

The Tree

Trees are an anchor to all that is natural in our world. We have never known a time without their constant presence. They have been on an extraordinary evolutionary journey to adapt, survive and flourish in climates and habitats around the world. Some exist in mild, temperate and accommodating environments but others have adjusted to life in those that are inhospitable at best: the saltwater mangroves, arid deserts and sub-arctic tundras. Yet they have existed for millennia. Imagine what they have witnessed, what events have materialised before these silent sentinels. We imagine the towering heights of the redwoods when we think of such trees and there are Giant Sequoias well over 2000 years old. But the oldest tree ever known was a short, gnarly gnome of a tree – a Bristlecone pine which tend to grow to about 20 feet. It is called *Prometheus* and sadly we only know its age because it was accidentally cut down in 1964 – it was 5000 years old. To put that into perspective, that was just as the Stone Age was ending. Almost unimaginable.

'For in the true nature of things, if we rightly consider, every green tree is far more glorious than if it were made of gold or silver.'

Martin Luther, German theologian 1483-1546

Civilisations have relied on trees for shelter, fuel, food, medicine, oils and timber. Their strength, resilience, longevity and beauty have inspired countless generations and they are interwoven in our culture, customs and folklore across the globe, imbued with symbolism and mystical importance. Some were valued for building the earliest temples such as cedars which are mentioned 70 times in the bible. Others like the ancient yew were deemed the vital advantage in the manufacture of weaponry like the English Longbow. A single mighty Baobab tree in Africa still serves as a central meeting point for an entire community offering shade, water and food.



The larger Baobabs are said to be able to store 100,000 litres in their trunks and the pulp of its fruit contains seven times more vitamin C than an orange. In fact, there are more than 300 traditional uses of the pulp, leaves, seeds, fibre, roots and pollen of the Baobab. They, like the Banyan trees in India continue to hold great social and spiritual importance.



The tree sprouting between the cracks of a city pavement, the parks that provide small but welcome green spaces in our towns through to the ancient forests planted hundreds of years ago, trees are still integral to our very existence. Even in an increasingly urbanised world, we still seek the shelter of their canopies to dream wistfully of a lost love, relax with a book or hide from a sudden downpour. Nostalgic images of summer show makeshift treehouses or precarious homemade swings on sturdy boughs.

Our natural affinity towards trees has a basis in science. Japanese studies point to the positive effect that walking amongst trees can have on stress level indicators in the body, depression, the immune systems response and even on lower glucose levels in diabetics.

It is the wood as a product from our trees that serves as our daily connection to these guardians of nature that have existed for thousands of years. The hook you hang your coat on, the chair you sit on, the stick your ice lolly is on, the handle of the tools you use their energy and splendour surround us. So should we not understand a little more about them?

"A tree is our most intimate contact with nature".

George Nakashima, American architect and woodworker 1905-1990

How does a tree grow?

Seeds start the whole miracle of growth and have been designed over millennia with pure survival in mind. The seed must contain everything needed to start the journey of life but first it has to find the right environment in which to germinate. How to ensure it gets there safely is the first way the estimated 70,000 plus different species of trees make a distinction in approach. Some opt for the protection of a hard shell like the acorn, or the enticing fleshy fruit of the plum or eye-catching red berry of the holly and the yew. Others that rely on the wind to disperse them like the maple, hornbeam and ash, produce winged seeds. Then there is the Brazilian Grapetree which grows its seed-bearing fruit on its trunk to make it easier for animals to reach, eat and therefore disperse the seed - with fertiliser included. Either way, one design of seed most definitely does not suit all.

The Norway Spruce is particularly industrious and can clone itself so when one tree dies, another grows up from the same roots. In Australia there is an equally inventive but slightly more sinister approach taken by the Strangler tree. It has sticky seeds which get carried into high branches of a tree by birds or bats. The seed then grows roots down the trunk of the tree until they reach the ground. The roots graft together and enclose the host tree.

For those that need to go back to basics however, it is only once the seed lands by one method or another that it germinates and the process really begins. The root



breaks through to secure it to the earth and reach the water that will help the tree begin to develop.

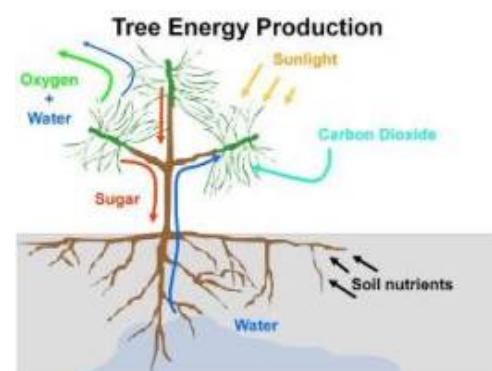
The first embryonic shoot that emerges becomes a seedling once it is above ground, but its succulent growth makes it a tasty meal for grazing animals, and it is also at its most

vulnerable to disease, so it is a perilous start. The seedlings that survive become saplings once they make it to a metre in height - these are the teenage years where their trunks are flexible with smoother bark than the mature trees. How long a tree takes to mature depends on the species but when they are fully grown they produce fruit or seeds to begin the life cycle once more. An Oak may produce acorns after 40 years and continue doing so for 300 more whereas a Rowan may produce berries after 15 years but be approaching the end of its lifecycle after 120 years.



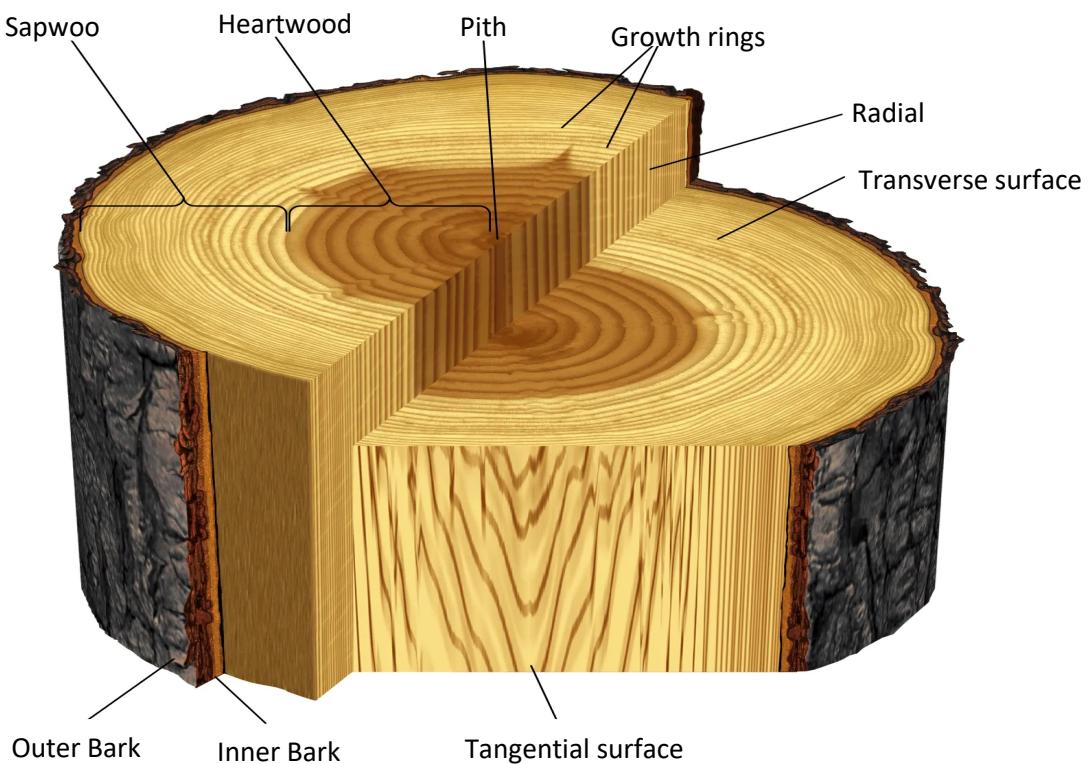
The roots of the tree tether it to the earth. Some, like the Oak, have a main root that plunges deep down whereas others have shallower roots that reach out in all directions always seeking moisture. The great storm in UK during 1987 was the downfall of many like the beech who have shallower roots however and a total of 15 million trees were toppled. Roots provide the water the tree needs but it is its leaves that produce the food. The leaves are essentially nature's solar panels, little chemical factories where the miracle of photosynthesis takes place - the larger the surface area of the leaf, the more sun it can absorb.

Put simply the leaves take carbon dioxide from the air, water from the roots, trap the light energy from the sun within their cell structure and convert it into chemical energy or food. The glucose produced is energy – essentially food the tree has generated for itself – and is stored as sugars, starches, resins depending on the need of the tree and the oxygen is released into the air. The xylem cells in the trunk and branches of the tree transport the water from the roots up to the leaves, then the phloem cells transport the glucose produced back to the growing shoots, where the sugar molecules provide the basic building blocks to make cellulose and lignin, the main ingredients of wood. It is a constant ongoing micro biomechanical process. This sap as it descends forms a zone or ring of much denser tissue around the loosely formed zone that had been formed by the



ascending sap in the earlier part of the year. It is this alternation of density and porosity in the successive layers of tissue which produce the annual rings with the interior zones of tissue solidify as the tree ages and this is known as heartwood.

The outer zones of tissue through which the sap circulates are known as sapwood and is a looser, spongier texture.



Hard to see how this is so important? It may sound like micro-science but it is essential biology that is the basis for all life. The oxygen released by this process in trees helps keep the equilibrium of carbon dioxide and oxygen in the atmosphere in balance. A single fully grown oak may have over 700,000 leaves and soak up 1,400 litres of water a day. Miraculous in its simplicity. Wondrous in its effect. Essential to life on earth.

Growth rings define a growing season in temperate climates, another layer of wood added on, they circle the pith and are variable in width because they tell the story of what the tree has lived through. During periods of drought or fire, or insects ravaging the nearby land or flooding, growth is difficult and the rings may be so narrow and close together that they are almost indiscernible. The rings tend to be closer together in hardwoods making the grain closer and are further apart in softwoods which grow quicker making the grain wider.

The grain of a wood that varies so magically between species is actually the patterns created by the trunk fibres. Some are straight and uniform whilst others delight with their intricate swirls. In many cases the best of the grain is often in the root structure

itself, buried underground and habitually condemned to rot. The hair like lines that radiate out from the pith are the medullary rays, vessels that carry nourishment from the descending sap to the interior of the tree. The walls of these cells get quite thick

and hard over time with the absorption of the wood producing matter so provide strength and stiffness, almost acting as ribs. When cut these appear as the silver grain seen in Oak or Beech.



Softwood



Hardwood

food to last them over the period of dormancy and to provide energy reserves for new growth in the spring. The Softwood evergreens like the pines, spruces and cedars have needle like leaves which remain (although Larch is an exception). Softwoods naturally grow in colder regions such as Alpine climates and grow quickly which means that softwood trees can be used for timber after 20-30 years - making them cheaper than hardwood and are therefore often grown commercially.

When a tree passes beyond maturity and becomes older than trees of the same species as itself it is described as ancient. Depending on the species, a tree might be called ancient when it is only in its early hundreds, like rowan, or when it is thousands of years old, like yew. So it is not age itself which determines whether a tree is ancient but key characteristics, such as a small canopy and a wide trunk which is likely to be hollow, both of which are indicators of great age in a tree.



The final stage in the life cycle of a tree is decay and ironically this is where it may provide the most life to the local habitat. Trees begin to decay from the heart and from the root upwards and outwards although sometimes the decay has already hollowed out the trunk and it is only sapwood supporting the bark. Dead trees provide a home to a plethora of fungi, insects, birds and small mammals which in turn attract those higher up the food chain,

all of whom can find shelter in the hollows and holes forming in the dead and decaying wood. This is a vital part of woodland biodiversity, and the reason trees are often left where they fall.

What is the history of Arboriculture?

Trees have always been part of our existence, but when did we get clever about it and start proactively planning, planting and cultivating? There are references in the Old Testament to Abraham planting a Tamarisk tree in Beersheba but arboriculture is not just tree planting, it is the cultivation, management and study of trees for the benefit of wider society.

"A society grows great when old men plant trees in whose shade they know they shall never sit"

Greek Proverb

Gratifyingly early it appears that civilisations saw the value of protecting, sharing and expanding the cultivation of trees. Early Egyptians transplanted trees with a ball of earth and originated the practice of shaping the soil around a newly planted tree to form a saucer to retain water, a method still used. In approximately 300 BC a Greek philosopher named Theophrastus wrote *Peri phytōn historia* which translates as "Inquiry into Plants". In it he talked of the transplanting of trees and treatment of tree wounds.

Then we have the conquests of Alexander the Great to thank in some part for the fruit trees which came to Europe from Asia, including apple trees, pear trees, apricot trees and plum trees. In their heyday, Ancient Greece and Rome developed advanced techniques for planting, grafting, pruning, pollinating and creating new varieties by selection which remained unequalled for centuries.

The medieval period began to see arborists emerge and realise the importance of maintaining trees for their structural integrity, especially in urban environments. Special techniques, which would later influence practices like tree cabling and tree bracing, were developed. These methods were crucial to ensure trees could withstand strong winds and other environmental challenges.

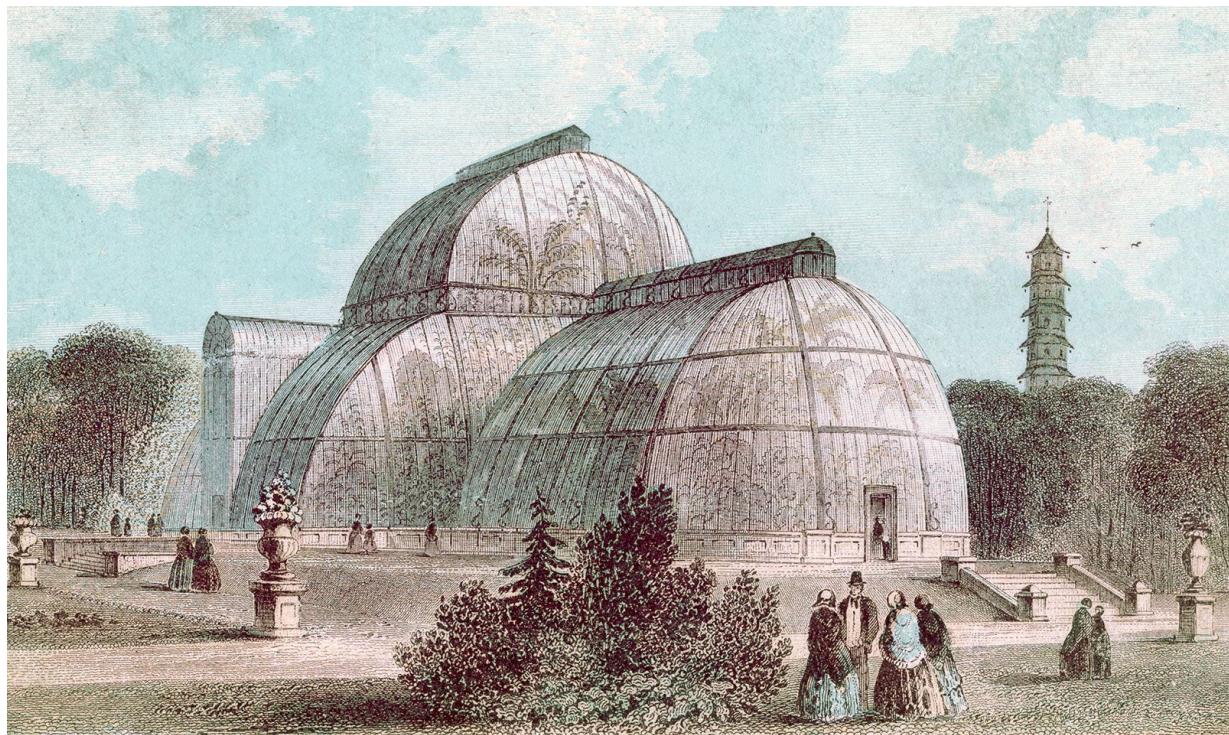
A scholar of Arabic at Oxford University is said to have grown a cedar from a seed he brought back from Syria in 1638, but it was only as the world began to open up, that work of missionaries, botanists, explorers and naturalists meant collective eyes turned to the range of tree and plant species.

An important milestone for arboriculture comes when Princess Augusta, mother of King George III, creates a nine-acre botanic garden within the pleasure grounds at Kew in 1759 but more so when in 1768 Joseph Banks sends seeds to Kew whilst on Captain Cook's voyage to South Seas, and becomes Kew's first unofficial director on his return.



Four years later Francis Masson, Kew's first plant collector, goes to South Africa and returns with thousands of plants and in the years that follow, Kew gardeners travel on the major exploratory sea voyages like the HMS Bounty in 1788.

Later, during the 19th and into the 20th century, arboriculture became more common among the middle classes and their great enthusiasm for the practice resulted in the



creation of conservatory orchards or outdoor collections of fruit trees, and an abundance of literature on the subject.

The expansion at Kew so crucial to growing understanding was part of this, with the Palm house opening in 1848 and the Herbarium in 1853. The latter has been extended 5 times to house its collection now sitting at about 7 million species. Laboratories there have developed our understanding of the genetics of plant and tree life and educated countless masses to the beauty and diversity of the natural world.

The Scottish botanist David Douglas famously introduces the Douglas Fir into Britain in 1827, but actually introduced over 200 new species into cultivation from North America including the Sitka Spruce and the Noble Fir. It is the bravery of these early travellers that truly expanded arboriculture. David Douglas himself died for his art, gored to death by a wild bull on Hawaii in 1834.

A medical officer and customs assistant in Shanghai had travelled to the Hubei province and sent more than 15,000 dried specimens that were used in Chinese medicine back to Kew gardens for research. More than that, he told the directors at Kew of the many beautiful trees he was seeing and Ernest Henry Wilson, who was to become one of the most successful plant collectors of the early 20th century, was dispatched. His work and that of others in the field sent abroad from nurseries keen to obtain the trees seen at Kew or botanists travelling on the early sea voyages are responsible for the beauty and variety of trees available to us now.

Civilisations have adapted arboriculture throughout the ages, none more pronounced a change than that of the 20th century when the two World Wars transformed

arboriculture into a practice that focused on production. Although the concept is not new with the French planting sessile oaks to provide timber for the future needs of their navy. HMS Victory using 5000 oak trees for its construction in 1765.

The early American settlers of course discovered bounty beyond their imagination alongside the habitable shores, in fact the scale is hard to imagine. Forests lined the entire shores of the continent, spanning nearly one fourth of the earth's circumference. In some places those forests extended up to two thousand miles inland. Partial historic records and details from the lumber industry suggest that over 1,400,000 square miles or nearly one half of the entire land mass was forested.

The settlements were established accordingly, indeed their survival depended on those forests, it was only when transportation became widespread and affordable that they could venture further towards the prairies. Those that ventured to the edges began to clear the forest to make way for crops so essentially the first settler was the first 'lumberman'.

As populations increased and towns sprung up the lumber industry expanded to meet the increased needs, initially from local supplies but when these were exhausted they looked beyond their immediate settlements to feed their mills. The resource was



never seen as finite, indeed the forests were a barrier to those seeking to farm or seek to make a living from profitable grain production. The History of the Lumber Industry of America published in 1906 maintained that the US could no longer afford to be profligate with its timber resources but should focus on

conservation.

The International Society of Arboriculture was formed in 1924 but it was not until later that real progress was made with the understanding of the need for arboriculture gaining traction with the ban on harmful DDT spraying and the spirited fight against Dutch Elm Disease in the 1980's. With over 77 million Elms estimated in North America in the 1930's, the disease was said to have decimated 75% of the population. The positive to come out of such destruction was the acceptance more research was needed into trees in urban and semi urban environments.

In UK, the Arboricultural Association was founded in 1964 as a scientific and educational organisation, keen to promote the care and value of trees in no forest settings. Today its work continues alongside others such as the Woodland Trust, Forestry Commission and the Tree Council.

Our understanding of how to grow, where to grow and the infinite positive effects trees have on us and the world around us has improved. There are many who choose commercial gains over good sense and the debate on climate change bears testament to that.

Once you've grown a tree, when do you cut it down and what do you do with it?

On some primeval level we remain uneasy or unsettled when we see trees being felled, as if unwilling witnesses to a public execution. Something so big that we presume has lived so long that can be so easily destroyed. That discomfiture is because we fundamentally misunderstand that trees have already died. Yet in a forest setting there is actually a duty to make room for the saplings to grow, to create the space for them to reach the life-giving sunlight, in what is the natural life cycle of nature.



Once a tree matures, unless it is cut down its only destiny is to rot and disintegrate, the wood is essentially comprised of dead cell walls. In fact, only one percent of a mature tree contains living cells, although the remainder are not biologically alive, they do remain important to support the tree, transport nutrients and be the external defence.

So, when age and weather finally bring a tree down it is time to be grateful for the timber it offers us.

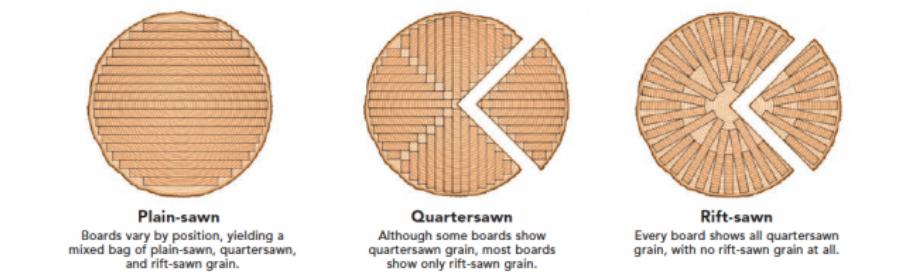
The truth is that felling a tree and designing a beautiful new use to let it live again is the way we honour the tree. George Nakashima, the renown woodworker and furniture maker talks of the 'soul of a tree'. and that it is a duty to find the beauty inherent in the wood in order for a noble tree to have a second life. His eloquence convinces of the need for a tree to offer strength and utility once more or to be something of great artistic beauty. The skill comes from using the wood well. Not chopping exquisite, rare woods into paper thin veneers to maximise monetary return or cut mighty timbers perhaps ten feet in diameter into six-inch boards.

To honour the wood we must know the wood, look closely at the characteristics that make it unique. It may have one use, one way to really shine and it is surely worth waiting until that becomes clear?

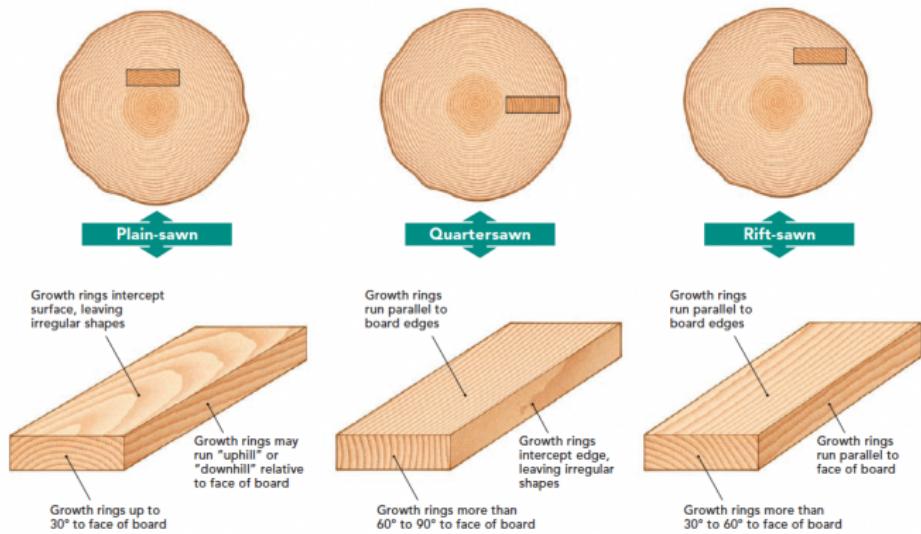
A tree should be felled in winter in cold and temperate climates when the weather is cool and the sap is not rising, or in the dry season in tropical climates. The initial sawing is key as it has enormous bearing on what the log should become and is essentially the first unveiling of the wood. The thickness, direction of the cut and positioning of the log need to be handled sensitively but with intent. Has the tree grown vertically or has it twisted as it grew, are there knots and burls that will add character and depth?

Once felled, a tree is known as a log or balk and could still have up to 85 per cent water content so needs to be seasoned, or dried which can be done either naturally or artificially. There are a number of ways that the logs can be sawn, plain, quarter or rift and will depend on how you see the grain. Quartering the logs removes the pitch

CUTTING PATTERN: HOW A SAWYER SEES A LOG
 If you do an internet search for "rift-sawn vs. quartersawn grain," you'll get a bunch of images that look like the three below. The drawings are labeled with terminology used by the sawyer cutting
 the log into boards, and to them, quartersawn and rift-sawn refer to the cutting pattern, not the grain. To a carpenter or woodworker looking at the grain, the labels are misleading.



GRAIN PATTERN: HOW A BUILDER SEES A LOG
 The sequence used to cut a log into boards will, of course, vary. But below is a look at where in the cross section of a log the boards that a builder would define as having plain-sawn, quartersawn, and rift-sawn grain are located. Each board has distinct differences, not only in appearance, but also in stability and amount of seasonal expansion and contraction.



rings are at a steep angle relative to the face, the board is said to have quartersawn grain. If the growth rings run at a slightly lower angle, it's called rift-sawn. The latter is produced by milling perpendicular to the log's growth rings producing a linear grain

and exposes the log to show any defects which allows for further adjustments to be made prior to further milling.

A board with growth rings running roughly parallel—usually in arches—relative to the face of the board is called a plain-sawn (or flat-sawn) board. If the growth

pattern but also results in the most waste, increasing the cost and is therefore a less common approach.

To allow the seasoning process to happen naturally and not artificially accelerate it delivers better results in preserving the strength and ensuring the durability. Seasoning the wood also serves to increase the stability and resistance to decay of the wood and should begin as soon as the tree is cut.

The best logs should be air dried for one or two years, the rate of drying depends of course on the climate and the species. Some logs can take being weathered for many years whereas the process for logs from cherry and ash should only last a few months. The free movement of air around the logs allows for the reduction of moisture, it takes time but produces beautifully seasoned wood.



A second seasoning is where the logs are milled into planks or boards to allow the sap to dry on the interior parts that could not be reached during the first process.

Logs should be selected seasoned for their intended use, so for furniture to be used in

warm, dry, centrally heated houses logs will need to have been finished off by kiln drying. Artificial seasoning such as kiln drying can be done in a matter of days and is essentially pumping steam and warm dry air around the planks till the moisture content is at the accepted level.

What is left should be planks and boards ready for the woodworker's artistry. They are best stored upright, planks from the same log grouped together to allow them to be browsed, felt and imagined before the final selections are made.

In the right hands and with the right creativity they may become part of impressive structures or stunning, unique pieces of furniture. The years of a tree's existence, the growth pains, droughts, fires, storms, impacts, holes that have healed – all with have left their mark and all wait to be realised and honoured.

The final part of the moral contract to respect the origin of this wood is the finish. Sometimes the finest finish of all is not the oils or stains applied but that which is simply a result of aging, that is surely what truly reveres the tree and its gift to the world.