with vanilla pods (and cocoa beans!). In the 1520s, Spanish conquerors brought vanilla pods from Mexico back to Spain. They were an immediate hit for flavouring chocolate.

IN THE LATE 1700S, THE FRENCH TRIED TO GROW VANILLA on the islands of Réunion and Mauritius in the Indian Ocean. The plants grew well and had plenty of flowers, but they never produced any pods. That's because these islands weren't home to the special kinds of birds and bees that flit between the flowers to fertilize them.

IN 1841 EDMOND ALBIUS, an enslaved boy working on a farm on Réunion, found a way to do this job of fertilization himself. Using a little sliver of bamboo, he cut the membrane between the male and female parts of the vanilla flower and squeezed them together for a few seconds. Two to three weeks later, a pod grew – thanks to his helping hand!



MOST VANILLA NOW COMES FROM BIG PLANTATIONS in Madagascar and Indonesia, but every single vanilla pod is the result of this technique invented nearly two hundred years ago by twelve-year-old Edmond.

VANILLA FLOWERS OPEN ONLY FOR A SINGLE DAY, so farmers must employ people to search every morning for the ones that are open and ready to pollinate. This means that vanilla is still very expensive, so much so that most vanilla flavouring doesn't come from the vanilla orchid at all but instead contains a substance called vanillin, which is made in factories from chipped wood. Natural vanilla extract contains vanillin too, but about two hundred other flavoursome chemicals as well, which means it smells and tastes much more interesting.

If you have a chance to taste ice cream or hot chocolate made with natural vanilla, or sniff a jar of sugar in which a vanilla pod has been kept, you will discover why it has been prized for centuries.

Vanilla

Vanilla planifolia

The vanilla plant is an evergreen vine of the orchid family, and is native to the tropical forests of Mexico, where it climbs up tree trunks.

Its large, waxy **FLOWERS** smell faintly of cinnamon. In the wild, they trick bees into visiting and fertilizing them by appearing to be full of sweet nectar, but they don't actually give them any.

The fruit of vanilla, which contains its seeds, is a **POD** that forms where each flower has been fertilized. After about nine months, the pods are the length of a pencil, but they don't smell like vanilla... yet.

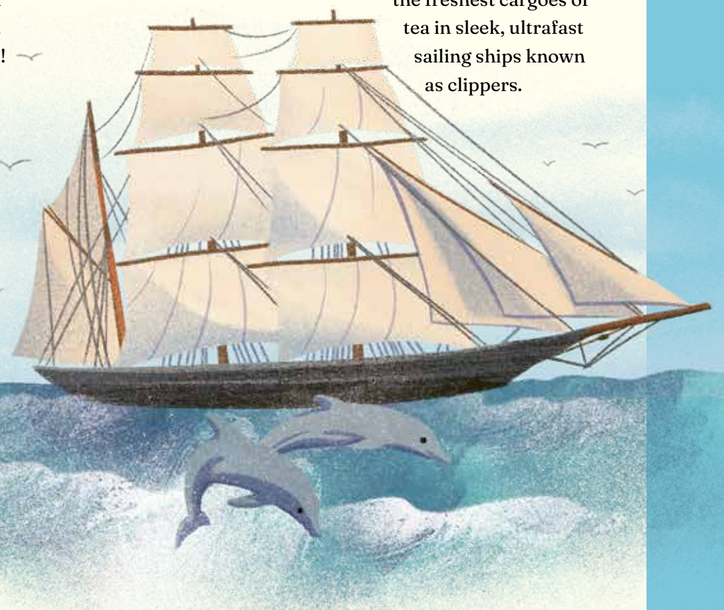
The pods are picked and dunked into hot water, then dried in the sun and sweated under blankets.

After six months, they're dark brown and shrivelled, and finally... they smell and taste utterly fabulous!

Tea. The emerald-green leaves of the tea plant are used to make one of the world's most popular drinks.

WHILE THE NATURAL CAFFEINE IN TEA helps the plant to defend itself against pests, and even discourages other plants from growing nearby, it makes a refreshing and stimulating drink for us! People first began drinking tea in China about 2000 years ago, and the Portuguese brought it to Europe in the 16th century. It became especially fashionable in England but remained an expensive luxury until the 19th century, when Britain set up large tea plantations in India and tea became a drink that most people could afford.

THE TEA TRADE WAS BIG BUSINESS. In the mid-19th century, American and British sailors competed to bring back the freshest cargoes of tea in sleek, ultrafast sailing ships known as clippers.

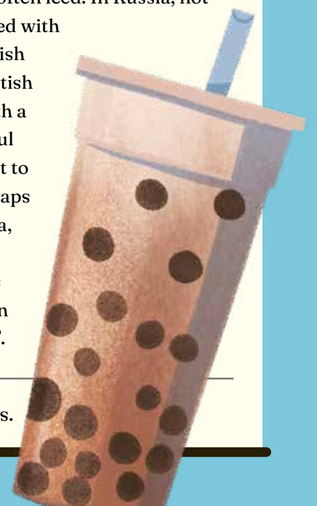


TO MAKE GREEN TEA, FRESH TEA LEAVES ARE HEATED, pressed and dried, which takes away much of the mouth-puckering, bitter taste and leaves a seaweedy, grassy or toasty flavour.

BLACK TEA is made by leaving the plucked leaves to wilt before being squashed between rollers and allowed to ferment for several hours. This releases exciting floral and fruity flavours.

TO MAKE A CUP OF TEA, the dried green or black tea leaves are steeped in hot water to release the flavours. In China and Japan, the everyday drink is green tea.

TEA IS SERVED IN MANY WAYS AROUND THE WORLD. In India, tea leaves are simmered in milk and water, with sugar, cinnamon, cloves and cardamom. In Tibet, black tea is mixed with yak butter and salt. Some Europeans drink tea with a slice of lemon, while in North America it's often iced. In Russia, hot black tea is sometimes served with a lump of sugar or a small dish of jam on the side. Many British drinkers prefer their tea with a splash of milk and a spoonful of sugar, along with a biscuit to dunk in the hot liquid. Perhaps the most peculiar is boba tea, which contains milk, added flavourings and chewy balls of tapioca, drunk through an especially large 'boba straw'.



During Chinese wedding celebrations the bride and groom serve tea to their future families.

Tea

Camellia sinensis

Originally from Southeast Asia, tea is now grown around the world in warm or hot climates with plenty of light and rainfall.

Tea is often cultivated on hills where the plants grow more slowly, giving the **LEAVES** a better flavour.

Left to itself, tea grows as an evergreen shrub or small tree, but for ease of picking, it is usually sown in rows in large plantations and pruned to chest height.

If tea is allowed to flower, its white or cream **BLOSSOMS** are followed by small greenish brown **FRUIT** containing a few round seeds.

The best tea comes from young **BUDS** and **LEAVES**, which are hand-plucked every two weeks during the growing season.

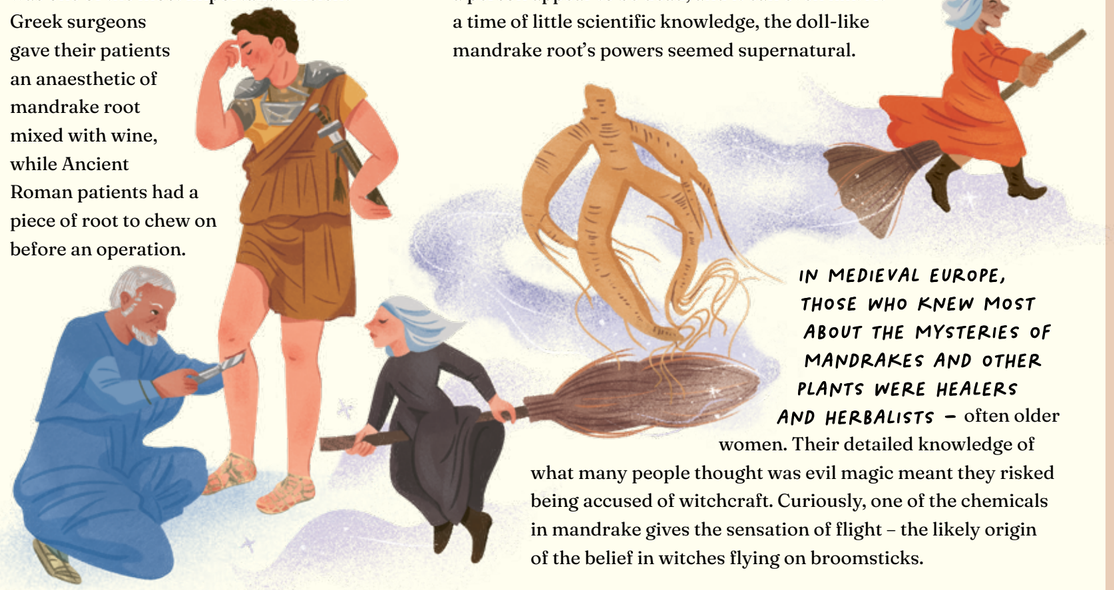
Young leaves, which are tender and vulnerable, also contain the most **CAFFEINE**, a natural pesticide.

Straight from the bush, tea leaves taste horribly bitter, which discourages animals from eating them. The pleasant flavour of tea depends on proper preparation of the leaves to make either green tea or black tea.

Mandrake. At Hogwarts, the school for wizards in the Harry Potter stories, mandrake plants have strangely human qualities and are cultivated for their magical powers. In real life, the mandrake is certainly powerful, and even associated with witchcraft.

BEFORE THE ARTIFICIAL ANAESTHETICS OF THE MID-19TH CENTURY, all painkilling drugs came from plants, of which mandrake was one of the most important. Ancient Greek surgeons gave their patients an anaesthetic of mandrake root mixed with wine, while Ancient Roman patients had a piece of root to chew on before an operation.

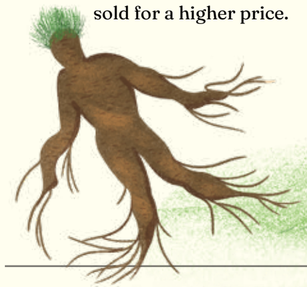
MANDRAKE NUMBS THE BODY BUT ALSO CAUSES HALLUCINATIONS – visions of things that aren't really there. In higher doses, it can temporarily make a person appear to be dead, and it can even kill. At a time of little scientific knowledge, the doll-like mandrake root's powers seemed supernatural.



IN MEDIEVAL EUROPE, THOSE WHO KNEW MOST ABOUT THE MYSTERIES OF MANDRAKES AND OTHER PLANTS WERE HEALERS AND HERBALISTS – often older women. Their detailed knowledge of what many people thought was evil magic meant they risked being accused of witchcraft. Curiously, one of the chemicals in mandrake gives the sensation of flight – the likely origin of the belief in witches flying on broomsticks.

MANDRAKE ROOTS WERE SOLD AS AMULETS – charms to ward off bad spirits. Sometimes, mandrake-sellers would pierce tiny holes in the "head" of a root, filling them with grass seeds. When they sprouted, the "hairy little man" looked even more convincing and could be sold for a higher price.

MANDRAKES WERE SO VALUABLE THAT HEALERS OR TRADERS DELIBERATELY SPREAD SPINE-CHILLING RUMOURS to discourage others from picking them. From Roman times to the 17th century, a common belief was that when a mandrake was uprooted, its intense shrieks could kill. The obvious solution was to plug your ears with beeswax, tie the plant to a dog and throw a chunk of meat so that by chasing it, the dog could safely yank the root from the ground.



Today, there are perfumes and cosmetics called *mandrake* and *mandragora*, which even now conjure up a mood of excitement and mischief.

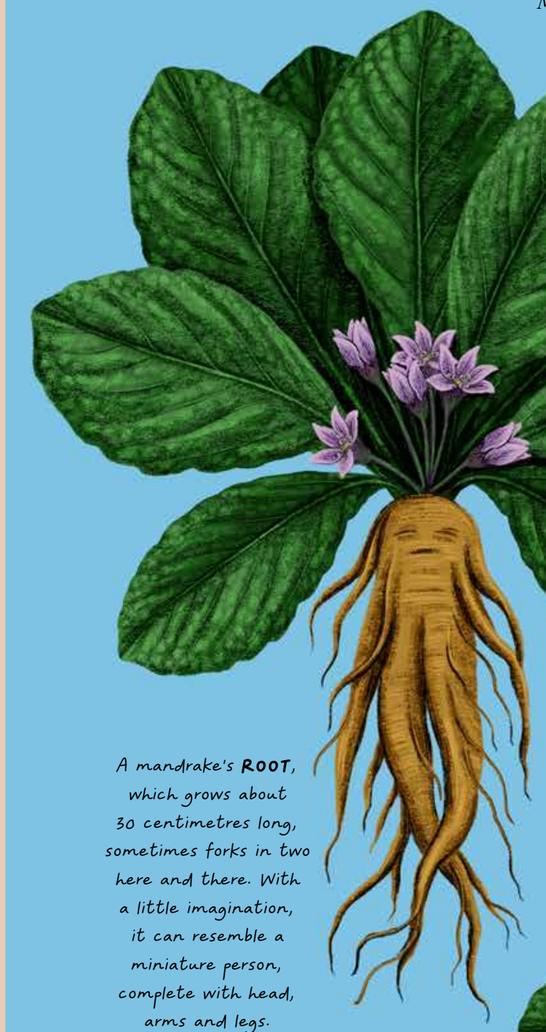
Mandrake

Mandragora officinarum

A stemless, straggly little plant from the Mediterranean, mandrake enjoys full sun at the edges of fields and in olive groves.

Clusters of **FLOWERS** vary in colour from greenish-white to dusky purple. Each bloom is the shape of an upturned bell.

Mandrake **FRUIT** change colour as they ripen, from glossy pea-green to an inviting gold, although their earthy scent is peculiar.



A mandrake's **ROOT**, which grows about 30 centimetres long, sometimes forks in two here and there. With a little imagination, it can resemble a miniature person, complete with head, arms and legs.

The fruit belongs to the same plant family as tomatoes and looks temptingly similar, but beware: the mandrake is **DEADLY**! All parts should be avoided, but especially the roots, which contain powerful poisons to ward off foraging insects and animals.

Dark lettuce-like **LEAVES** grow from the centre, no more than ankle-high.

Papyrus. Beautiful, towering papyrus was a versatile treasure of the ancient world.

PAPYRUS CLUMPS PROVIDE SHELTER FOR ANIMALS AND SLOW THE FLOW OF WATER, trapping nutrient-rich silt. For ancient Egyptians, the papyrus swamps of the Nile River delta were a living larder, full of fresh fish and game birds. They also cooked and ate the pith of papyrus stems, carved its woody underground parts for tools and burned it as fuel. Women used their teeth to strip the tough outer layer of the stems to make string for baskets, nets and mats.

EVEN THE ROPE USED TO SHIFT HUGE STONES FOR THE PYRAMIDS WAS MADE FROM PAPYRUS. It was such an important plant to the ancient Egyptians that they carved papyrus designs into many of their palaces, temples and tombs.

AROUND 3000 BC, ANCIENT EGYPTIANS INVENTED A PAPERLIKE WRITING MATERIAL MADE FROM PAPYRUS. To make it, layers of pith from the stems were laid criss-crossed on top of each other, then soaked and pounded together before being pressed flat, dried and "polished" with powdered clay. Papyrus sheets or scrolls were the main writing materials in ancient Greece and Rome and were used in Egypt right up until 900 AD.

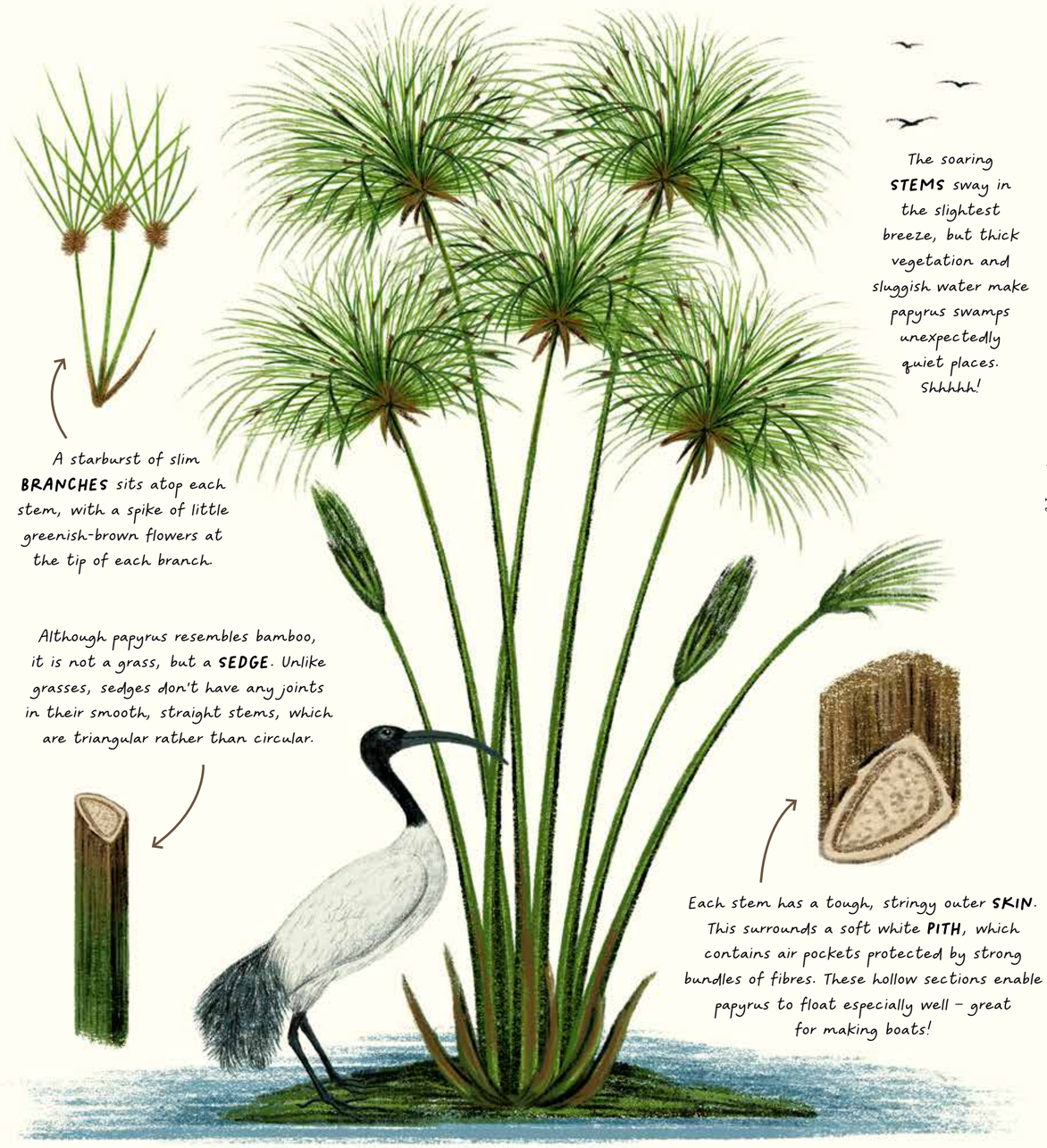
PAPYRUS SWAMPS ARE UNCOMMON IN EGYPT NOW because the land has been reclaimed for growing crops, but they cover huge areas of Central and East Africa. In the Sudd of South Sudan, one of the world's largest wetlands where they are a source of food and a home for wildlife, sheaves of papyrus stems are still bundled together to make boats – just as in ancient Egypt, thousands of years ago.

The word *papyrus*, from ancient Greek, is the origin of the modern word for paper in many languages. And papyrus pith, from which the earliest paper was made, was *biblos*, which gives us words such as *Bible*.

Papyrus

Cyperus papyrus

Papyrus inhabits steamy swamps and shallow riverbanks, growing in dense clumps of stems as thick as your wrist and often five metres tall.



The soaring **STEMS** sway in the slightest breeze, but thick vegetation and sluggish water make papyrus swamps unexpectedly quiet places. Shhhhh!

A starburst of slim **BRANCHES** sits atop each stem, with a spike of little greenish-brown flowers at the tip of each branch.

Although papyrus resembles bamboo, it is not a grass, but a **SEDGE**. Unlike grasses, sedges don't have any joints in their smooth, straight stems, which are triangular rather than circular.

Each stem has a tough, stringy outer **SKIN**. This surrounds a soft white **PITH**, which contains air pockets protected by strong bundles of fibres. These hollow sections enable papyrus to float especially well – great for making boats!

I dedicate this book to people who celebrate curiosity and ask LOTS of questions! – Jonathan Drori

Glossary

COLONISATION: Taking control over indigenous land and people, often for economic benefit.

CULTIVATE: To prepare the land and grow, tend and harvest plants.

ECOSYSTEM: A community of living organisms – plants, animals and microbes – in a particular area.

EVERGREEN: A plant that has green leaves throughout the year.

EVOLVE: To change or adapt over time into a form more suited to its environment.

GERMINATE: The process in which a seed begins to grow or sprout.

HERBIVORE: An animal or insect that eats plants.

INDIGENOUS PEOPLE: The original, native people of a place.

LATEX: A milky fluid produced by many plants – most notably the rubber tree.

MATERIAL: A thing that makes up something else – in other words the stuff that stuff is made of!

PHOTOSYNTHESIS: A biological process carried out by green plants, which use the power of sunlight to create solid materials, as well as oxygen, out of water and carbon dioxide.

PITH: A spongy white plant tissue that helps to store and transport nutrients around a plant.

POLLINATION: When pollen from the male part of a plant is transferred to the female part of a plant.

NATURAL RESIN: A sticky, often antiseptic substance produced by some plants and trees.

SUPERSTITION: An irrational belief in supernatural influences which can lead to good or bad luck.

About Jonathan Drori

Jonathan Drori CBE is a Board member of both Cambridge and Oxford Botanic Gardens and Honorary Professor at Birmingham University's Institute of Forest Research. Previously, he was a Trustee of the Eden Project and the Royal Botanic Gardens, Kew, and for BBC TV, was responsible for many science documentaries. He is known for his TED talks on botany, which have been viewed millions of times. Jon is the author of the best-selling books *Around the World In 80 Trees* and *Around the World in 80 Plants,* revealing how the worlds of trees and plants are intricately entwined with our own history, culture and folklore. This is his first book for children. See more at www.jondrori.co.uk

Jonathan Drori is an ambassador for WWF-UK
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