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Bark: Tree Protection and Habitat

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The bark of woody plants is something with which we are all familiar. We know that its patterns vary, and very often from this we can recognise the type of tree that the bark comes. However, we may be less familiar with why these patterns are different and in this article we will take a look at how bark is formed, some aspects of bark as a habitat, the challenges that bark faces from pests and diseases, and finally, some of its uses. The purpose is to encourage you to observe bark closely and report your findings so that we can understand its importance more clearly.

To identify a tree accurately, we really need to see its leaves, its flowers and its fruit. For most of the year, though, that is not possible – for most of the year a tree will not be in flower, and in winter there are no leaves on deciduous trees. However, we can still get an idea of its species from the overall form of the tree and from its bark pattern (Fig. 1); and although coniferous trees do usually have foliage in the winter and may retain some cones, the differences between their barks can still provide a useful identification tool.

Figure 1. *Quercus rubra* Red Oak (top) *Quercus robur* Pedunculate Oak, English Oak

What is bark?

The anatomy of the formation of bark has been investigated, but studies on bark are not as extensive as on other tree tissues because bark is difficult to section and its commercial uses are not as great as those of timber.

The centre of a tree trunk is the heartwood and this may decay to give a hollow cavity in old trees. It is distinct in colour from the outer wood - the sapwood. The sapwood contains the tree's transport system - the vascular system – comprising the xylem, which carries water and dissolved minerals up from the roots, and the phloem in which the products of photosynthesis are moved around the plant. The sapwood of a deciduous tree holds on to many of the nutrients when the leaves fall, so that they are available for the next season. Sapwood contains layers of actively dividing cells that produce both the vascular system and the outer, protective bark layers. It is the vascular cambium layer that divides towards the inside of the trunk to produce the xylem and to the outside to produce the phloem. Another dividing layer is the phellogen (Fig. 2). On the inner side of this, the phelloderm is formed which, with the phloem, makes up the inner bark. On the outer side, cell division produces the phellem or outer bark. The phellem, phellogen and phelloderm are collectively known as the periderm (Fig. 3). The rhytidome, or dermosphere, is the outermost layer of bark, which is what we see on the external surface of the tree. It is mainly dead tissue and so is often described as the region outside the periderm.

The process of division and specialised tissue formation is common across woody plants, but with some variation between broad-leaved and coniferous trees. So, if the process is common, why does bark have different patterns on different species and different aged trees? The best-known explanation was first given by T. C. Whitmore in 1962. His explanation was that the outer phellem contains dead cells so it cannot expand. Therefore, it fissures when the tree grows. (The dead cells of the phellum also shrink as they dry out, and this causes further cracking of the outer bark.) However, the periderm (with its dividing phellogen which creates the phellem) happens to be arranged in different patterns in different species, and these different periderm patterns necessarily give rise to different fissure patterns: for example, some oak species have a number of periderms arranged in nearly parallel lines, each with a thick, dead phellem. So, the outer bark, under expansion strain, is ridged. By comparison, beech has a single periderm that surrounds the tree and the beech phellem is thin and mainly alive, so it is under less strain. The result of these differences is that beech bark is smooth. Similarly, young trees and branches are under less expansion strain and this explains why they are not as ridged as main trunks.

The dead, outer bark may also be sloughed off, often at the same rate as new bark is produced. In smooth-barked trees like the paper-bark birches it will be sloughed off in sheets. In others, like London Plane (*platanus x hispanica*) with a different periderm pattern, the bark sheds in scallop shapes.

The bark is an essential component of a tree. The periderm is corky ('suberised') and contains tannins which make it more waterproof and reduce water loss from the trunk. The tough bark also protects against some pests and diseases and provides partial physical protection (e.g. from fire), and some insulation against cold and heat. If the bark does become damaged, it can repair, to some extent, through the dividing layers of the vascular cambium and phellogen.

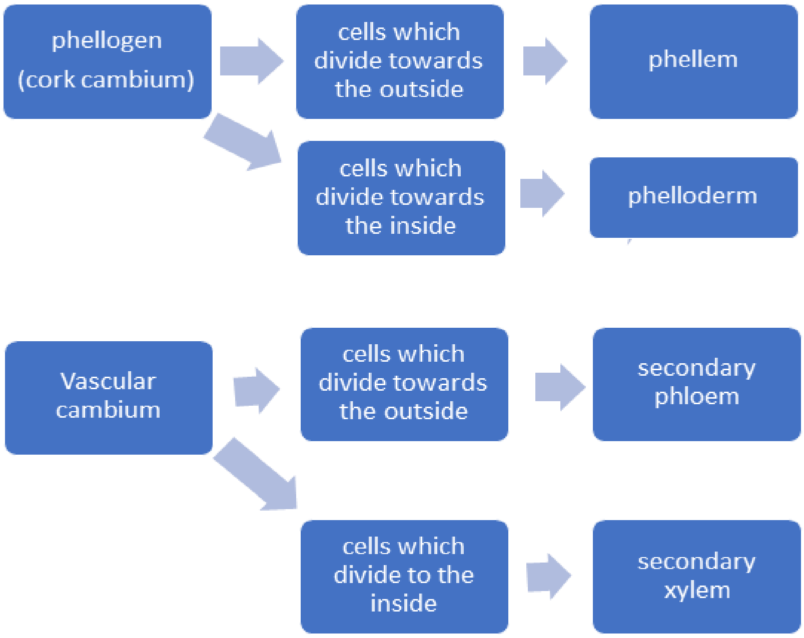

Figure 2. Two separate layers of cambium have cells dividing towards the outside and towards the inside of the trunk and produce new tissue.

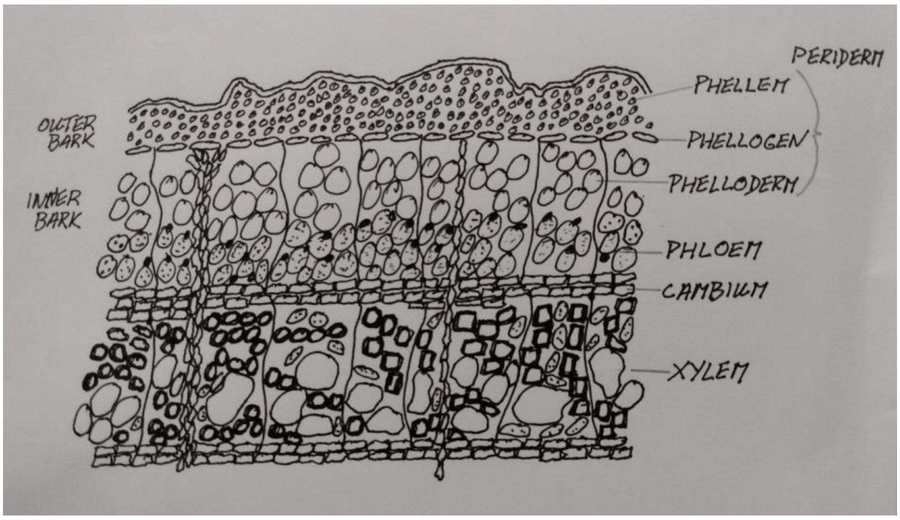

Figure 3. Diagrammatical cross-section of outer layers in woody stem (after E. F. Gilman University of Florida

Human uses for bark

Tree bark is all around us and is an easily accessible resource which has been put to use by humans for as long as we know. It has provided us with medicines since ancient times, and continues to do so. Examples include witch hazel ointments for treating the skin, and the pain reliever salicylic acid (from *Salix* bark), which is now made synthetically into aspirin. Quinine, an old treatment for malaria which is still used in Indian Tonic mixers, comes from *Cinchona pubescens.*

Spices and flavourings may come from bark. In the case of cinnamon, from *Cinnamomum,* we actually put a piece of bark into our food or mulled wine. Industrial chemicals may also be extracted, such as tannins for tanning leather, or be made from the resins that flow through ducts in the bark (e.g. rubber from *Hevea brasiliensis*). We may also use bark directly in our gardens as mulches to retain moisture in the soil.

The structural qualities of bark give us useful materials of which cork is perhaps the best known, whether as bottle stoppers or tiles. Birch bark canoes are still made and the bark of the Paper Mulberry tree, *Broussentia papyrifera,* is processed in South Pacific nations into the decorative cloth tapa or mesi.

Pests and Diseases of Bark

Bark does provide a considerable amount of protection against disease attack. The dead cells in the outer bark (phellem) lack protoplasm, and so give nothing upon which biotrophs can feed. The suberin and resin provide a physical barrier and there are no symplastic pathways (i.e. pathways enclosed by cell membranes through which water and solutes diffuse freely) which would otherwise be used as virus entry points. However, wounded bark allows pests and pathogens to pass through and enter the living wood, and some of these attackers, particularly bark beetles are even able to penetrate intact outer bark.

Figure 4. Fungi, bryophytes and lichens on a fallen tree bark

Bark beetles may cause serious damage when they become out of balance with nature (usually in farming or forestry systems). We are all familiar with Elm Bark beetles *Scolytus sp.* which spread the fungal Dutch Elm Disease. More recently, the Great Spruce Bark Beetle (*Dendroctonus micans)* which was first found in England in 1982 has now spread to Scotland leaving tree loss in its wake. There are other beetles, not yet found in the UK, which would cause very serious damage to our trees if they were allowed to enter. This is why we need tight biosecurity measures and border controls on the import of plant and plant materials. Asian Longhorn Beetle (*Anoplophora glabripennis),* which has a very wide host range, is one example, as are the Emerald Ash Borer *Agrilus planipennis,* whose larvae burrow into the bark, and the Bronze Birch Borer *Agrilus anxius.*

Phytophthora ramorum is a pathogen, first seen in the UK on larch in 2009, which has caused landscape-scale damage to commercial forests and to many other trees and shrubs such as *Rhododendron sp.* and Sweet Chestnut (*Castanea satvia*) This pathogen's swimming zoospores can penetrate the bark from water held in the bark fissures (Brown and Brasier, 2007).

Bark as a Habitat

The rhytidome, or dermosphere, is the outermost layer of bark; the mainly dead tissue that we can see on the outside of the tree. It has an estimated area of 0.9ha per ha of a typical temperate/boreal forest and so represents a huge surface on which other organisms can live. Hoffman *et al.* (2023) pointed out that "despite its vastness, the bark micro-ecosystem of forests remains unknown…" (extract from Section One, Introduction)

Examples of species which inhabit the rhytidome habitat (Fig. 4) include: algae – often giving colour to the dermosphere as green or orange; bryophytes; lichens (the pH of the dermosphere often determines which lichens will grow e.g. the alkaline bark of ash (*Fraxinus sp.)* is especially suitable for many lichen species); epiphytic ferns; slime moulds; fungi (though those we usually associate with tree bark, such as bracket fungi, are not usually bark dwellers as such, but are saprophytes living on dead wood which are exposed through their fruiting bodies); bacteria and other micro-organisms; insects (aphids, beetles including burrowing larvae, wasps, moths hiding during the day, ants); arachnids (spiders, mites); molluscs (slugs, snails); mammals (rabbits and deer feeding on bark, bats sheltering behind loose bark or in holes).

So, there is much to fascinate us with bark, and much to observe in its habitat. Take a close look!

References and Further Reading

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David Skydmore was awarded FBNA in 2020. He is Emeritus Professor and a Director of the Lovell Quinta Arboretum in Cheshire.

At the 2023 National AGM David gave a talk *"Barking up the Right Tree"* which this article was adapted from and was published in the Country-*Side* magazine in Summer 2024. It has now been reproduced as this members article.