# TREES AND THEIR LIFE HISTORIES

PERCY GROOM

ILLUSTRATED
FROM PHOTOGRAPHS BY
HENIOT IRVING


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AND THEIR LIFE HISTORIES

SILVBR BIRCH- *BBTVLA ALBA:* SUMMER.

# TREES AND THEIR LIFE HISTORIES

BY

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# PREFACE

IN this book I have endeavoured to consider the tree, not as a mere object to be identified, but as a living being whose struggling life is to be watched, whose wants are to be studied, and whose changing lineaments are to be observed. And I have sought rather to guide the interested observer of Nature than to attract the book-lover, and rather to concentrate the reader's attention on the tree itself than to lure him from the woodland to his book-room.

The explanatory Introduction will be found useful to those unacquainted with botany, but superfluous to others. Every pursuit must have its own technology to ensure accuracy, but throughout this work I have reduced technical terms to a minimum.

Analytical tables, diagnoses of families, and numerous illustrations will enable the reader to identify the various trees, and certainty in this respect is quickly ensured by the brief mention of distinctive features that is prefixed to the account of every tree described.

But the accounts of the various trees are not mere descriptions of the forms of these, nor are they alike in nature and scope. Particular trees have been selected for more detailed discussion, so as to serve as types by which to demonstrate certain structural features or general phenomena observable in tree-life. For example, branching of the tree is specially illustrated by the Scots Pine, Larch, Yew, Horse Chestnut, and others; branching of a shrub and weeping tree, by the Elder and Laburnum; the repair of injuries, by the Scots Pine; the attacks of Bark Beetles, by the Elm; the deformation of diseased shoots, by the Spruce and Birch; the habits and behaviour of a shade-enduring tree, by the Beech; the shape and conduct of a light-demanding tree, by the Larch and Birch; the degeneration of flowers, by the Sweet Chestnut and Ash; the evolution of sexuality, by the Maples, Horse Chestnut, and Ash ; the part played by insects in fertilisation, by the Horse Chestnut, Laburnum, Guelder Rose, and others; versatility is exemplified by the Juniper and Mountain Ash ; variability of form and action, by the Common Spruce ; and so forth. By this analytical method I have attempted, not only to add interest to the study of each tree, but also to enable the reader ultimately to combine all the different points of view in connection with any particular tree that he may wish to study. If the reader, then, have only a solitary tree available for constant examination, he will find in it sufficient material for years of observation, interest, and—discovery.

That this book will thus incite some of its readers to enrich our knowledge of tree-life is the hope of the author.

PERCY GROOM,

CHELSEA PHYSIC GARDEN.

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# TREES AND THEIR LIFE HISTORIES

Fi(T, i,—Under the Beeches.

## INTRODUCTION

### I.—ACTIVITY OF THE TREE

SO gradual is the growth and so hidden from casual inspection are the various forms of activity of the tree, either in its summer garb of foliage or in its winter nudity, that one is apt to forget the rapid unfolding of the leaves in spring, the sudden outburst of blossom, or the sprouting of countless seedlings, and thus to regard the tree as akin to an inert stone rather than to an active animal. Yet the tree is a living being which breathes, feeds, grows, moves spontaneously, reproduces its kind, and provides protection as well as nourishment for its offspring. Its seeming quiescence or dnll, slow working is illusory, and masks unceasing activity.

But in other respects ttie tree presents a deceptive appearance. Lashed by wind and bereft of its branches, or uprooted by storm; robbed of its foliage by countless insect foes, by frost, or by drought; sickening under insidious fungal attack that is

Fig. 3— Young Beeches.

revealed in rotting boughs or disease-infested twigs, the tree seems but a helpless victim doomed to fall at the relentless hands of animate or inanimate Nature. Yet its **apparent helplessness** conceals **a** faculty of defence that, within limits, is as **onerting** as it is unconscious. The tree

**Faculty of L**

- has a policy to pursue in reftretici its surroundings, and to these it has a marvellous power of adjusting itself **either** during the life-tiim- of one individual, or in the course of ages. The nature of its struggles will *he* recounted in connection with the life-histories of the different trees • icribed, but here we may illustrate &fl point by mere allusion to the modes in which **a** tree rooted in sand **poshes the** main root rapidly down to the depths where water lies, but on rock or ruin spreads out shallow lateral roots whitii penetrate crevices, and **perhaps** cleave rock or ruin asunder; or to **the** manner in which a **tree** whose stem-tip is injured repairs the damage by forcing its upmost branch or bud to grow erect, and Ilms stretches towards the light that it needs ; or how the tree sacrifices **and** sheds the old branches, **when** once **they** have become too overshadowed to be of service; and conversely how it shoots **forth** numerous **branches** from old **parts** o( **the** stein, when these arc exposed **to** stronger light, or when new **branches** are required to replace old ones that have bt;rn

Fig. 3.—Young Beeches.

*F\Z. 4*—IVY ON SCOTS PINE.

*Fig.* **5.—Drooping Wych Him.**

destroyed by mishap ; or finally how the tree **ravaged** by foe, or perhaps ncurly dying of thirst, may burst into a marvellous blazt; of blossom as if in one despairing effort to preserve the race by the sacrifice of its own life. All these illustrations convey the truth that the individual tree has a **reraark-** iibk power of adjusting itscli to the outside world, and that, within **the** limits of its powers, it seems to possess the still more remaikable faculty of inevitably doing the right thing -^ a faculty of which man's reasoning power has robbed him.

**Hostile Forces.**

But the powers oi a tree cire not infinite ; frost, heat, or drought may cause leaves and buds to wither, or stems to crack and thus admit deadly fungal foes; **animals** or fungi injure the roots; or shade may destroy the whole plant. To these and other hostile forces different kinds of **trees** show different powers of resistance, **afld** have become adapted in the course of ages to live in diverse situations. In every forest may be seen examples of the truth of these statements, especially in reference to one external agent, light, to obtain which forest-plants are engaged in unending warfare in **which** millions of humble herbs, infant trees, or tall striplings* perish under the lethal shade *at* moni successful rivals. Some trees have fitted themselves for the war fare by acquiring the faculty of successfully **withstandhlg** a considerable **amount** of shade, and are said to be *shade-endwittg.* And H is instructive to observe how the shade-enduring young Beech-tree grows upwards slowly, **but** spreads its deadly shade over its young rivals *(sec* p. *2*; Figs, *z* and 3). **Certain** other trees cannot withstand much shade, and are therefore described, as *light-demanding.*

These when young often shoot swiftly upwards, produce but little shade, and soon rast off their lower brandies.*

Trees have not only advanced in **Complexity** and developed elaborate structural **devices** fitting them, for

**DegmrtfaKi.**

cxistencc -m spccilll **gjfca.** tii ins, but they have in some **cases** retrograded by reducing certain of their parts that have become useless or a source of danger ; such reduced parts are said to be *degenerate.* Large leaves possessed by the ancestral tree may dwindle to scales in the descendant; l°ngt leafy branches to short scaly spines; gay blossom to dingy inconspicuous flowers ; or winged seeds to wing-It ss seeds.

*It must not be forgotten, that all trees tlcmant.1 a certain amount of light, that each flourishes in a given situation only between certain limits of darknews **sad tight,** and finally that increased shade often involves more mots Lure while increased light ofien jmphnjs **greater expenditure** of water. Hence the terms *light-demanding* and *shade-enduring* are vague ami partly misleading ; **but** practical forestry in Europe justifies tluur use.

Irregular as may be **the** shape of **a** tree, its form is determined by gcowth a A ordered and orderly as that of any

Re ·hrit of 5? **Orowth.**

anlma] ; bvIt its regularity of design is obscured or obliterated by two circumstances. First, **the** tree grows year after year throughout life, and preserves certain of Its parts in a permanently juvenile condition : a British tree, in the strict sense, is never full grown. Secondly, the tree has the power of bringing into activity some of these perennially young parts, and of thus replacing missing members or creating new limbs. Its irregular shape is not the result of disordered growth, but of **irregular** experiences and demands. The tree is like a warrior who has been maimed and scarred in many a battle, but has the magic power of replacing lost limbs by others springing from different predestined parts of his body.


**Fly. 6,—Holm Oak.**

Very simple, probably degenerate, **male (♂) and female** (;) flowers **and** inflorescences.

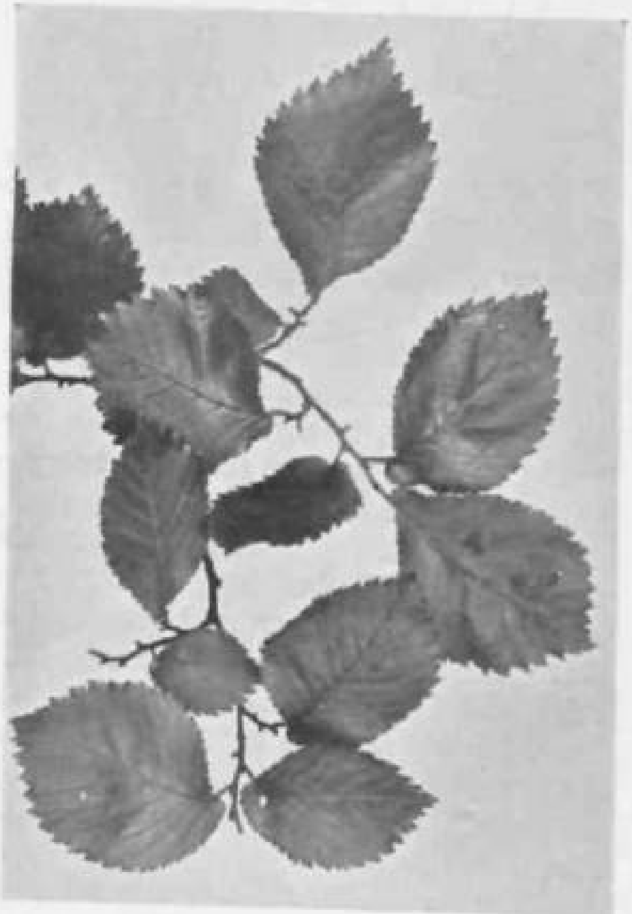


Fig. 7,—Common Him: shoot.

**Fig.** 8.-Wych Elm : shoot.

## ".-NOURISHMENT OF THE TREE

An animal compared with :\ «reen ulint is ao epicure demanding elaborate food m tin- form of starch, wgar, or filt, and all™ **minons substance; the ttee is an** ascetic, for although ultimately needing these elaborate substances, it can obtain 31 manufacture thorn from simpl, ingredients contained in the .,,,. water" *Z &!££*

I-»rest soU in whkh the roots He i' J' h^ v r, simple in composition," nor is -- cumuL of ^ U Forest sol,. '™-al matter, but fe rathe, a world ^thing with life , is permeated by countless fungal threads occupied by inconceivable mvri uls of micro-organisms, and burrowed 'by manv subterranean animals, mcludhig earth worms. All these plav a part in building «P ***** which, in ^, cannot exist in absence, Under &<& **influence dead** n" , leay *? ** "^ Stems, md ™™1 P^ S J J ? comw^ into food-material for the trees, able that f ^ ^ Penetra^ and moisture IT 1 '" ^ ^ Sta^mtil^ Were merely forest *ZM^T*& *a ^ ^ ^ ^ T 7,^'aild m its P 1 ^ stunted -^d reign. Or were the air to be driven out permanent inundation, then would give **way to** mossy, £* oV ^ssy **W and fen.**

tafj T. J°* only fa and SaPPott the Y, they also *absorb* *f*™ ®* A^orption *SOil w&ter and* *substances dis*- of Water* solve cold tljis ubsorI>ti"n is retarded or stopped, and -** «- conditiun of affairs during our winter.

The raw sap thus **obtained** is carried up **the** outer wood of the stem **to** the growing purts and green leaves, From these **a** small part of the water exudes in the form of drops, but a vastly **greater** part is exhaled as water-vapour.

Transpire tion.

This latter process of evaporation is termed *transpiration ;* and it is important to note that *the greatest loss* ^ tt›fl/(·r *takes place through the green leaves,* so that when **these** are shed, the tree is not expending much water. Loss of water by transpiration is increased by larger number or size of leaves, by heat, dryness of air, wind, and by light. Yet transpiration can continue, however cold the weather or climate, even when the roots are not absorbing. And it is, at least, partly fur this reason that our trees shed their folinge before winter ; <r if tile leaves be retained as in Firs, they are thick-skinned and tough, and transpire slowly.

Green Leaves as Factories of Food.

Hut *green leaves* have another duty to fulfil. In the presence of light they *absorb carbonic acid gas* from the atmosphere, and split this into oxygen and carbon. The **oxygen** is released as a gas, and goes to enrich the atmosphere ; but the carbon is retained, and combines with the water and raw mate-rial obtained through the roots. In (his way ***elaborate*** *food is vrn'mfaclured by the green leaves,* whence it is transported to growing twigs, flowers, and fruits, to thickening stems and subterranean roots, in all of which it is utilised in building up the tree, or is stored for future **consumption,** Destruction of the leaves of a tree, therefore, involves **a** loss of power **to** produce appropriate fund-material, and threatens the

**Fig. 9.—K nee -roots of Marsh Cypress.**

tree with starvation. How this danger is averted will be seen in the sequel.

The greater number of green leaves that a tree acquires, the more food does it manufacture, and the more water does it expend, Consequently increase in the foliage and branches demands a corresponding increase in the size of the root-system to supply the larger demand for water and raw material, as well as to support the additional weight, and to withstand the force of the wind now acting on a larger and taller surface.

But the tree accomplishes yet another gaseous interchange with the atmosphere:

Respiration.

it breathes, taking in oxygen and giving out carbonic acid. This process of *respiration* proceeds in light and darkness, by day or night, and not only in the green leaves but in all living parts of the tree. Just like a human being, the tree requires oxygen. This is well brought out when we note the behaviour of the Marsh Cypress whose roots are sunk in a water-logged soil from which the free air has been expelled. Such roots would seem to be exposed to the danger of suffocation, But the tree sends up from shallow horizontal roots knee-like roots (Figs. 9, 146-7, and 149), which act as lungs by taking in air (with oxygen), and conveying it to the parts lying in the mud.

A tree, therefore, requires air, water, food-material in the soil, sunlight, and—it may be added—an appropriate temperature. Excesses of heat or cold, of drought or humidity, of shade or sunlight, or over-abundance of certain substances (common salt, lime) injure or kill the tree.

## III.—ROOT SYSTEM

The root of the infant plant inside a seed is usually represented by a single short rod —the *main root*—which subsequently elongates solely by growth at its tip, and tends to descend vertically. From its sides, not far behind the tip, spring root-branches—the *lateral roots*—which grow and branch in like manner, but tend to spread out horizontally or descend obliquely. All these roots thicken in their older parts, but are thin at their constantly young ends. The thin parts alone absorb water.

Some kinds of trees are *deep-rooted* and

Deep and Shallow Roots.

even unable to adapt themselves to shallow soils, or, if compelled to grow on these, are readily uprooted by wind and may develop feebly for lack of water. Other kinds of trees are *shallow-rooted,* emitting long, horizontal, lateral roots which enable them to thrive even on rocky soil. But each individual tree more or less adjusts the form of its root-system to the nature and depth of soil in which it finds itself,

The stems of some trees, such as the Sweet Chestnut and Spruce, have the power of emitting roots ; indeed certain trees, including Willows and the Lombardy Poplar (Figs. 10 and 11), are mainly propagated by shoots in the form of cuttings.

Conversely the roots of the Black Poplar, Common Elm, and some other trees, manufacture and send out of the soil erect leaf-bearing shoots which are known as *suckers.* Such trees may be propagated by root-cuttings.

## IV.—SHOOT SYSTEM

A simple *shoot* consists of a *stem* and lateral appendages, known as *leaves.* The stem, like the root, elongates by growth at its tip, where it produces new leaves ; it therefore ends in a *bud* which consists of a short young stem bearing crowded young leaves,

In most cases a stem (Figs. 12 and 13) shows leafless bare parts—the *internodes*—

Fig. 12.—Lombardy Poplar, in Winter.

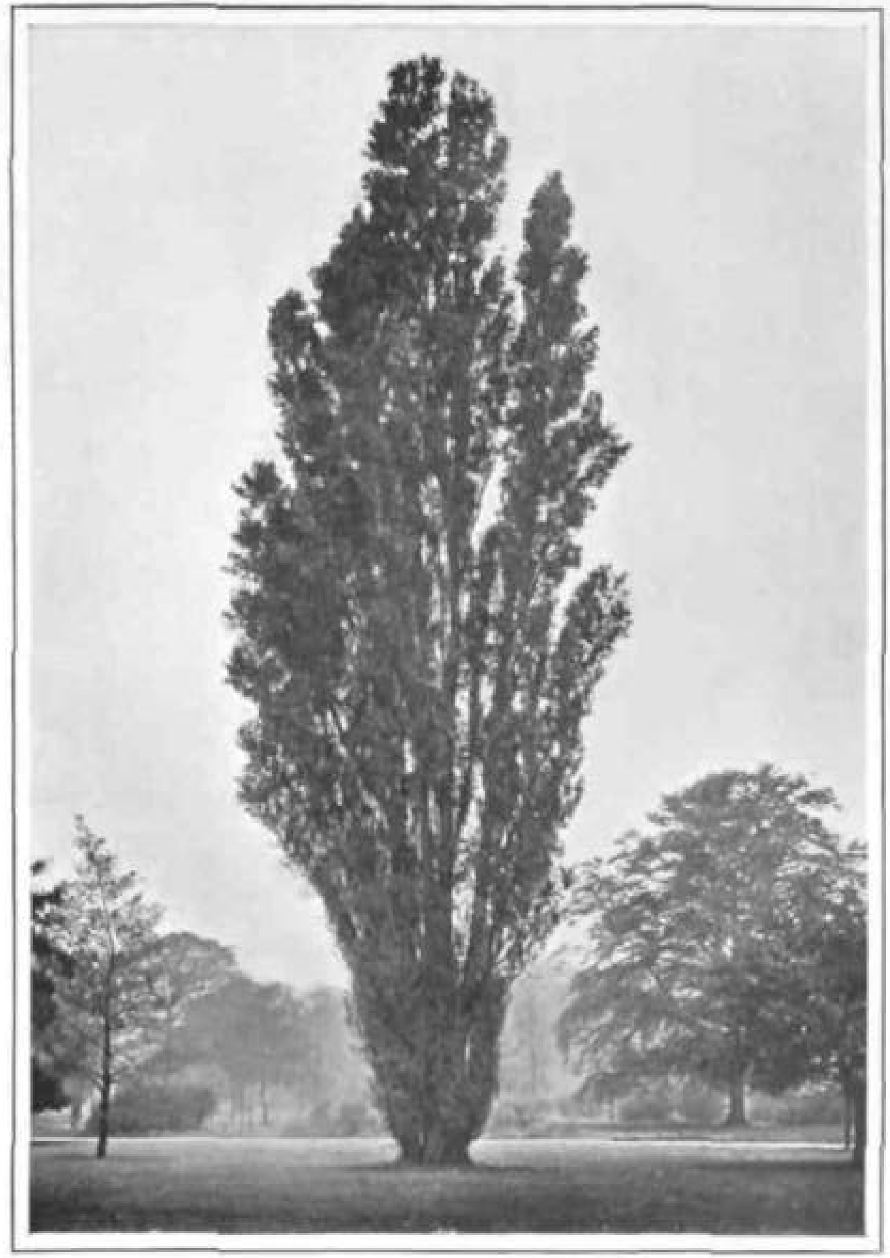


Fig. 11.—Lombardy [redacted], in Summer.

**Fig.** *12.*—**Common Maple.**
**>lim>i with opposite leaves.**

connecting the leai-beariag pavts^-the nodes —which are sometimes joint-like or swollen (Fig. 488). Hut in **maay** Firs the leaves succeed one another at such short distances thru tiu-re are no distinct intemodes (Figs. 119 and 120).

**Leaf Arrangement.**

Green leaves are not arranged irregularly round the stem. This is very evident if **we** examine a Maple (Fig- 12), whirli has two leaves at each not\e# These are on directly opposite sides of the stem, and are succeeded (above or below) at the next nodu by two leaves standing at right angles above (or below) the middle of the gaps between them. Such a *leaf-arrwgement* i> described as *opposite,* and the **leaves** at the successive nodes are said to alternate with one another. Tt will be noted that with two leaves at a nodt there are four yanks of i«ivts> a\ong the stem *{e.g.,* Maplts, Ash, Horse Chestnut). The two (or more) leaves inserted at one node constitute a *whorl,* and when more than **two** leaves occur at a node, the arrangement is said to be *uhorled.* Even when there is only one leaf at each node the leaves are not arranged irregularly, but form a spiral, so that there may be two, three, five, or more ranks of leaves along the stem ; this *leaf-arrangement* is said to be *alternate* or *spiral {e.g.,* Hazel, **Willow,** Oak, Apple). **Observations** on the leaf-nrrangement often aid us in distinguishing between **trees** of somewhat similar foliage ; the Plane •(Fig. 3Z6) and Mountain Ash (Fig- 454), with alternate leaves, are thus respectively distinguished from the Sycamore (Fig. 349), or Maples (Figs. 12 and 354), and Ash (Fig. 494), with opposite leaves.

**Lateral Buds.**

The stem, in addition to ending in a bud, which is the *terminal* in position, ;iko bears *lateral* buds. Each ordinary , . , t , , , .t lateral mid stands m the upper angle between the stem and leaf; this upper angle is termed the *axil* of the leaf, and the lateral bud is said to be

**Fig. i:.—l.omtvir.U Poplar.**
**Shoot, showing alternate 1e*v#* ami axillary bud*.**

*axillary.* In broad-leaved {dicotylous) trees in the axil of most of the foliage-leaves stands a bud ; and, as such **a** bud may remain attached and living for many years, though in a resting condition, the tree possesses numerous buds capable of shooting out when occasion arises. In most conifers a considerable number of the green leaves have no buds in their axils, and it is partly for this reason that coniferous trees usually exhibit a smaller power of replacing leaves or shoots which **have** been destroyed. But many trees are endowed with the power of producing new buds on old stems or roots, and of thus atoning for any lack of long-lived axillary buds: in this respect, too, conifers are generally less capable than broad-leaved (dicotylous) trees.

## V.—LEAVES

### I.—FOLIAGE-LEAVES

A complete green leaf has three distinct parts : (i) Leaf-base, (2) Leaf-stalk, (3) Leaf-blade.

Leaf-base and Stipules.

The *leaf-base* attaches the leaf to the stem, and often bears at its sides two fiat outgrowths known as *stipules* (Figs. 14 and 24-6). As the stipules often serve merely to protect the delicate young parts of the bud, they usually shrivel or fall off shortly after the leaf bearing them has expanded (Fig. 15). Hence, in examining a leaf to see if it be really stipule-bearing, one must always remember to be prepared for the presence of scars left by fallen stipules. Sheathing tubular stipules embracing the stem are possessed by the Plane, which also completely conceals its lateral buds within **the** hollowed base of the leaf-stalk (Fig. 325). Protection of another kind is provided by the stipules of *Robinia,* which are converted into hard woody spines (Fig. 410) that persist, and apparently serve as weapons of defence against browsing animals. The large green leaf-like stipules of the Hawthorn (Fig. 479) persist for an entirely different reason, namely because they perform the offices of green leaf-blades. In some cases the leaf has neither leaf-stalk nor leaf-blade, but is reduced to its two stipules, which then

Pig. M-—Tulip-tree.
**Opening buds, showing the separation of the stipules.**

**Fig. 15.—Tulip-tree.**
**Bud protected by stipule*; the stipules of the expanded leave* hove iiilltii.**

form paired scales protecting the resting-bnds.

On the contrary, **the** leaves of some **trees** (Sycamore, **Ash.%** in. place of being ***stipulate*** (stipule-bearing) never produce stipules. The presence or lack oi stipules often enables us to distinguish between trees whose foliage" is [more or less iilikc—for instance, between **the Plane** and Maples, or the Ash and Mountain Ash.

In some cases the stem is raised up into a ridge or swelling *{leuf-cushion)* when[1] **each** leaf is attached, eg., Ash, Spruce.

Leaf-stalk.

The *leaf-stalk* merely serves to thrust **the** loaf-blade into its correct position and pose *m* relation to the light, so that it is sometimes wanting. The **mode in [which** the leaf-stalk regulates **the** exact pose of the leaf by adjusting its length, direction, or by executing **a** twist, can be fully realised only by examining the leaves on the tree itself. But in this connection attention may be drawn **to one** special case, that of many conifers whose- spirally-arranged, flat, narrow leaves are twisted (in tht- **branches SO** as **to** asstnne a double comb-like arrangement (Figs. 61 and 118),

**Leaf-blade.**

The *leaf-blade* is the part that is mainly responsible for the absorbing and manufacturing activity of the leaf. Its skin is perforated by many microscopic pores—the *sfomata*—whose position is sometimes visible to the naked eye, because **white** wax coats **the** stoma-bciiTing part of the leaf, and that part only (Figs. 61 and 118).

The leaf-blade is usually flattened, and more or less broad in dicotylous (broad-leaved) trees, but is needle-like, or only slightly broader *(linear},* in Fir-trees and most other conifers (Figs. 6t and 62).

In the former type of blade the veining is net-like, as the finest wins unm- **to** form a network. The chief veins, **however,** vary

**Fig. 1o.— Pintt.iu-Jv w ,,K.,i Leaves of the Mcdl.n -tree.**

Fig. 17.-Palmately-veined leaf of the *Catalpa bignonioidcs* ;\Valt.j.

iii their arrangement. In most cases only **a** *single* jnedian vrin or nerve—the *mid-rib*—runs from the base to the ti of the blade, and from its sides lateral veins are given off right and left (Figs. 15 and 16); such wining is *pinnate.* But the leaf-blade of the Sycamore, Maples, or **Plane, sh<*»S** several chief veins radiating from its base, and the veining is *palmate* (Fig- 17)-

**Veining.**

The margin of the Icatofode may be *toothed* in various ways, or the indentations may be larger and deeper, so as t0 divide the blade into *lobes* Qr *S£Smefits* •• , *[n* this way a palmately-veined leaf becomes *palmatdy-lobcd (e.g.,* Sycamore, Plane: Figs. 349 ™*d* 326), while a pinnately-veined leaf becomes *pinnatdy-tebed {e.g.,* Oak: Fig. 235). Sometimes the blade is divided completely into separate ***leaflets,*** and the leaf is said to be *compound* in contradistinction to a *simple* leaf with a single leaf-blade. Such a leaf may be *f innately compound {eg.,* Eider, Ash, .Mountain Ash: Figs. 18 and 454) or *ptdmaldy compound (e.g.,* Horse Chestnut: Pig. 381},

**Division of the Leaf.**

As tlie delicate, soft* young leaf-blade is **Specially** liable to be attacked by parasitic fungi or by noxious insects, and to be dried up by excessive transpiration, it is developed as far as possible under protection of older parts of the bud. For this reason it is tucked inside the bud so as to occupy as little space as **possible,** by being *folded* or *railed* in various ways. **When** the blade is tlmist out of the bud by sudden elongation of the loaf-stalk, it is often more or less folded or rolled, and coated iv-it>} glistening balsam or *slim?> or* clothed with hairs which persist or are shed **a** ft ar the blade has fully unfurled. Even protected as they are, the young parts of the buds nf ()aks, S|>i itr.es, and otbu *t* **trees, are pierced** by gall-insects, and consequently give rise to galls *[see* pp. 195 and 196, Figs. 19, 20).

**Protection of the young Leaf-bltule.**

**Pig. 18. — *Pyrus Sorbus.***
**Twig with pirniilely compound Icnuts-**

Fig. 19.-Currant Galls on Oak.

characters in our woodlands, causing them to differ from evergreen forests. In the first place, the bare or thinly foliaged branches and trunks in early spring allow much Hgfct to reach the ground ; to this light we owe me gay carpet of primroses, bluebells, and the like, haunted by many insects which would not enter the gloom of a perennially K*aged forest. Secondly, many trees burst into blossom in spring before the leaves shoot forth ; the consequence is that there is no mass of foliage to conceal flowers from the vision of insects, or to obrtrii.ct the powdery pollen that requires to be blown from Sower to nWer.

## II.—SCALES

A tree possesses in addition to foliage several other kinds of leaves, which are fitted to perform different kinds of work,

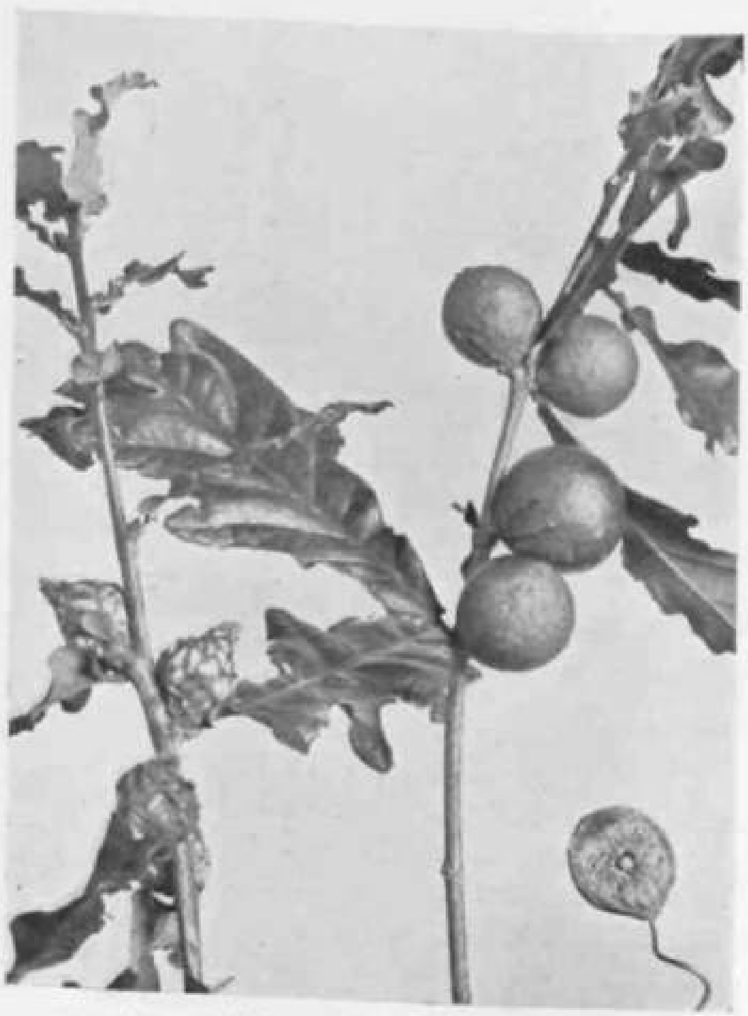


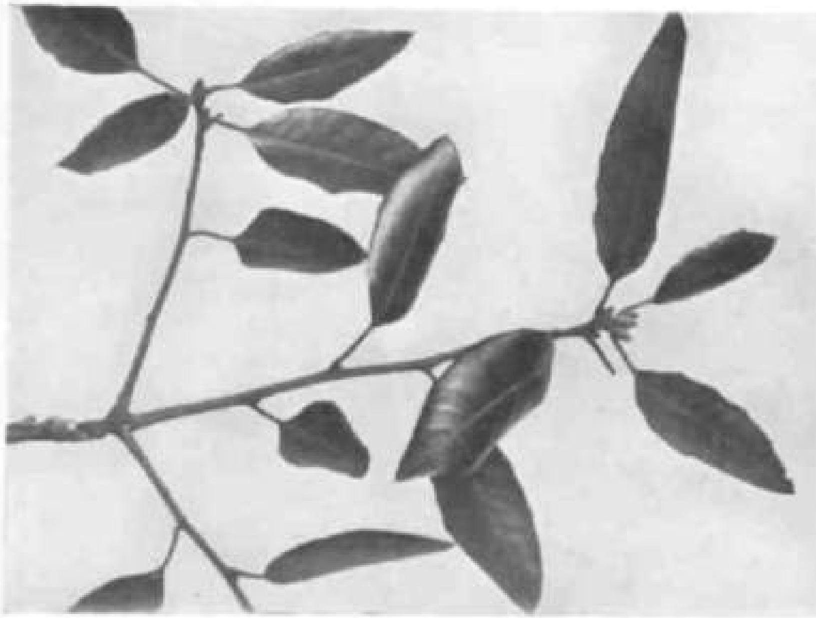
Fig. so.-Artichoke and Marble (kills on Oak.

Tlii» green leaves of most of our trees change their tints in autumn to yellow, brown, or red, and fall before winter arrives. But the Holly, Ivy, and Box, as wed as nearly all coniferous trees, retain theii foliage through the winter, and are therefore described as being *evergreen,* in contradistinction to trees which shed their foliage annually, and are therefore referred to as *deciduous* trees. Even in the evergreen trees each foliage-leaf lives and remains attached only for a limited number of years; tlir longevity of the leaves varying with the kind of tree and the situation, from two to twelve or more years.

The habit of casting tin- leaves each) year not only brings in its

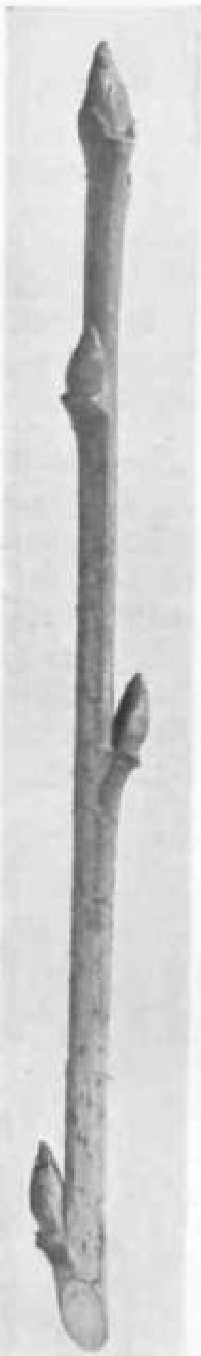
**Fall of the Leaf,**

tmin tUe bea^y «* olir atttWn»5J y w]len poverty in blossom is atoned for by glory of leaf-tint, but is also associated with certain and therefore assume different shapes, but are **arranged** spirally or in whorls. Some of these are small, broad - based, stalkless, simple in outline, and not green. Sueti *scales* are produced in place



F'ijf. 21.—Holm Oak.
Shoot with i-vtrKfccii leaves.

of foliage-leaves towards the conclusion of **the** growing season in summer, so that tho terminal bud of a shoot is encased in *bud-scales,* which serve to protect it for years, or at least during the succeeding winter (Figs, 22 and 23}. In the following spring, ***when*** a *resting'hitd* of this kind sprouts, the scales do not develop into green foliage-leaves, nor does the part of the stem bearing them elongate **appreciably;** the consequence is that, as the **scales** fall soon, they leave behind them a number oi **closely** clustered scars, wliich thus **dearly** mark the conclusion of a year's growth <>*i* &e twig (Fig. 23), It is therefore evident that tIn- piece of stem lying between two of such rosettes of scars represents one year's growth ; it is therefore termed the *ycar's-sh&Ot,* **Other** kinds of scales apart from **bu&gcales** arc **met** with in Pine-trees *(sec* p. 50), Scales are mainly protective in function, and therefore require **neither** green colouring matter nor a **leaf-stalk.**



Ft}:. 21. -Pyrus
So r bus.
Twig In winter, with
resting-buil*.

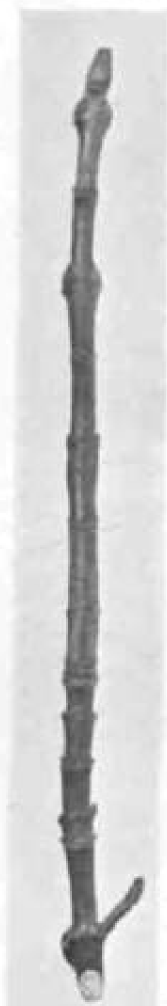


Fig. 23.—Acer
Negun o.
Twig I" winter, with
rnH r - buds «nil
showing Kir* o*
fallen Icn«s.

## III.—COTYLEDONS

The first **two** leaves borne on the seedling o£ **a** broad-leaved (dicotylous) tree are always opposite, and arc usually simpler

Fig. 24, -Lime.
Opening buds, hi-t stugu.

than, or differ m form from, the foliage-leaves subsequently produced (Fig . 27). **These two** leaves are termed ***artylefons:*** and *dicotyledons* or *dicQlylous* plants are so-calledbecause they possess two cotyledons in their infancy. The coniferous seedling has a whorl of two or more narrow cotyledons. Cotyledons may serve merely to store lood for the infant plant, or **may** absorb food stored outside the latter and thus render it available to the seedling ; they may or may not subsequently emerge from **the** Soil* become green, and perform the office of foliage-leaves.

The foliage-leaves succeeding the cotyledons often differ markedly from those produced later on, and are then referred to as *primary leaves {see* pp. 56 and 283),

**Fif. 25.—Lime.**
Opening **bud,** second ***ttuge.***

## IV.—BRACTS

Near the flowers foliage-leaves avt usually replaced by simpler, smaller, often scale-like **leaves,** which are known as *bracts* (Figs. 264 and J71). These leaves usually protect the young flowers, and are apt to be feebly developed when protection is otherwise provided. But they also may 'take on **other** functions, such as that of assisting in the scattering of the seeds **(d.jj^JJme,** Hornbeam).

## V. -FLORAI. LEAVES

Tht' loaves ciiti-r-ing **into** the composition of **the** flowers are termed *floral leaves,* and will be discussed on **pages** 2^-31,

HR. a6.- Linu\
Opening **bud,** itiir.l **stage.**

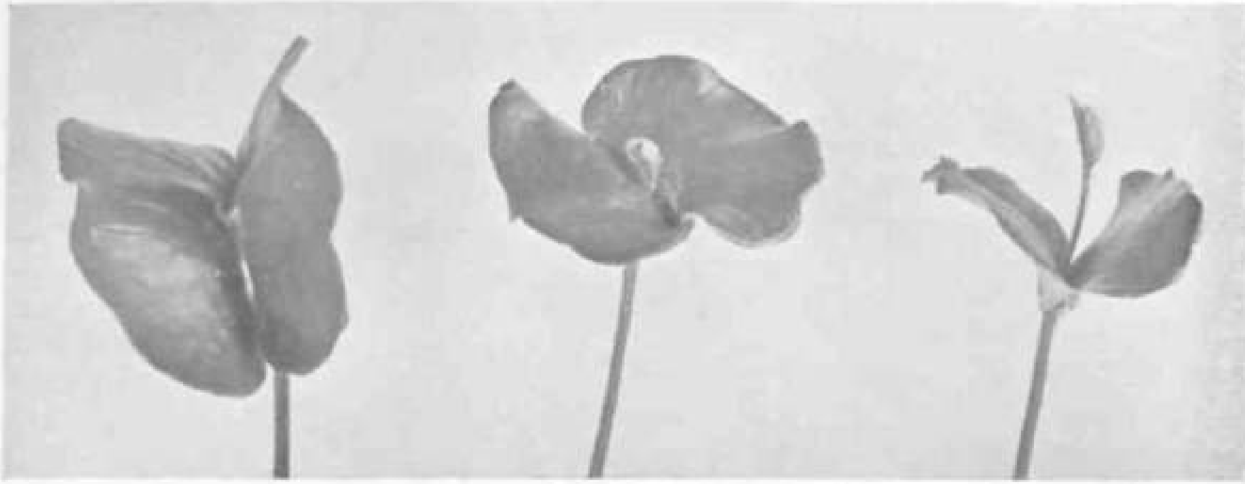


Fig. 37. -Seedling Beeches.

## VI.—STEM

The infant plant within the sped or the seedling itself has a **short** stem—the *mum skm*—**which** is tmbrandied. This grows in length by means of its terminal bud, and produces lateral buds in the manner already described. In the Scots Pine and other firs the tormina 1 bud grows year after year, naturally with intervening periods of quiescence, so that the successive year Vshoots **together** build up a **true** stem in the form of the tall main trunk. But in the majority of dicotylous trees the terminal bud dies at the conclusion of the growing season, and in the following spring its place is usurped by the topmost lateral bud on the year's-shoot, which thus provides a substitute to continue the growth of the leading shoot. The main trunk of such *a* tree *therefore* consists of a scries of **branched** strung **end** to end to form a *false stem.*

The rate at which the main stem grows upwards during the youth of the tree varies in different trees; it is usually greater in tliose trees which demand **much** tight and in this way seek to obtain it quickly, but is less in those trees that are **not** easily harmed by shade.

Before going on to discuss the production ol branches it is necessary to point out the difference between an *active bud.* which is in process of vigorous growth and is not scale-clad, and **a** relatively quiescent *resting-bud.* **which,** with lew exceptions, lias Lin external coating of scales. If we follow the growth of the main stem (or of **a** branch) of a tree during one season, we note that the lateral buds produced on it are rest ing-buds which do not as a rule grow-out before some subsequent season. Thus the year's-shoot in its first season, or, as it is termed, **the** *current years-shoot,* **bears** leaves but **produces no** branches. In the second year this shoot sends forth branches, though it is now devoid of **leaves** if it belong not to an evergreen tree. The *brunches grow in length in* f he *same* manner as the main stem, and their stems are consequently true (in most firs) or false (in most dicotylous trees). **But** the growth of a stem is **sometimes** arrested by the utilisation of the tnd to produce flowers, as in the **Horse Chestnut** (Fig. 380), Elder (Fig. 501 ), **Mistletoe** (Figs. 28 and 29), and many trees (Fit;. 45). It will now be evident **that,** cxci'pt in the case of conifers, it is rare for a true stem to grow in length for more than **a** limited period.

Active Buds and Resting-huils

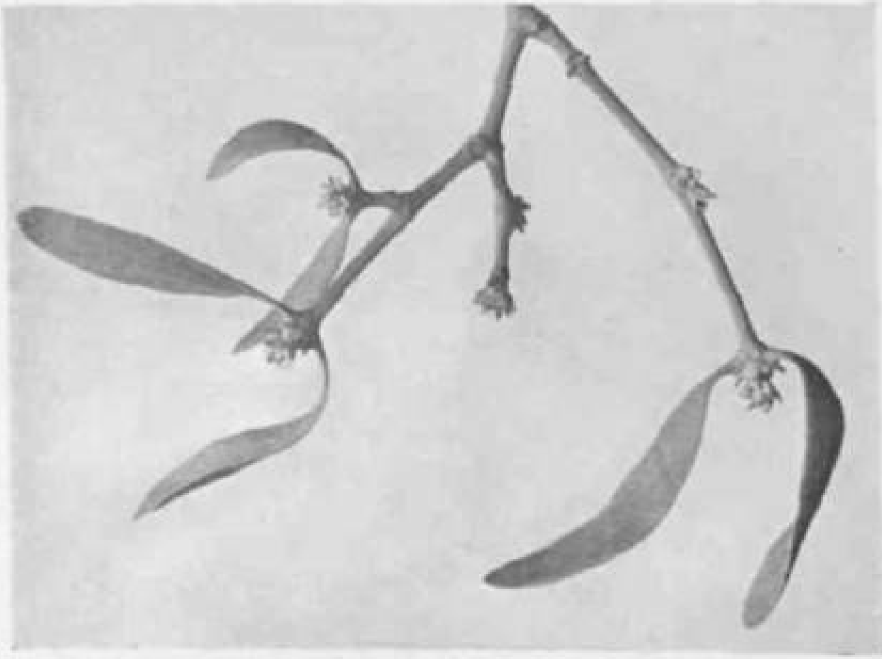


Fig. 18.—Mistletoe.
Flowers at the end of the stems.

lower buds on this develop into dwarf-branches, inflorescences, or flowers, or remain dormant. As a result the tree preserves a main trunk, the boughs become long, and the finer twigs show stronger branches occupying positions near the tips of the successive year's-shoots. This latter feature is particularly obvious in Pine-trees, in the Silver Fir (Fig. 118), and Spruce (Fig. 135). A *shrub,* in contrast with a tree, has in place of a single main trunk a number of more or less equal-sized stems rising from its base. The shape of the shrub is due to several peculiarities in its behaviour. First, no stem, false or true, continues to increase greatly in length for more than a very limited number of years; secondly, it is usually the buds near the base of the year's-shoot that grow out most strongly i

A tree often shows at least two different kinds of vegetative shoots: (i) *Long-shoots,* which have more or less elongated internodes, and are themselves of comparatively considerable length, (2) *Dwarf-shoots,* which are shorter and have shorter internodes, so that the leaves are apt to be tufted. Very clearly marked dwarf-shoots are possessed by Pines (Figs. 68 and 94), Larch (Fig. 106), Cedars (Fig. 111), Beech (Fig. 255), and Ash (Fig. 459).

Long-shoots and Dwarf-shoots.

If we watch the fate of the various buds borne on a year's-shoot, we find that not all of them develop with equal vigour nor at the same time. In the case of a *tree* the resting-buds nearest the tip of the year's-shoot grow out most vigorously into long-shoots, while the

Trees and Shrubs.

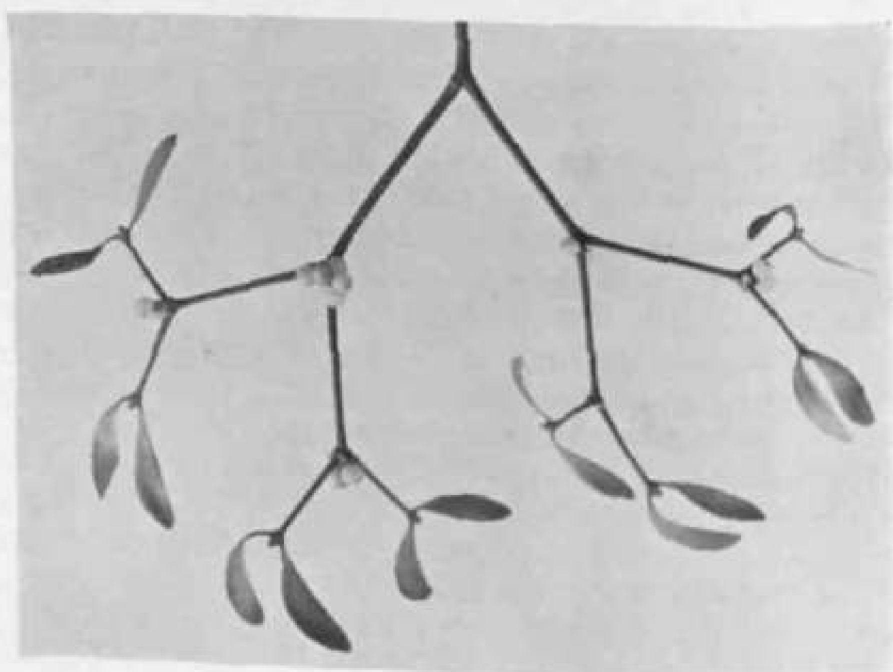


*Fig. 19.*—Mistletoe.
Fruit at the end of the stems.

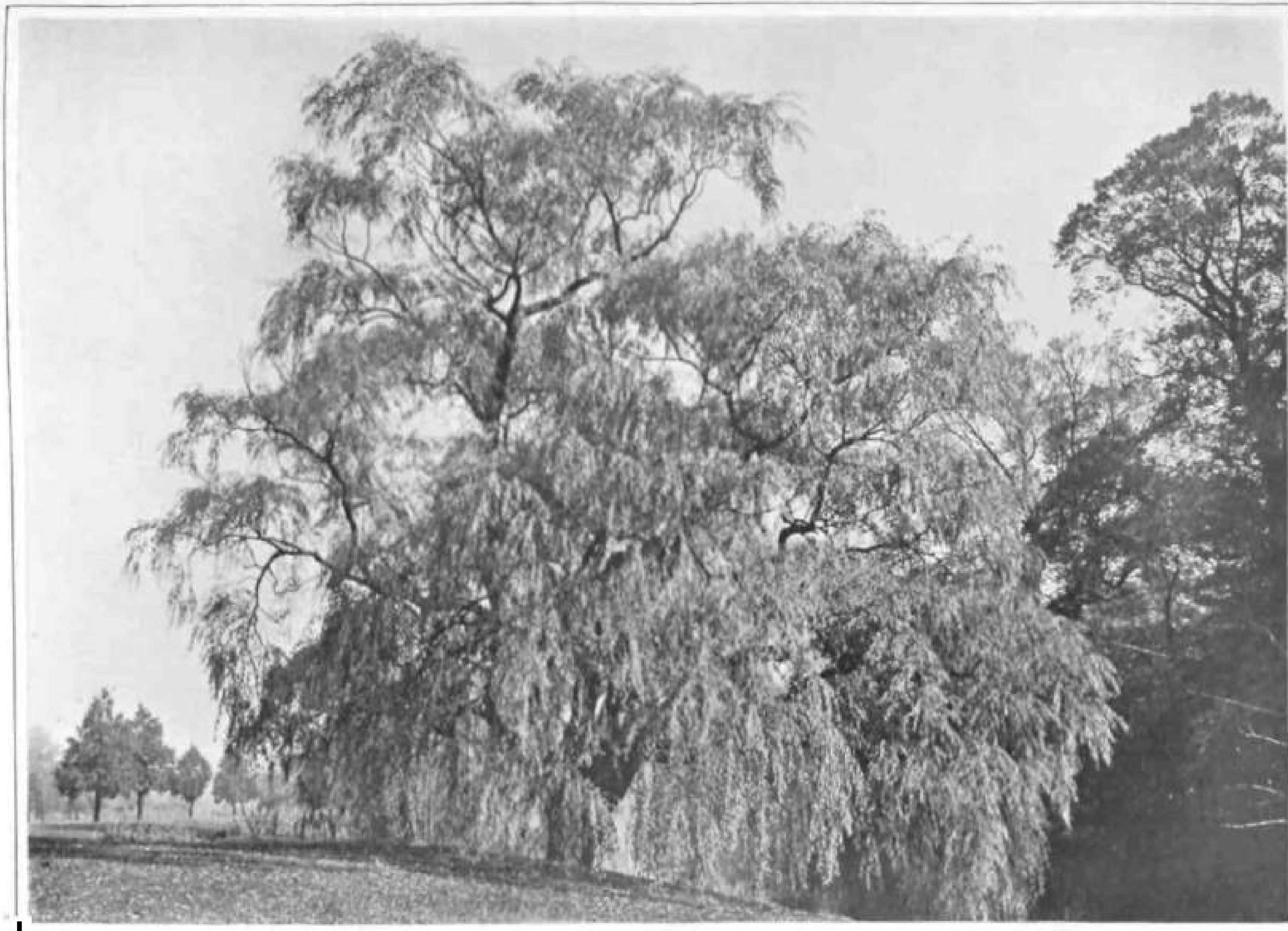


Fig. 30.— WBEPIN(i WILLOW *SAUX BABVLOSICA*.

Fig. 31.—Wind-clipped Oaks.

thirdly, new erect shoots readily spring from **old** stems (or roots) near the ground.

A peculiar fountain-like mode of growth, intermediate between those of trees and shrubs, is **exhibited** by "weeping-trees" such as **the** EluYr („. **292),** Laburnum (p. 322), and Weeping Elm (Fig. 5). Moreover, a shrub can be madt^ to assume a tree-like form if all the lower buds be annually removed; and, conversely, a tree can be reduced to a bush by removing **the** higher buds or clipping the higher shoots. This interchange between tree and shrub is often accomplished by natural agencies. For instance, far north, or high up mountains, or on bleak sour moors, trees are dwarfed so as to be pygmies only a few inches or feet in height *{see* p. **106).** Again, in windy «, I Hiscrd places **the** brasuffersgnsaterd^nih,-tion than **the** shrub or herb because the **force** of the wind increases with a rise above the ground. Hence on wind-swept hills or near the sea the wind causes the leaves **on the** upper parts of the developing tree to transpire with sutf, rapidity that the highest shoots arc dried up; moreover th<- leading shoot at Jts summit and the adjoining branches are bent away to leeward, so that a **wind-dipped tree** assumes a characteristic, dwarfed, more or less flattish-lnpped, lop-sided form (Fig. 31), and may be **bush-Ilka** in stature.

1 he buds do not all shoot forth simultaneous%i **either** on different kinds of trees or on the 8antte ***ree.** The date of sprouting of **the** buds is nut without **influence** on **the** form or **even** distribution of trees. For example, m our temperate climate, buds that sprout early in spnng are in danger of bi-i ng nipped off by late frosts, so that certain *Mds of trees whjch thHve ·n the climate of England arc absolutely excluded Irom frosty parts of Central Europe.

Sprouting of Buds.

I *he* sprouting of buds is promoted not only by heat and moisture, but also by light, as may be seen when numerous little branches shoot out from an old tree-trunk that has been suddenly exposed to stronger light (say by the fall of adjoining trees).

Shade does more than arrest the sprouting of buds, for it actually kills branches already in existence. Thus it comes that in forest, and to a less extent in open country, the lower branches given off from a tree-trunk die and drop off as they become overshadowed by higher branches or other trees. The bare, branchless portion of the old trunk thus denuded is termed the *bole;* while the portion of the trunk, together with the mass of boughs, branches, and foliage, surmounting it compose the *crown* of the tree.

The bole may subsequently send forth younger branches at different heights (Fig. 336); and new branches—*stool-shoots*—may spring up from the very base of the trunk, or from the stump of a felled tree. All these new branches springing from old parts arise either from axillary resting-buds that have remained dormant for years, or from entirely new buds which are first brought into existence on these old stems.

Bark.

As the stem thickens the original skin (perforated by stomata) becomes too small to cover it, and a new covering, dead *hark,* replaces it. The dead bark is a protective layer guarding the tree against the attacks of animals, the entrance of parasitic fungi, excessive loss of water, frost, and perhaps against the burning sun's rays. And it is instructive to note how carefully the tree seals up artificial or natural wounds ; the scar left by branch or leaf that is naturally cast off is a "clean " one, not ragged, and is closed by cork ; while the wound made by mechanical injury is, in the course of time, covered by cork or bark. The importance of this closing of the wounds will be more fully appreciated when it is remembered that many parasitic fungi attacking stems and roots can gain entrance only through a wound. The bark therefore is impermeable to water and to gases except at certain spots or along certain lines, which usually take the form of *hnticels.*

Lenticels permit the free entrance of oxygen and exit of carbonic acid gas, and thus enable old stems and roots to obtain the oxygen they require for respiration. Lenticels on twigs are usually noticeable as little lumps differing in colour from the rest of the surface (Figs. 497 and 498), and are still more obvious as long transverse lines marking the bark of the Birch and Cherry trees (Figs. 274 and 418).

Each year the tree adds to its bark from within. If this production is balanced by the outer bark being regularly shed in the form of scales, sheets, or strips, then the bark remains thin and relatively smooth, as in the Plane (Fig. 319) and Strawberry-tree (Fig. 34). If the outermost bark does not flake off at frequent intervals it may become thick and furrowed, as in the Oak, Elm, and Ash. But even rough-barked trees shed scales at longer or shorter intervals, and in one and the same tree the rate of the shedding may differ at different heights up the trunk, as in the Scots Pine and Birch (*see* pp. 50 and 225). The nature of the bark frequently gives some clue to the habit of the tree. Trees with thin, smooth, often dark-coloured, bark usually are shade-enduring species (and often live in moist woodlands), as is the case with Beech, Hornbeam, and Silver Fir; whereas trees that soon acquire a thick, rough bark are usually light-demanding (and often capable of living in drier places).

Thickening of the Stem.

So far we have considered only the *dead bark,* but lying within this and encircling the wood, from which it is separEltcd by the thinnest of r . , . , . , , ,* ™ - films, is the *living bark** This serves to transport elaborate substances

* The definition of "bark" here implied conforms with ordinary English usage, and does not agree with the technical one given by most English and American botanists.

Fig. .12.—Smooth Hark of a Strawberry tree (*Arbutus Andrachne*, Unn.), with thin, SSg scales.

new living bark on its outer **face,** and new wood on its inner face. **Each** ••••ir, in the case of British trees, it thus manufactures one clearly recognisable ring of wood, **which** is deposited outside the pre-existing wood iinil is termed an *annual-ring.* By counting the **atfnual** rings of wood in **any** part of tht stem we **learn** the exact (or, in exceptional cases, the approximate) age of that part. The outer, and **therein** youngs, **an-**nnal rings of wood alone **carry** up **the** raw sap. As the inner rings become older and die, they may change in tint, **became** heavier, more resistent to decay, and cease to be capable of conducting water. Such central coloured wood is termed *heart-wood,* as opposed to **the** lightor-colmired surrounding *sap-wood.* (In **popular** parlance the !"• •irt-wood and sap-wood are often loosely referred toas"heart"and"sup!? respectively.)

(such **as** sugar) manufactured in the **leaves to growing** or **storing** |Xirts **of** the tree and stores them itself; moreover, it a< **ts** as **a re-**cepta.lo for useless **excretions, wfcreh** *mav* **subsequently be** thrown off **with the dead** bark. Tlio bark as a whole is added to, thanks to the activity of two or more ddicate **thui,** *creative layers,* one of which rtms as a **psmnent** film-like sheet round the stem imm«liutely outside the wood. **Tnisparticii** kr creative layer, year after year, produces

U is remarkable **that** the direct effect of *l,e surroundin g-il, weather, and climate ~npon the "idividual tree is Facult>- «<niir;t]1y such us to fit the wher U htter for ^ence in the spot se inTf I. P* ltSeH to thc "lltsi^ **world,** i, f |! o " a manner **tl*at** the exercise Th TQ TMmm Z P°^rs could not better. in ? ^ more northern ^ SEl"le kind of tree if P^ted higher up

a mountain tends to put into action its various vital processes, sucli as the sprouting of buds ;tnd possibly the production of flowers, at a Inter date in the season, but to complete them at an earlier one ; it thus **avoids** extremes of the more rigorous climate and rapidly utilises the shorter favourable season. Again, in the presence of sufficient light, in moist air there is a tendency for numerous buds to shoot forth, and for the leaves *to* be krge as well as *numerous, so* that the tree can throw off a large amount of water despite the humid air; but in dTy air more numerous buds remain dormant, ;tnd the leaves tend to be fewer and smaller, so that there is less danger of expending; an excess of water. Again, in the moist shade of forest the protective bark is thinner than in the drier, well-lighted, open country where the danger of desiccation is greater In the open country th<-* branches remain attached lower down the trunk, for they receive plenty of **light**; but in the *iovvti* the lower brandies, **being** soon overshadowed, **be*** come useless and are sacrificed. Furthermore thts dwarfed form assumed by trees in windy places, and in Arctic or sub - Alpine situations, enables *thr* hush-liko plants to withstand the **danger** of drying up. **Many other** examples of this apparent *direct adaptation* will be encountered.

As the various kinds of trees differ in **their** wants find powers <*[ accommodation, there may be considerable **variety id** the vegetation of a small area. ITTt? may stretch a heath mainly occupied by **heather** and gorse, dotted with isolated Scots Pines, **able** to absorb sufficient water from the soil. At a **little** distance, fringing **a** stream may be Willows or Poplars, which demand light, but possess roots capable of resisting suffocation in periodically soaking soil, A little farther, ***the*** *soil may ha* occupied by forest, in which light-demanding and shade-enduring trees, shrubs, and herbs do battle.

**I-ig. 33.—ROURII, Scaly Hark of the Medlar-tree.**

Fig. *34-* — Malt; FJowens *i)* and One-year-old Cone v» ol Scot Pint.

## VII.—FLOWERS

The function of a flower is to bear seed, in whose production only two kinds of floral Verves—carpels iiud stamens — participate. The simplest flowers consist, therefore, of either carpels or stamens, or of both.

The little cone-lite flower of a Pine (Fig. ;;5), or **a** Spruce (Fig. **131,** $ ), that gives rise to the **familiar** woody cone-fruit, consists solely nf a stem—the *receptacle*—and a number of spirally arranged scale-lik. leaves. To the upper face of each leaf are attached two egg-shaped bodies, iVie *ovule s,* which are capable of developing into smte. A. leaf that h«ars ovules is **termed** a *carpel.**

But the Scots Pine h.is other yellow cone-like flowers [Fig. 34) each consisting of astern—the *receptacle*—and many spirally arranged scale-like **leaves**—the *stamens.* On the lower face of each scate-like stamen are two closed little bags containing numerous microscopic yellow grains

* The **exact** structure oi tbia cone is described on pagt 54, **whettf** it wilt be seen tliat IIIL- s*:;ili-j, .ir,- -Uul k>, and that there fa some doubt as to iuUrpriitalUjit ◁f tlwi *caivn.*

Fig. 35-" Female Flowors of Scots Plrte.

—the *pollen-grains ;* the bags are therefore known as *pollen-sacs.* A floral lcraf that produces polleu is **termed** a. *stamen.* The part of the scale projecting **outwards** and upwards beyond the pollen-sacs is the *connective.*

Each pollen-sac splits open, and the pollen is transported (in this case, it i^ blown by the wind) to the carpels, and reaches the ovules. This act of transference is known as *pollination.* A pollen-grain thereupon sends a tube into **the** ovule ;md brings about the act of *fertilisation,* one consequence of which is the change of **the** ovule into a *seed* containing an infant plant—the *embryo.*

A flower containing carpels but having no stamens is a *female* {$) **flower**; one possessing stamens but no carpels is a *male* (,?) flower ; both kinds of **Bowers** are described as *unisexual,* in contradistinction to flowers possessing both carpels and stamens which are **said** to be *bisexual* ( ?).

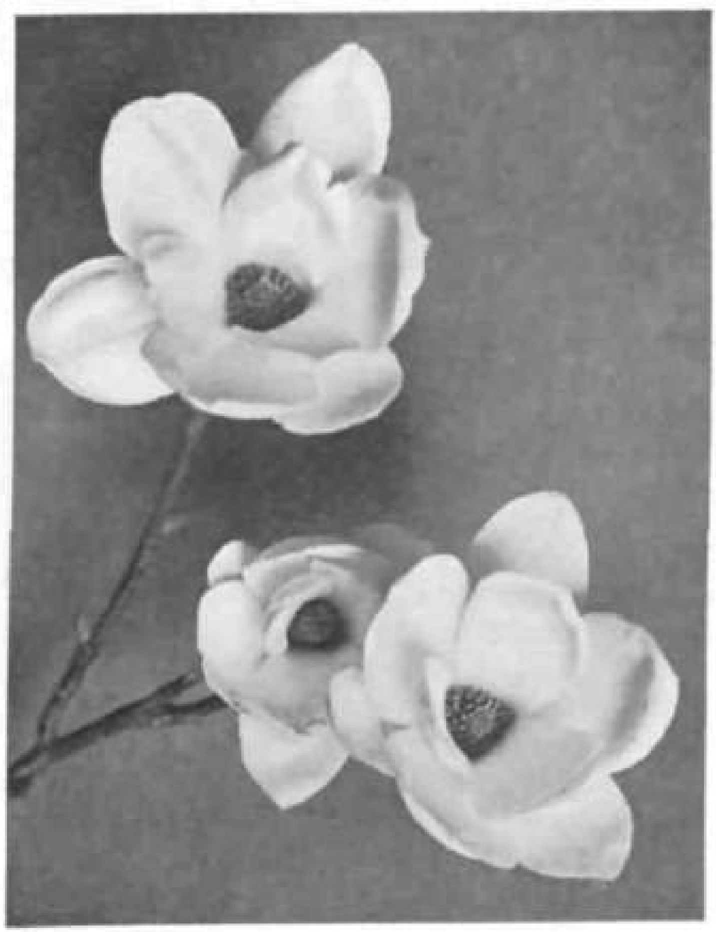
Gymnospermæ

It is important to note that neither the ovules nor the seeds of **the** Scots Pine arc contained in a. closed **dhamber.** Plants like **Pines,** Firs, Cedars, Cypresses, and others **having** naked seeds are grouped together to form the great class *Cytntwspermce.*

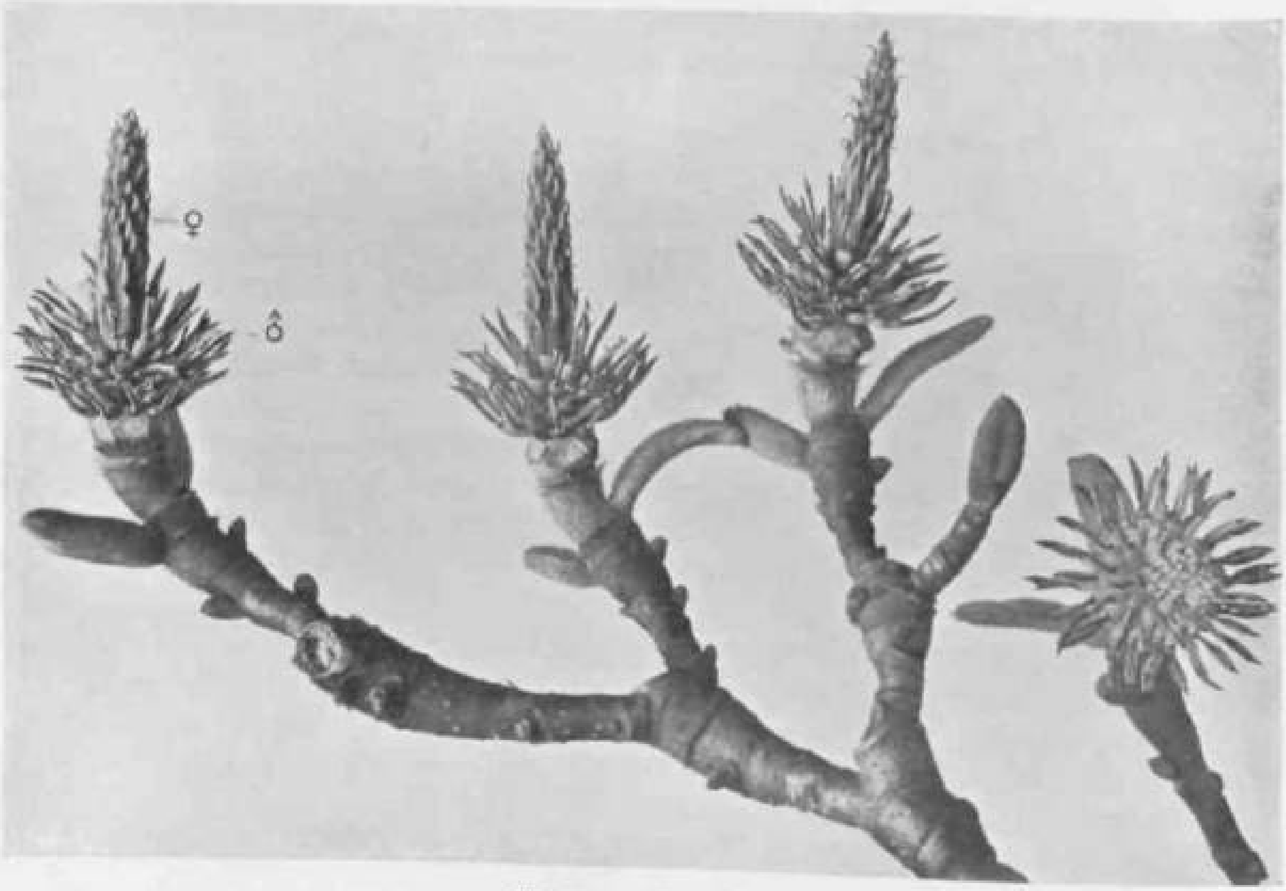
Angiosperms.

Opposed to the simpler Gymnospermæ are ***the*** vast majority of Flowering Plants which form the more **advanced** *^ngio$pcrttue,* and are so-c;dled because tlieir ovules and seeds are contained **within** *a,* closed **chamber—**the ***ovary.*** **If.** for instance, we examine the flower of Q Pea or Laburnum, we find in **the** centre a pod-like body containing within its single chamber a number of ovules attached in a double line down the one side. This ovule-containing part is like a miniature pea-pod, and is tJic *ovary.* Rising from its summit is **a stalk-like** structure—the *style*—which is capped by a broader part—the *stigma.* The whole structure, composed of ovary, style, and stigma, is termed a ***pistil,*** and is produced by the folding of one leaf—the *carpel*—whose margins unite and so produce the dosed ovary. The stigma is the part intended to receive and retain pollen-grains, which send tubes down the style, and thence to the ovules.

But **a flower** may include **a number of** *separate* closed *cur pels* or pistils, as is the case with the Magnolia (Figs. 36 and 37). Still nmre frequently the flower contains two or more *carpels* that are *united* to produce a single pistil; in such a case the ovary often has os many chambers as there are carpels, and some-tunes there is the same **number** of



*Vig. 36.*—Magnolia,
Flowers **.*howfnjf ttie *separate* white petals.**




Fijt 37—Magnolia.

Flowers, Stripped Of s;pols and petals, sliowing many stamens (♂) and separate carpels ,(♀) attached to the receptacle.

styles, or stigmas or stigma-lobes. For instance, the ovary of the Sycamore is produced by the union of two carpels and is two-chambered; similarly, tluit of the Horse Chestnut is three-<-lminhered, and that of the Apple five-chambered.

The *stamens* of Angiosperma: are very different from those of the Scots Pine.

Stamens. Eadl is USUaU>' ***** and shows the following purts : (i) *n* stalk known as the ***filament***; {2) the thicker terminal part known as the *anther*, which bears four pollen-sacs. The **four** pollen-sacs are often grouped in pairs so that the anther is *two-lobed,* and the 1,\w **halves** or lobes are connected by a **narrow** bridge, the *connective,* wlrich sometimes is prolonged above the anther as a little scale-lik(! crest. In most flowers the stamens are separate from onr anutlu.-r, but in **the** Laburnum the **filaments** of all ten stamens in **the** flower **are** united to form **a** tube surround big the- contra I **ovary.**

Experience has **taught** us "that, at least in many cases, more or better seed is pro-

Pollination. duml if the pollen conveyed i" the carpel is derived from **a different** individual plant (of the same kind). Such a mode of transference is described as *cross-pollination,* and is opposed **to** *self-pollination,* which implies **the effective transference of** pollen on to **the** carpel *oi* **the** same II.nvcr. In this country pollen is **conveyed** from one flower of a tree to another cither by *wind* or by ***insects.***

*Wind-pollinated* trees are exemplified by all conifers, and by **the** Oak, Poplar, and Ash ; all these possess relatively inconspicuous **flowers** that pour out no honey-prod uc ing solu it ion of sugar *{nectar)*. Their **pollen** is powdery, not sticky, and **the** grains are usually devoid „f any marked outgrowths, such as spines. As the wind **may** blow **in**

**I-ijj. 38.—Common tHm** ***\Ulmas campestris);*** **flowers-**

any dfeeetiofl, towards or aw;iy from tr««s of the same kind, a vast amount of pollen i.s **generally** produced by wind - pollinated trees, and the stigmas are usually **large, being *oBm* branched** or brush-like. Frequently the anthers are pushed **far out** of the flowers, or are arranged **in** *dangling* inflorescences, ami *ih^* are readily caught by the breeze. **Moreover,** many wind-pollinated plants are *social;* that is to say, numerous individuals of **thesame** kind grow dose together to form, so to speak, pure **populations** or *communities*: and this is true whether they be herbs likti grasses, or trees such as Oaks, Pines, and Firs,

But *insect-foilinakti* **flowers** possess devices which attract the notice o{ insects, and allure them. They are therefore more showy or scented, and usually include sugar - producing glands known as *nectaries.* The pollen is often sticky or rough at the surface so that it will cling to an insect's body. As the pollinating insect is apt to go from one flower direct to **another of** the same kind, there is no necessity *to* **produea** an **overwhelming** amount of pollen. **Coupled** with this economy in **pollen** is **also** the smaller size of the stigma. Moreover, in order to ensure that the visiting insect shall transfer pollen to the stigma, there is a certain correspondence between the position of the anthers and slij^mns *{see* p. 325), and sometimes **the** flower is **elaborately** constructed so that an insert visitor strikes the anthers or stigmas with exactly the same **part** of its body *{see* p. 303). Thus the filaments and the style are of utility in raising the anthers and stigmas into **the** correct position.

**Showy** (loral leaves are therefore **designed** to

**Fig. 39. White Poplar** ***{Popaltis albst.*** 
**Catkins of mnle** llmn-i *.

**Fig. 40.—Kegular Flowers of the Medlar-tree.**
**Each .-iliowiiiR; liv« separate pcial^ anj** ***tnany*** **stamens.**

attract the notice of insects, and are dispensed **with** when a plant gives up its habit of insect-pollination and adopts a policy **of** \vind-pnllination; such degenerate flowers are possessed by the Common Ash (p. 388).

*Self-pollination,* or **even pollination** by pollen from the different flowers of one tree, is rendered **difficult** or impossible by: (1) the male and female **flowers** being on different trees or branches; (2) the male and female flowers on one tree, or the stamens and carpels **of** one flower, maturing **at** different times; (3) the stigma being out of reach of the anthers, or the anthers opening away from the centre of the flower. But if no rross-pnllination has taken place, many flowers make provision for subsequent spontaneous self-pollination, as will be described in **the** sequel.

**Protection of Flowers.**

At least during their youth, flowers require protection, from desiccation, from insect-foes, and from fungi; indeed there are some fungi which can pass certain stages **oi** their lives only in young flowers. Such protection is provided either by the close aggregation of flowers, by bracts, or by special flnnd leaves. Hence a **flowe*** may possess in addition **to** stamens and carpels two other different kinds of floral leaves :—

(1) An outer envelope of usually green leaves, the *sefiate,* which compose the *calyx.* These are protective. The sepals may be separate *{e.g.* Magnolia) or **anited at** their bases *(eg.* Laburnum).

(2) An inner envelope of showy *petals* composing the *corolla.* The petals may N separate, as in the Magnolia, Plum, and Medlar (Figs. 36 and 40), or united to produce **a** shorter or longer **tobe** with **separate** teeth or segments, as in the Strawberry-tree (Fig, 42), Elder, and Guelder Rose.

In some cases there is no distinction into sepals and petals, and the general envelope is termed a *perianth,* which may be green or petal-like. Its floral leaves may be termed perianth-leaves, but in this work thev are, for the sake of simplicity, described as sepals. It may be noted that when the fiowcre **are adequately** protected by bracts, or by close aggregation, *the* sepals or perianth-leaves may become reduced and degenerate, or even suppressed, as in **fchfi Betulacese,** Fagaceas {pp. 215 and 216), and Elder (p. 393).

**Arrangement of Roral Leaves.**

**The** iloral **leaves** may be arranged in spirals or in whorls; in the latter case the successive whorls usually alternate with one another. For example, Hie Holly-flower has four sepals; within these, but opposite to the gaps between them, arc four petals; these are succeeded by four stamens, which **alternate** with them and are therefore opposite to the sepals; while in the centre are placed lour carpels, which alternate with the four stamens and are thus opposite to the lour petals.

The part of the flower-stem actually bearing the floral leaves *is* termed the *re-ccj>tack* (which is shaded **black in** the accompanying three diagrams). The **receptacle** may be convex, so that the sepals, petals, stamens, and carpels, are respectively attached ;il suceessiwlv ln^ha ti v- K : in such a case the Mower is said to be ***hypogynous*** (Fig. 41c?), and tlu* ovary is *sufifrior,* **as** in Magnolia (Fig. 37), the Lime, Sycamore, and Horse Chestnut. But in some flowers the receptacle is concave at its end so as to form **a** b.'tsin or cup, **to whflfie** rim are **attached sepals,** petals, and **stamen,** and to whose lining or bottom are attached tin: carpels or ***A*** lump bearing these; such a flimvr is *pcrigytioHs* {Fig. 41&), **and the ovary** Is sii|M3rior, as *m* the Cherry and Plum. **Finally,** the receptacle may be concave as in the preceding type but also joined by its inner lining **to** the ovary-wall, so that the ovary cannot be plucked out of the flower but seems to stand below all the other floral parts; such a flower is *efiigynous* (Fig. 41c), and the ovary is *inferior,* as in the Apple, Pear, Medlar (Fig. 40), Hawthorn, and Elder. In **all** three of the above types of flowers the stamens may, however, be attached to the petals, as, for instance, in the Elder.

The **receptacle sometimes** bears a glandular, glistening outgrowth, which is known as the: ***dish,*** and often excretes nectar, *e.g.,* Sycamore, Horse Chestnut, and Cherry.

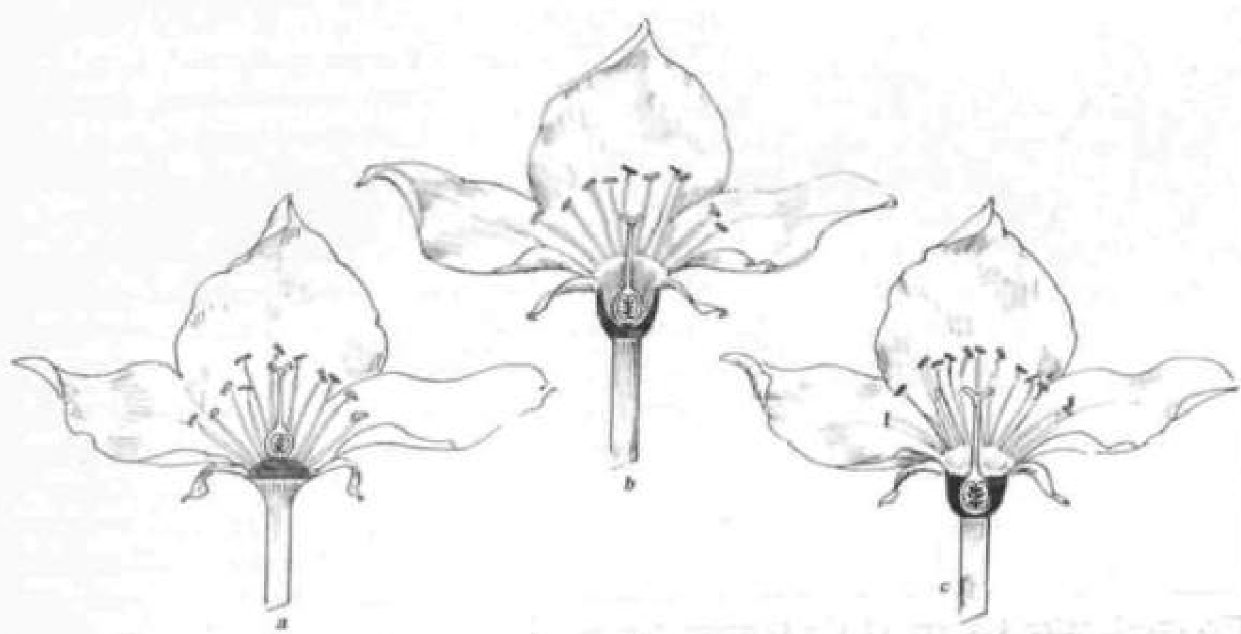


**Fig. 41.-Three Diagrammatic Flowers, cut down the middle to sho« the shape of the rt-ceptncle.**
(a) Hypoj»-fll>us, (*> perigynous, <] epigynous.

**IK'S III' for contenting** ***Nectar.***

The production of a tube, either by the union of the sepals or petals, or by the receptacle becoming **concave,** is frequently u device for concealing the nectar and keeping at bay useless or noxious **insect:** visitors. Tin- plant would reap no **advantage** from the visits of insects that stole nectar and pollen without effecting cross-pollination. To avoid such **waste** of material, some flowers have become shaped to • iiu-rtain certain classes of insects. In <>!!>-r to appreciate the **policy** pursued by **insect-pollinated** plants it is neces-' sary to remember that among flower-liaunting insects intelligence is gen**entity proportionate** to length of **tongue.**

**Fif. 43.—Bird Cherry *[Prunus Pad us)*; flowering shoot.**

**Fig. 42.—Regular [-lowers of the Common Strawberry-tree *iArbutus Unetlo,* Linn.; with united petals.**

**Hence,** flowers pollinated largely by unintelligent short-tongued flies and beetles have freely-exposed nectar, as m tfie Elder, and are usually white or yellow, Flnwi-rs, such ;i* those of the Chvrry, with **nectar** partially **con**cenled in a tube, are visited by a high **percentage <if t&o longer-tongaed** bees iind buttt'rflk's or motlis. While the Laburnum, with its **specially shaped Bowers,** :ili>o its carefully placed and concealed nectar and pollen, is particularly adapted for pollination by the most **intelligent** insects—bees. Finally, the **Honeysuckle** and Pink, with very long tubes, are **particularly** pollinated by **moths** and **butterflies,** which have

Fig. A^.—Irregular f-lowers of *Catalpn higiMtiioldcs* (Walt.) with united petals.

the longest tongues though not the highest intelligence.

The blossom of the Laburnum illustrates the shaping **of** a **Sower** so as to exclude all insects excepting certain special kinds that enter in **a particular** manner, and inevitably effect cross - **pollination** *(see* p. 325). This is often **achieved** *by* unequal growth of the **petals** of a flower, **which** is then s;iid to bo *irregular* {or, more strictly, is said to have an irregular corolla). Such tlmvi-rs as those of the Laburnum (Fitf-408), Horse **Chestnut** (Fig. $3^{80}$). and *Calalpa* (Fig. $4^{6}$)> though invgular, are nevertheless symmetrical, because each can be **divided** into two exactly equal and **similar halves.** **A Sower** (or **a corolla.)** is *regular* when the floral leaves composing each whorl are all equal .HKI sjmiLir. Regular flowers present much the same appearance when **viewed** from any side, and **their** insect visitors can alight wilh equal convenience on all sides. Such flowers tend to be erect or to hang down vertically (Fig. 42). Irregular flowers ] -i istNil different **appearances** from the front, bark, and sides ; nnd as they are adapinl 10 receive **insects thai alight** m a **particular manner,** they are directed horizontally or obliquely (Fig. 48).

**Fig-. 45.—Wild Service-tree *Pyras tormlnatis'.***
**Terminal** inflorescence.

## VIII.—INFLORESCENCES AND FLOWERING

Catkins.

Flowers are usually **grouped together** on the tree in **ttou and** ; • - . **They** are fre**quts&fiy arranged** t<> form *inflorescences,* in which the flowers or flowering branches stand in **the** axils of reduced or modified leaves termed *bracts.* Among the many varieties we may single out one particular kind of inflorescence far mention, namely the *catkin.* This is an elongated unisexual inflorescence consisting of an apparently unbranched stem, bearing on its sides a number of bracts (catkin - scales) *in* whose axils are inconspicuous stalkless unisexual flowers; as a rule the catkin falls off as a whole. Such catkins are possessed by ihe Hazel, Oak, **Poplar,** Birch, and others (Figs. 46 and 39). The precise reasons why flowers are grouped into inflorescences are not fully understood: one advantage gained is that the blossom is rendered more conspicuous; another is that insects can pass more rapidly from flower to flower; a third is that certain buds can be set apart for **the** production of flowers, while others arc left free to produce fcliaged shoots. Inflorescences are either terminal, as in the Wild Service-tree (Fig. 45), or lateral, as in the Sloe (Fig. 48).

The age at which a tree **Bowers varies** widely **in different trees; some kinds of trees Sower w&en** only **a few** years old. **where a* others** do not blossom unt^ **&ey** have reached the ripe age of fifty or more years. A tree in the open country usually flowers at an earlier age than the

I)nil* ftf HowerinK

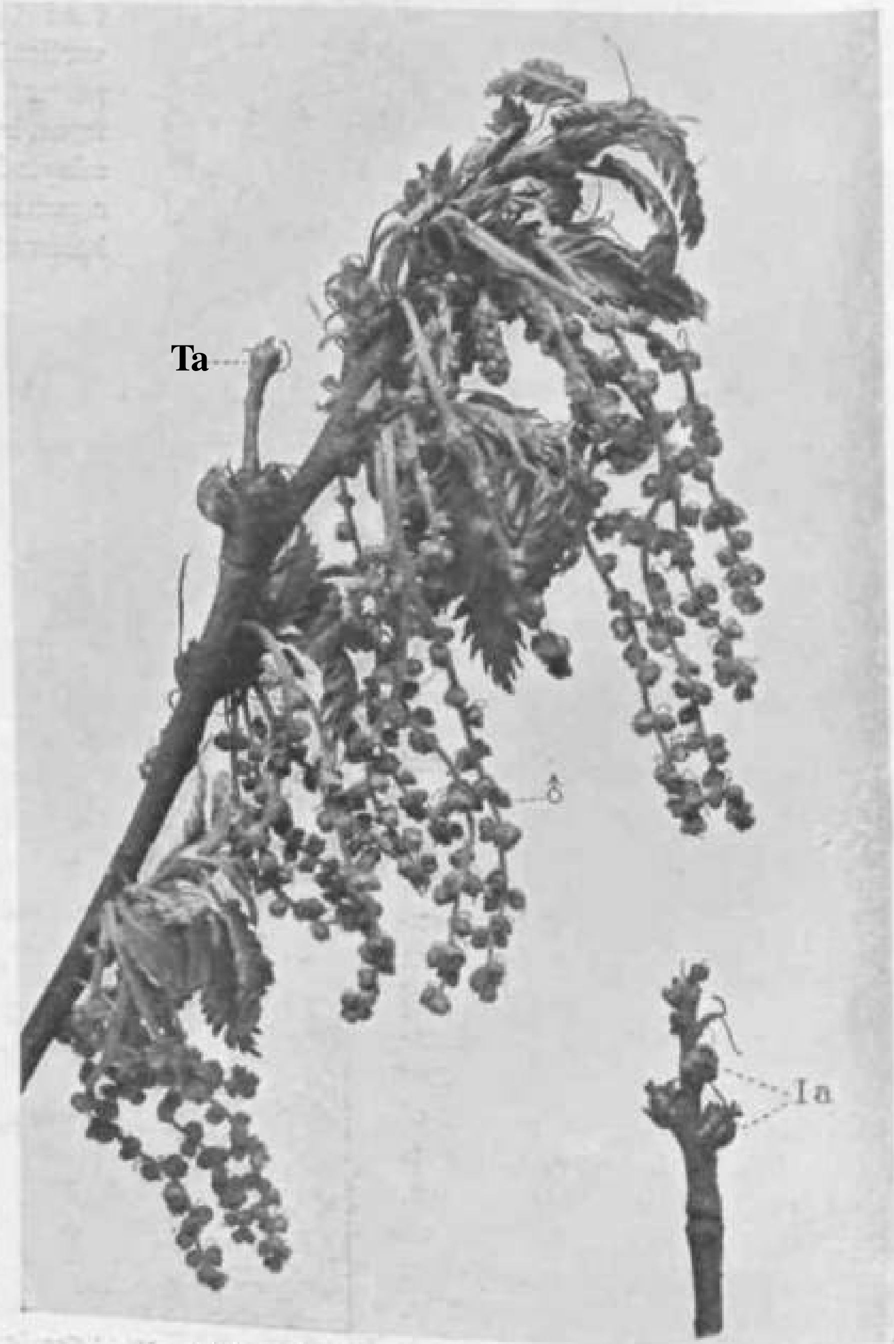



Fig. 46.—Turkey **Oak** ***(Quervua Cerrls).***
Catkins of male flowers (♂) **and one-year-old ymir.B acoriw (U).**

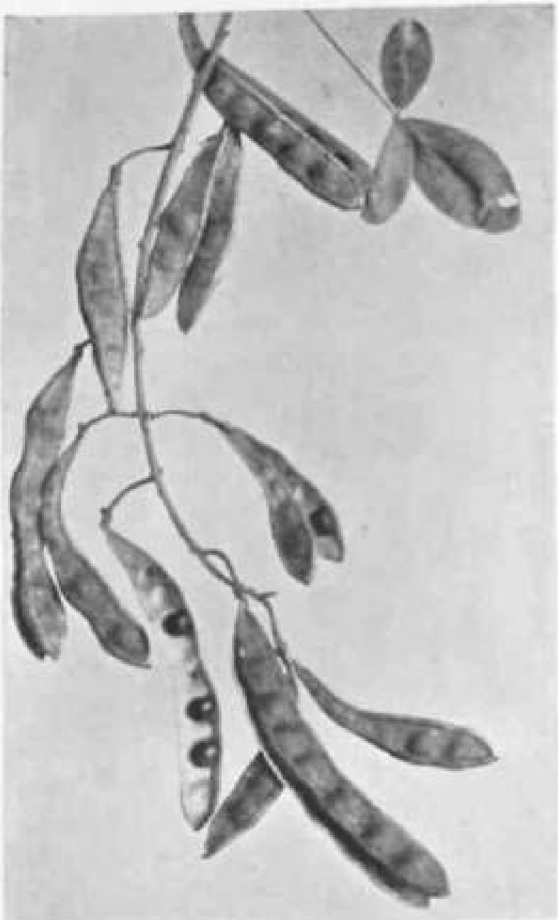
Fig. 47. *CATALPA BIGNONIOIDES* IN BLOOM.

*Fie* **48.— Blackthorn** ***iPrunus splrto&a).***
F dwir ng shoot.

**Why** light should promote flowering, or why various trees should **flower** at different dates in the year, we do not know. Yet we can sii^-st s<me **advantages** reaped by the **confinement** of flowers to well-lighted shoots ; for, by this means, the flowers and subsequently the fruits **may** necessarily be freely exjjosed to **animals** or breezes that cause pollination or seed-dispersal There is no close relation between the **tones** of flowering and fruiting, for though **some** Willows and **Pojta** blossom and fruit **eariy** in the **year,** the Hazel **flowers** \vt **earlier** but "does nut bear **ripe** mits until **late** autumn, ***ma*** I'nu's require **more** than **one** or two years to mature their woody **cones.**

same kind of tree in the **forest**: light promotes flowering. Nor does a single tree flower with equ'il abundance every year : good crops of blossom and seed follow **at** intervals of two or more years Again, each kind of tree has its own flowering season' which usually lasts very few weeks, though excei> tions to this rule are met with in the Hr.lh- .ind some other trees. The flowers may emerge before with, or after the leaves. In **the** first two cases **they** are usually prepared during the preceding season, and remain **as** minute young stmctu- res concealed within rcsting-buds all through the winter so that under exceptional circumstan.Y* th<v shoot out **in** autumn instead of waiting until **the** fol-Imvmg **spring. These** flower ing-buds are often dis-tingiiishable from the foliage-buds, **as** *m* the Elm (Fig. **493** ; sometimes, indeed, the inflorescences themselves are visible m autumn, but rest Daked and closed throughout the winter, as is the case with the male catkins of the Bircli (Fig. 279)

Fig. *4 9* • **—Wych Etm (*Vint us $_x$labra).***
Pralnlcd vegetative budj;, ,un) ruunOcd inttorc^cencv - hods cuinniuncinif to **open.**



Fig, jo.—Laburnum ; fruits opening.

## IX.—FRUIT

As the ovule changes into a seed **the** carpel or **carpels** of **the** flower grow, and the result is the flower is replaced by a *fruit.* In the AngiospcrniEE the ovary enlarges and becomes the seed-vessel within **which** ;irv- **the** seeds. It must be noted that **a** fruit is the product of one flower, not of several flowers; thus the bbrkbmy-likt- " mulhriTy-fruit " **(Fig.** 306) Is not a fruit, **because** it is formed by a number of Sowers. Again, the edible chestnut is a fruit **because** it is the changed ovary **containing** one seed ; **whereas** the somewhat similar seed of the Horse Chcst-nut is a seed because it is a changed ovule.

**NeedA of tlte infant Plant.**

The infant plant and its store of food inside the seed require protection against injury by drought, heat, or cold, against mechanical violence, and against the attacks of animals and fungi. But at \ha same time it is **necessary** for the seeds to be dispersed. Consequently arrangements must be made to cover the contents of the seed **with** a hard coat, and to provide some means of dissemination. Seeds and fruits of our trees are mainly scattered by wind or by animals.

U we compare ati **ordinary** filbert, with a plum, the most obvious distinction be-nwin these two fruits is **that** one has a covering which is *dry* and woody, while

**Fig. 51.—Winged Fruits of *Alfanthus glandutosa* (Deef.),**

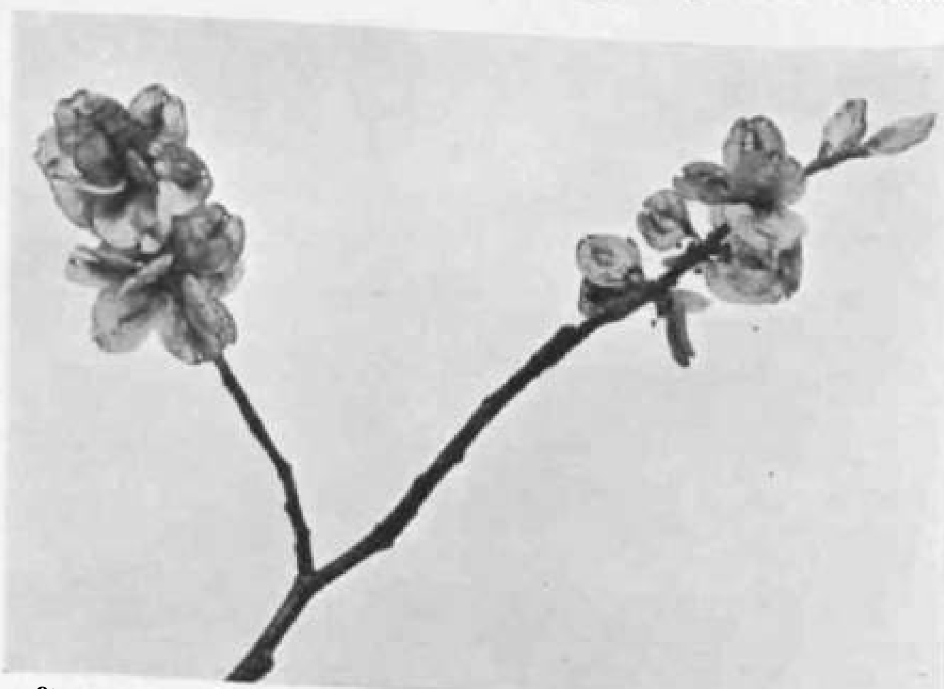
Fig. 52.—Wych Elm (*Ulmus glabra*); winged fruits.

the other is encased in an envelope which is *fleshy* and juicy in part. There are two main types of fruits—*dry* and ***flashy.***
^ Commencing **with** the *dry* ***fruits,*** \\u- **filbert** ts **a** nut containing onu sr.-d. and it remains closed until the time

Dry Pratt* ' . T T r "

of germination. **Here the** fruit itself is scattered (partly by squirrels), and ]jrotection is provided by the hardening of the ovary-wall which becomes the nut-shell, while the seed-shell inside remains thin and **papery.** The fraits of the Oak, Beech. and Chestnut are likewise nuts. But a Pea - pod (or a Laburnum - f r ti: t), when ripe, splits open spontaneously along two lines, **and** becomes a t **w** 0-valved open fruit. In this case the seeds escape from the **seed-vessel,** and it is they that are scattered and **require** to produce their own hard shell; hence the seed-shell of the Pea or Laburnum is thick and hard, **When** dry fruits of **trees** are dispersed by thy wind, they acquire sailing devices for **"catching** the wind "; often such fruits are flat, and **one-winged** as in thv Ash(Fig. 4q5),or two-winged as in **the Sycamore** (Fig, 353} and **the** Elm (Figs. 52 and! 53), whuY in the Hornbeam (Fig. 275) and Lim< (Fig, **343)** wings are provided by the bracts. Less commonly wind-dispersed **feats** are buoyed up by hairs, as is the case in the P^treefFig.

J2^' mit wlt, ...n the seeds themselves are frced and scattered by wind, U is tlKV that acquire similar appendages: for ins*ance,



ft. ., rftniBi ,,. (*Ulmus campestris*); winged fruite.

**Fig* S4.-Crack Willow** *[Sallx fragtUs).*
Open fruits shedding the cottony seeds.

opening fruits or **the** naked seeds of conifers mi' sometimes conveyed from place to place inside birds, which **are attracted** by the distinctive colouring of the seeds rind **allured** by a fleshy seed-**envelope.** Thus the fruit nf the Spinrik[1]-tree splits open tuid reven Is three **seeds, each** clothed with an *umngc-caloui'tl* fleshy coat which lies outside the true, hard M ril-shell. Again, the naked seed of **the** Yew is surrounded by a red juicy cup which birds **eat**; **while three** fleshy carpels **of** the **Juniper** combine to form the bluish juniper-berry. In all these cases the **seed-contents** are protected from injury by a hard **seed-shell lying** within the fleshy coat.

These **examples** o[r] seeds dispersed by animals lead on to *fleshy (mils* in which the juicy coat, although it is not a part of the

the seeds released from the two-valved • >|Hiiins fruits of Poplars and Willows (Figs. 188 and 54) bear **tufts** of cottony hairs; while the seeds **of** a **large number of** naked-seeded plants {Gymnnsperraie), including many Pines, are winged (Fig. 65). Tiie modes in **which the** soeds of \\u-Pines, Larch, Cedars, and **Silver** Fir are released from the protective investing woody cone - scales are recounted on pages 55, 86, go, and 99, but here **it** may be **mentioned** that in the **case** of the first two the scales simply gape asunder (Fig\ 71), whereas in the hist **two** the scales tumble **separately** off the nxis (receptacle) of the cone, which t!ui> seems to break into pieces (Figs. 125-6).

The seeds of the

Flgi ss·_Ulacklhorfl *›Prunus spirlos(t):* stone-fruits.

**Fig. $6.-Service-tree** ***(Pyrvs Sorbus)*****; fleshy fruits,**

seed but is produced by the original wall of the ovary, yet subserves the same office of attracting animals by its bright colour and its sugary contents.

**Ffehy Fruits.**

One familiar type, the *stone-fruit*, is represented by the cherry and plum. Here the original ovary-wall becomes thick and differentiated **into** three layers ; the firm outer skin, the pulpy middle layer, and the hard, bony, inner, stone - layer which effectively protects the seed, and thus renders ;niy thick seed-shell superfluous. The stone-fruit of some trees includes several stones, each of which is formed round one chamber of the original chambered ovary. The so-called " berries " of the Holly, Hawthorn, and Mountain Ash are in reality stone-fruits. In **a** true *berry* the original wall of the ovary produces no hard layer, but **rather** an outer rind and a soft inner pulp, so that the seed requires to manufacture a thick seed-shell in place of the papery one of the stone-fruit. A pear or an apple is intermediate between a stone-fruit and a berry, as the inner **parchment - like** chamber - walls represent " stones " which are so thin that the seed requires the additional protection of a firm seed-coat. All **these** fleshy fruits tend to remain green and **therefore** inconspicuous, also sour and therefore uninviting, until they are **fipe, when** colour and sugar invite birds or beasts to bite the **/""' ?**** ***pm*** **the well,** protected seeds unharmed their bodies.

Some fruits are pe type. The walnut, with its green, almost fleshy, outer layer, spontaneously but irregularly opens, nut-like inner layer, is obviously not a nut. Again, the fruit of the Horse Chestnut yet its spiny wall splits mto three halves.

Fig. 57.—WiW **Service-tree** ***{Pyras torminstts.-*****; fleshy fruits.**

## X.—SEED AND GERMINATION

The seed contains an infant plant which is termed the *embryo.* But until the young seedling has manufactured efficient roots and green leaves by which to gain its sustenance, it is dependent upon food stored inside the seed. This food is, broadly speaking, of the same nature as that supplied to the young of animals or to human infants, as it consists of starch (convertible into sugar), or oil and albuminous substance. These substances may be stored inside the cotyledons, which with the tiny main shoot, main root, and a connecting piece between these, constitute the embryo ; but they may be stored altogether outside the embryo (as *endosperm)* ; the former is the case with the Laburnum-seed, which is thus wholly occupied by embryo, while the latter system of storage is adopted by the Pine-seed.

Cotyledons that do not store food usually emerge from the ground, become green, and function as green leaves, for instance in Pine-trees ; but those cotyledons which store food may remain below ground as mere reservoirs, for instance in the Oak, Hazel, and Horse Chestnut; or may force their way into the light, and become green, as in the Beech and Sycamore.

## XL—CLASSIFICATION AND NOMENCLATURE

Plants are grouped together according to their " blood "-relationships. All the plants dealt with in this book belong to the great group of Flowering Plants *(Phanerogamia),* which is subdivided into two main classes :—

1. *GymnospermcB,* with ovules and seeds naked, usually with narrow or needle-like evergreen leaves, and with two or more cotyledons to the seedling *(see* p. 41).

2. *Angiospermce,* with ovules and seeds enclosed in an ovary, and usually w'ith broader leaves, showing a different type of veining. The Angiospermce are again subdivided into : *(a) Monocotyledones,* including Palms, in which the seedling has only one cotyledon. (6) *Dicotyledones,* in which the seedling has two cotyledons, and the leaves are net-veined *(see* p. 146).

These larger groups are again distinguishable into smaller ones. In regard *to* the Gymnospermse we may at once refer the reader to page 41. But in the *Dicotyledoncs* three not entirely natural subdivisions stand out:—

(1) Families with *no petals (see* pp. 147-269).

(2) Families with *separate petals (see* pp. 269-383).

(3) Families with *joined pe'als (see* pp. 384-404).

Among still smaller groups are *families.* In one *family* are included all those plants that possess a sufficient number of characters in common. For example, the Oak, Sweet Chestnut, and Beech are included in the family *Fagacece.* The family in turn is composed of various *genera ;* for instance, the Oak belongs to the genus *Quercus,* and the Beech to the genus *Fagus.* A genus includes a number of *species* which exhibit differences slighter than those between genera. For example, the genus *Quercus* includes *Q. Cerris* (Turkey Oak), *Q. Suber* (Cork Oak), *Q. Ilex* (Holm Oak), and many other species. Each plant, then, is known by a double name, its *generic* name (genus) preceding its *specific* name (species). Sometimes a species is divided into two or more *sub-species,* but it is often difficult to decide whether to term two different kinds of trees sub-species or species ; for instance, some

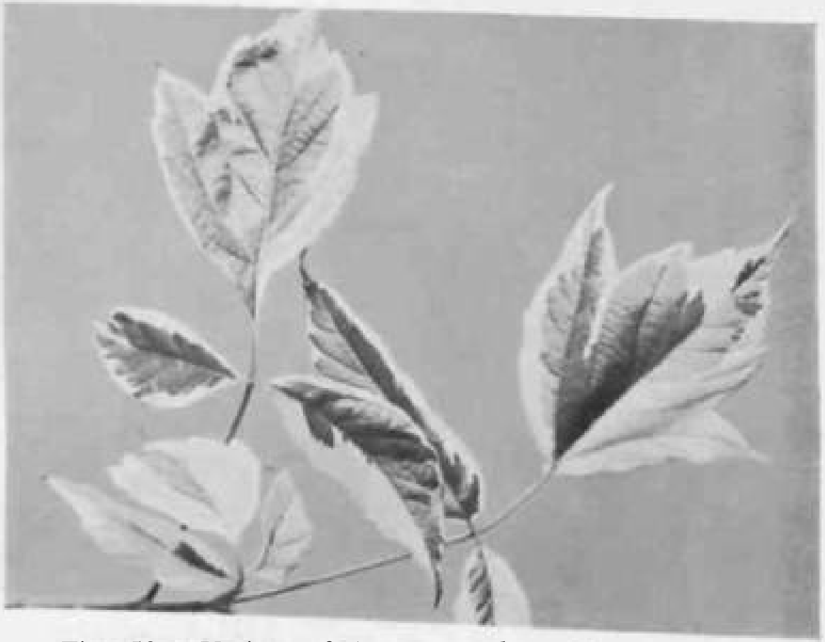


Fig. 58.— Variety of *Acer Negundo;* variegated leaves.

authorities include under the name *Quercus Robnr* our two British Oaks, and distinguish two sub-species, *scssilifiora* and *feduneulata*, but other authorities at once distinguish these us different species. Again, species or sub-spi>cics may be divided into a number of *varieties* which show and preserve in tluir progeny certain sHght, but constant, differences. Finally, each variety, sub-species, or species is **composed** of the separate *individuals* which are so alike as to deserve the same **name.**

Sometimes by pollinating one speries with pollen from another species of the same

Hybrids. genUS there reftuUs a *ew kind of plant, which is known as a *hybrid.* The name given to the hybrid is that of the parents; for instance the Grey 1 oplar is known as *Pofiulus canescens,* **but,** if r be trUc> ils is generally supposed, that this tree is a hybrid between **the** White Poplar *(P. alba)* and Aspen (P. *tremuk),* *& name is b reality a double one, P. *atba X P. trcmula.* Similar "*crosses*" or bastards between different ***varieties*** or even different *gene*™ **hare** been obtained.

The forgoing remarks make it clear that DJ seeking to identify a particular tree, the reader will ft* have to decide whdhcr it is a Bynmo^wnn or a dicotytedon ; and secondly, will turn to page 41 or page 146 m order to ascertain the f.,mily to which it belongs; and thirdly, by consulting the opening pag(<s tlealing ^ the f·imjly ™VLld at- v® lean its genus, and thereafter its species,

CLASS 1

# GYMNOSPERM/E

THE great class of plants characterised by the possession of ovules and seeds that are not enclosed in an ovary, is **represented** in this country by such trees as Pines, Firs, Cypresses, Juniper, Monkey-puzzle, Yew, and Maidenhair-tree. Even these, though not all natives of this country, only incompletely **represent lire Gymnosperm*,** which in other lands or in our hothouses include the Cycada"cej£—woody plants often presenting an appearance between that of a tree-fern and a palm—and **Gttetacae,** one **member.** *[Epktdra)* of **which** is occasionally met with in gardens in the form of a shrub with switch-like shoots and tiny leaves. Excluding the **Cycagacea** and Cm-tact'ic, the **remaining Gymnosperaue** were formerly all grouped together in one class under the name of **Goniferse**—conifers.

This term refers to the fruit, which usually assumes the form of a *scaly cone.* But such is not always the case, for the Juniper has a berry-like fk*shy fruit, while the \\,*w* fruit consists of a solitary seed lying within the familiar pink or red cup, nor has the Maidenhair-tree *{Ginkgo}* a cone. In the *cone the seeds are directly* exposed on the surfarc of the scales, or in the axils of these.

Flowers.

The flowers * are nearly always unisexual ; they are devoid of any calyx or corolla, but the colour of their scales or pollen **may** cmw them to be distinguishable at a distanee. The stamens vary in form, and are usually more scale-like than those of angiosperms. As the **pollen** can ^ain direct access to **tlit-** (-vule in the **female** flower, there is no necessity for the **carpel** to have a stigma or style, so that these, as well as the ovary, are **undeveloped.**

Fig. SQ.-*Arauc&rla imbrivaia;* female flower.

Leaves.

The leaves are nearly always m-fcllr-like or very narrow *(linear)*; but the ***GinkgO*** has broad leaves shaped somewhat like **the ultimate** segments of a IVtaidenhair-fern (Fig. 174), hence **its popular name;** and the **Monkey-puzzle** *[Armicaria*

" The *male* and ft male cones arc throughout described .15 flowers, and nut as inflorescences, because such a course inon; readily leads itwlf to brevity trad deomess of **dtttfrfptjgp.** But it is rjititc possible that tbtsc coma represent inflorescences.

**l-ig. 60.-*Anucarla imbricate;* male flowers.**

*imbnciita)* **has** broad, sharp-pointed leaves. In somo species of Cypress and Arbor-Vita: the leaves are reduced to small green scale-like structures; while in Pines all **the** leaves on the long-shoots are scales, the needles being confined to dwarf-shoots.

Another important character of these trees is that the overwhelming majority of them are evergreen, their leaves remaining attached for several years. To this rule there are three exceptions : *Ginkgo,* the Larch *(Larix),* and the Marsh Cypress *(Taxodium distichum),* all of which shed the whole of their green foliage in autumn. And we note that the leaves of these plants are of a lighter green colour, and generally less rigid than other coniferous leaves.

In most species the leaves are arranged spirally, but in one group, including the Juniper and Cypress, they are opposite or whorled. In some cases there is a sharp distinction between dwarf-shoots and long-shoots, as in *Gtnkga, Taxodium,* Pines, Larch, and Cedars (Figs. 6S, 106, no). The last three have needles arranged in clusters or tufts on the dwarf-shoots, and are thus easily distinguished from all other conifers. It is interesting to note **that** the dwarf-shoots of the Pines and *Taxodium* have **become** so closely identified in function **with** the leaves they bear that they are shed perind-i'^lv at **the times** sir]ıen the **greea leaves** alone would be expected to foil; thus, as each autumn comes, *Taxodium* casts its **folkge-bearing:** dwarf-shoots which, in fact, resemble pinnately compound leaves (Fig. MS).

The true arrangement of the l ves is frequently obscured by to ıs, especially in connection with shoo hat are not erect ; but to understand the ol these we must

of the stomata on the *Uit* n wu me leaf. This can often Stomata. bc belied with the naked eve

--ıed with are also incrusted with white wax. i£ ining, for instance, the Common Silver Fir, we note that the white lines are confined to the lower face of the leaf (F ree has flat leaves with stomata solely on their lower faces. NoW the leaves of the Silver Fir are spirally arranged on the horizontal branches, and were they to point in their natural direc- t — — tomata would, on the different leaves, face upwards, downwards, and in intermediate direction- *fc *i ~*w"*ws- **Out it** is important tiiat the stomata should be on the face away from the sunlight ; and t0 acMeVe **tliis** pose the ! leaves twist so that they are approximately horizontal, and the stomata-bearing lower faces directed towards the soO; COuacspieBtty the leaves seem at first glance to be arranged on the two sides of the branches, like the prongs of a double comb {sec Fig* 118), The same comb-like arrangement may be seen in the Dougias Fir (Fig- 61} and in the Yew. Another >I>vdrs of Silver Fir *(Abies Pinsapo)* has stomata on both faces of its thick, flattph leaves, which therefore retain their obvious spiral arrangement and point in various directions. The Common Spruce *(Picea cxcelsa)* possesses slender four-sided needles with stomata on the four flat faces ; its needles therefore do not assume the p< 1 *U* 1 1 comb-like arrangement, though those on the lower faces of the twigs twist *to* some extent, in order to avoid being concealed from the light. In Fines the stomata are on all the faces of the tufted needles, which therefore point m various directions. But in some Spruces the stomata are solely on the upper faces of the flat leaves, which

Fig. rn. — Douglas Fir *{Pseudoisuga dotiglasili.* Branchi Men \tiym •bttvc fright-ttund) and frelow (left-honiik

therefore twist and range themselves sorue-what in the same manner as in the Common Silver Fir. Finally, the sharp slender leaves of the. Juniper have their stomata solely on the upper white waxy face ; but fre-quently this surf;ice is shaded by being more or less closely pressed against the st sou The distribution of the wax (and the stomata) on the leaves of conifers we shall find hereafter to be of assistance in the identification of various trees.

The seedlings have two or more coty-ledons.

We may range the gymnosperms de-scribed in this work in three groups, as indicated by the subjacent table :

*A.* No TRUE CONE

I, Leaves broad and falling in autumn . . „ *Ginkgo.*

II. Leaves narrow, linear, and ever-green; the projecting seed surrouiiiitti by a fleshy red cup . . . . *Taxus* (Yew).

*B.* A TRUE CONE

III. Leaves narrow, often necdlc-likc (except *Araucaria);* >=(ՊNs concealed among the cone-scales *[Jwupcrus* has a berry-like cone) . Pinac*^,

EHstriln tion.

The present and past distribution of gyrnnosperms is of deep interest, The exist-ing representatives scattered over the earth from the Arctic to Equa-torial regions, Living on icy plains, high Tip mountains, in arid desert, dripping tropical forest, wet marsh, or forming vast forests in ot?r climes, are but a feeble and scattered remnant of the gyrnnosperms that flourished in past ages. Some of the {indent groups have been exterminated, another reduced to one solitary representative, and. still others broken up and their members banished to isolated spots. For instance, the *Ginkgo* family is now represented by a solitary species found wild only in Western China, though in past ages it was repre-Bented by many species of very wide distri-bution. The family (Xaxaceffi) to which the

Yew (*Taxus*) belongs is mainly sub-tropical in distribution, though *Taxus* itself is a temperat ... iaceae, which includes Pi ... Larch ... edars, Monkey-puzzle, Cypresses, Juni ... and others, is, on the other hand, a family ma... occupying the temperate zones or ... mountains of warmer countries. The representatives growing in the Northern Hemisphere (Pines, Spruces, and others) are replaced by entirely different genera (*Araucaria* and others) in the Southern. But even among Pinaceæ there is evidence of the extinction of species and their limitation to narrow areas. *Sequoia*, a genus including the American giant-trees, is now represented solely by two species which are confined to California; but in the Tertiary epoch it had many species distributed widely over North America, Europe and Asia. Again, in their local distribution conifers often show that they are ... mpetition ... *distichum* (the Marsh Cypress), for instance, occupies swamps.

How are we to account for this story of the defeat and partial massacre of the gymnosperms? So far as I am aware, no satisfactory suggestion has been made in way ... reply. To some extent the triumph of dicotylous trees over gymnosperms may be due to the superiority of insect-pollination to wind-pollination which prevails among the latter. The superiority of insect-pollination, however, is least when plants are social; that is to say, when many individuals belonging to one species live close together. Now, in temperate regions the coniferous, as well as the dicotylous trees, are largely social in the forest; but this is rarely the case in tropical countries, where a bewildering profusion of species is shown. I am of opinion, however, that the main reasons for the downfall of the gymnosperms must be

Defeat of the Gymnosperms.

sought in other directions. And as one can ... their relatively small power of ... njuries. Our knowledge of ... matter is, however, nearly limited to ... erate ... any kind ... of these has much more ... ous res... than the same ... would whether ... dicotylous tree: this is true, ... damage be due to physical or ... agencies, to animals, ... fungi. ... Spruce ... succumbs more ... sulphurous ... add (in smoke) ... broad-leaved trees ... more sensitive to this chemical ... life ... attacked by bark ... a very few years, yet ... Elm may ... for sixty ... under similar attack. A ... defoliated by ... be more vitally weakened than a dicotylous tree, though this may, in part, be ... the proposition in a different manner, if we compare the number of serious insect or fungal foes attacking coniferous and broad-leaved forest trees, the lists relating to the former trees are considerably longer. But the question arises: "Why do the conifers succumb ... this can be more easily? " Some reasons for ... conifers ... power of replacing destroyed ... leaves and shoots, which are the food-manufacturing organs, because their axillary buds ... more limited in number, and ... new shoots ... throwing out ... and root ... older parts of the stem ... second ... supposing ... oi an ordinary deciduous broad-leaved tree to be destroyed during the growing season, not only can the tree set into activity many buds, but it has lost only the leaves of one season (and the temporary ... the same activity), but with the same complete loss of foliage an evergreen conifer is deprived of that which required several years for its production. In this connection it is of interest to note that the solitary deciduous conifer growing as a forest-tree in Europe, the Larch, with its deciduous habit, also has a greater power of resisting serious injury than any other European conifers grown as forest trees. But it is possible that other more obscure characters cause conifers to fall easy victims to disaster—and we know that in transferring them from one climate to another they apparently exhibit smaller powers of acclimatisation than do their more successful rivals, the dicotyledons. There are some exceptions to the rules given above. The Yew has a great power of repairing injuries, and the Juniper an extraordinary capacity for enduring different climates and soils.

# PINACE/E

This family has cones consisting of a number of scales, among which the seeds are hidden ; so that its members are Conifers in the strict sense. The cone-scales are nearly always more or less woody when the fruit is ripe ; but the fruit of the Juniper is like a berry, and is formed by the union of three fleshy seeds.

The foliage-leaves are almost without exception narrow, but are broad and pointed in *Araucaria* ; their arrangement is spiral, opposite, or whorled.

The subdivision of the family and the recognition of the genera described in this work depend largely upon the structure of the flowers and fruits, and can be understood only after a study of these ; but here we may give a preliminary Table that will render possible the recognition of the different genera :—

I. Leaves broad and pointed. Cone-scales not double, with one seed above each . . . . . . . . . . . . *A raucaria.*

II. Leaves narrow, spirally arranged (except on the dwarf-shoots of *Pinus).* Cone-scales double, with two seeds on each:

A. Some of the needles in tufts cr clusters :

(a) Each tuft consisting of two to five needles (all the leaves on the long-shoots are scales) : evergreen. Ripe cones pendent and falling as a whole . . *Pinus* (Pines).

(b) Each tuft consisting of many needles :

1. Evergreen: Needles stiff. Cone erect, and with scales falling off separately . . . . *Cednis* (Cedars).

2. Deciduous : Needles soft and lighter green. Cone falling off as a whole . . . . . *Larix* (Larch).

B. Needles solitary, not in tufts :

(a) Scars left by fallen leaves flat or basin-like ; leaves flat with white lines on the lower face. Ripe cone erect, with scales falling off separately . . . *Abies pectinata* (Silver Fir).

(b) Scars of fallen leaves mounted on projecting lumps Ripe cones pendent and falling as a whole with the cone-scales persistent:

i. Leaves flat with white lines on the lower face. Cone showing woody scales and three-pronged thin scales . . . . . . . *Pseudotsuga douglasii* (Douglas Fir).

2. Leaves four-sided, with white lines on the sides. Leaf-scars mounted on conspicuous projections. Only one kind of cone-scale visible from the outside . . . . . . . . . *Picea excelsa* (Spruce).

III. Needles narrow, spirally arranged. Ovules more than two on each cone-scale, or two in the axil of each cone-scale :

A. Evergreen leaves. Cone-scales shaped like thick, short nails with five seeds on each . . . . . . . *Sequoia* (Wellingtonia).

B. Leaves deciduous, light green, arranged in two ranks on the dwarf-shoots, but spirally on the long-shoots. Cone-scales overlapping, with two ovules in the axil of each fertile scale *Taxodium distichum* (Marsh Cypress).

IV. Leaves opposite or whorled, narrow and elongated, or characteristic small green, and scale-like:

A. Fruit berry-like. Leaves white on the upper face, and awl-shaped in outline . . . . . . . . *Junipeviis cornmiinis* (Common Juniper).

B. Fruit a scaly cone :

(*a*) Cone-scales nail-like, not overlapping . . . . *Cupressus* (Cypresses).

(*b*) Cone-scales not nail-like, but overlapping . . . *Thuya* (Arbor-Vitae).

## PINUS.—PINES *(Pinacece)*

Pines are distinguished from all other needle-leaved conifers in that the spirally-arranged leaves on the long-shoots all assume the form of scales, while the needles are confined to dwarf-shoots, on which they are borne in tufts of two, three, or five. Cedars and Larches likewise have needles in tufts on dwarf-shoots, but each tuft includes many needles ; furthermore, the leaves, spirally arranged on their long-shoots, take the form of needles *(see* Figs, 110-1, 106).

Distinctive Characters.

The Pine-fruits are likewise distinctive. Of each double-scale only the upper (seed-bearing) one grows to any considerable extent ; it forms the woody cone-scale, and has on its exposed surface or *aftophysis* an outgrowth or patch—the *umbo.* This umbo at once distinguishes the cone from the more or less similar ones of the Spruce and Larch. The cone-scales do not become detached from the cone, which falls off as a whole ; whereas the fruits of the Cedar and Silver Fir have cone-scales that are shed separately while the erect cone is still on the tree (Fig. 125).

It is not easy to distinguish critically among all the species of *Pinus* without microscopical examination. But here we may give indications of the chief external characters that facilitate identification.

The number of needles on the dwarf-shoot is the first important aid in this respect. Some species are characterised by two, others by three, and still others by five on each dwarf-shoot, and are briefly described as two-needled, three-needled, or five-needled Pines.* The Pines described in this ... are all two-needled with the ... It is to be noted, however, that vigorous shoots of a two-needled species

Number of Needles.

* Those unacquainted with the construction of a Pine may not be able to follow this general account until they have read the special description of the Scots Pine, which immediately follows.

**Fijf. 6a.**—Stone-Pine *Pinus Pineai.*
**First and set *and* ve«r cone-tmtt-S and terminal reMidt -hml.**

we may first note the general form of the tree, as represented by the dit j>-branched W'eyniouth Pine, the relatively barf-trunk^d Scots Pine, nnd, in tlii>; ^mintr>p, the compact Stone - Pine, almost **resembling** an overgrown bush. The bark, too, aids recognition, especially in the case of the Scots Pine, in which its coppery-orange tint on **the** upper part of the trunk is veiy **distinctive.**

**Needles.**

The **needles** differ in length, thickness, colour, transverse section, **duration,** and tufting. We can **contrast** the long **needles** of the Cluster Pine **with** the **short** ones of the Scots Pine, the thick ones of the **former** with the **thin** ones of the Weymouth Pine, and their marked blue-green tint in the Scots Pine with the

Fig. **63.—Stone-Pine *(Ptaus Pines).***
**Second** and **third year** omi--lriiil.-.

may assume *n* three-needled character, while feeble shoots of the Weymouth Pine **nay have poly** four **needles tn** each tuft.

The next main character to be noted is the position of the umbu on the cone-scale.

**Position Of I'm bo.**

In **the** two-needled (and tliree-**needled)** species tin; nmbo stands in **the** centre of that part of **the surface** nf the scale that is exposed **while** the cone is closed; moreover, the **scale** is greatly **thickened under** its exposed **surface. In** other words, the *umbu* is *central* on a **thickened** ***apephysis.*** But in the **Weymonth** Pine **(and other fiw-needled Pines) the woody scales** are **relatively thin,** and **have the** umbo at the tip of each; the *timlo* is *terminal',*

Among other more detailed **differences** pure green of the Austrian Pine, their short duration in the Weymouth Pine with their longer life in the Austrian Pine, and their tufted **grouping** in the **Cluster** and Weymouth Pines with their regular succession. in the Scots and Austrian Pines.

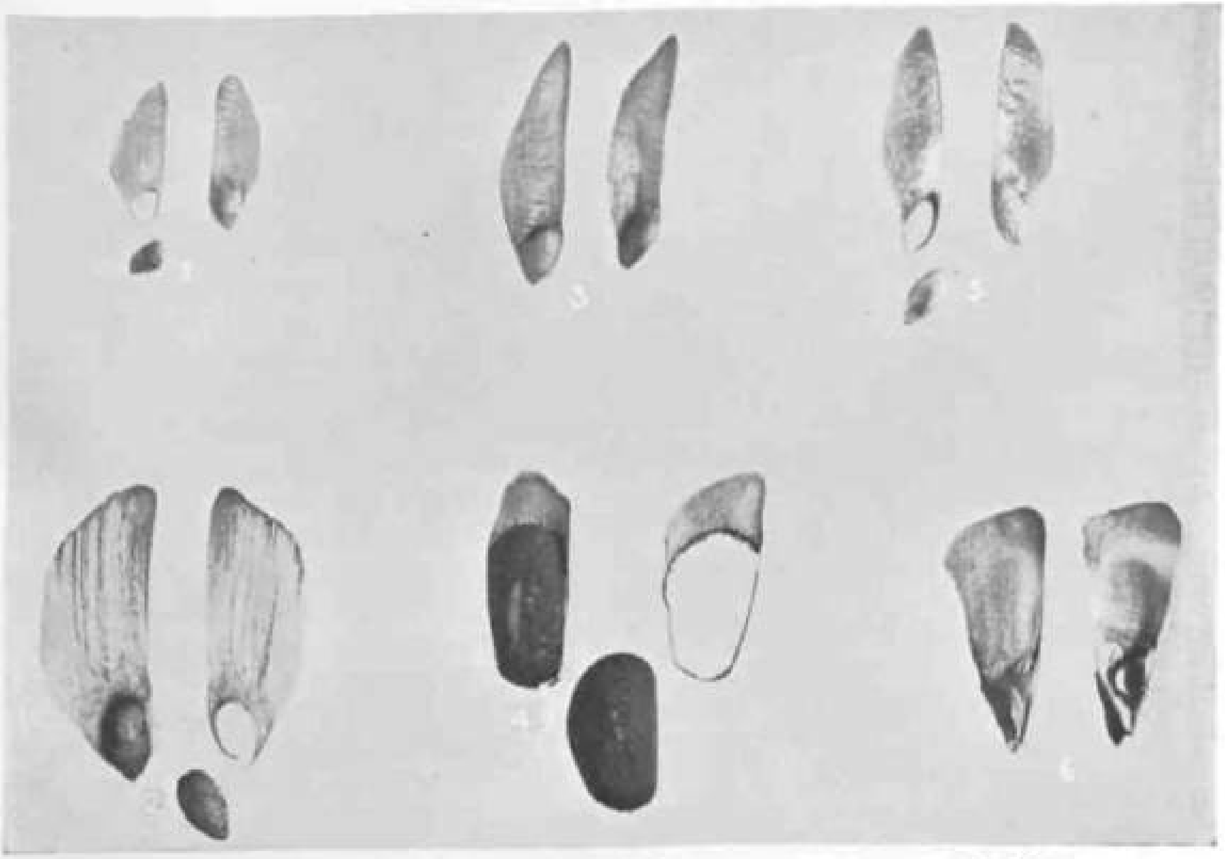
Resti buds"* The resting-buds vary in shape, size, colour, and surface. The significance of these distinctions may be seen by conMwring the larSe buc1* ^f **the** Cluster Pine **with** outwardly curved scales, the small resin-coated ones of the Scots Pine, and the sharp-pointed buds of the Austrian Pine which are int« r-mediate in type between those of the two preceding species.

The shape and size of **the** male **inflows-scences** show considerable differences, us instanced by **£hs long,** cylindrical, many-flowered ones of the Bishop's Pine, **the** small ones of the Scots Pine, JJjJj ers. **and** the few-flowered ones of **the** Weymouth **Pine.** The individual flowers likewise vary in **size,** but one critical feature to note in them is the size and shape of the connective-crest of each stamen.

In the female **flowers** and cones the **&fet** distinction **to** note is the **difference in** position between the *sub-tcrmi-* £J™|* owers. *nai* and *Utcral* ones, the **latter** being w, 11-rfpresented by th<* Bishop's Pine with **Lfa** false whorls of fruiu.

**I ,- mature** fruit-,..n. **shows** its Huiracteristic form to the best advantage **when** closed. In shape the large, rounded cones of the Stone-Pine contrast with Fruit Con*. aIl the ote species, **Which** taper at bast at their ends, **and** vary in **form** from **the** cylindrical **sjnridJe-shape of** tin- **Weymouth** Pine to the conical egg->)iape of the Scots Pine. In length tht' cones vary from the long ones i>f **the** Weymouth and Cluster **Pines** to the sliort ones of the Scots and Bishop^ Pines. In colour and l^tre distinctions exist; the dull-surfaced dingy-coloured cones of &e Scots and WVymouth Pines contrast with the **brighter, lustrous goes of** the other species. The **outline of** tlu< apophysis and its **genera]** or partial elevation into ridges should be noted, as should the shape und tint of the umbo and the absence or **presence** of nooks, spines, or **priekles.** In yet another respect the Stone-Pine differs from **the** remaining species described. its **cone** retjiiires three seasons to ripen, whereas theirs only need two seasons. The length of time that the ripe cones remain **attached**

**Fig. 64- Stone-Plne *iPinus PJnB«)*,**
**Open m«le Mowers, and, ut Hit tip. si^oullnft dUBrf.ih<>(lt;.**



i. I'inux •vlve-stris. 1. I'. hlnpl>u>. a. I*. l.iirii.ii>.
3. P. 1*111.l-lvr', 4, |«, I'fnpn. (i. Abie* pccllnntil.

Fig. 65.—Winged Seeds of Pines and Silver Fir,

affords a slight aid to identification : the Bishop's Pine retains its false whorls of prickly *closed* cones for a number *at* years ; the Wey mouth Pine allows its old **empty** cones to hang on for **several** seasons; but the majority of species retain their ripe, closed or open, cones only for tin- whole or part of one year.

Finally, the seeds are grouped into two classes. That of the Stone Pine is very large, and possesses a useless little wing which becomes detached before the seed leaves the cone ; those of the remaining species have <i weli-dcvelopcd wing, but show differences in the size and colouring of both seed and wing.

Seeds.

## PINUS SYLVESTRIS (LH»I.).—SCOTS PINE *[Pinaeea)*

The Scots Pine is usually distinguishable from other Pines by the bluish-green needles, which are arranged in pairs, also by the bark, which is light copper or orange-copper in tint, except near **the** base of the trunk, where it is thicker and darker in colour ; the fruit is a more or less conical cone with a dull (not polished) surface.

The main *wot* descends deep, and gives off wide-spreading lateral roots, so that **the** Scots Pine can **live** on dry, sandy soil, and is not easily uprooted; but when the soil is shallow and rocky the main root is short and deformed, so that the tree is easily blown over.

The tree can attain a height of i^o feet, but usually does not exceed ^0 feet, and at its base may be one yard in diameter. When in forest it displays a tall branchless trunk, capped by an umbrella-like crown, but like Lny^therTees in" the open it may retain L baches low down on the trunk for many years.

The bark is very characteristic. Excepting near the ground, it peels off regularly in thin scales, leaving a fresh orange-coloured to copper-coloured surface exposed, but low down the trunk the scales remain attached for a much longer time, so that the bark is thicker, darker, rougher, and marked with longitudinal and oblique fissures (Fig. 67).

The Needles.

The stiff, resinous, needle-shaped leaves are arranged in pairs exclusively on dwarf-shoots (Fig. 68). Each pointed needle is slightly bent, has minute marginal teeth, and is semicircular in cross-section. The stomata are arranged all round it, but wax is more abundant on the upper flat face, which is therefore bluish-green in colour, than on the rounded surface, which is of a dark green tint. The length of the needle is usually one and a half inches or two inches, but varies from half an inch to four inches. The needles usually live for three years; but in slow-growing specimens they may persist for five years, or, on the other hand, in old trees may perish in their second year of existence. Their span of life is probably largely determined by the amount of light reaching them.

It is of great interest to note that when the needles are dead or dying it is not they alone that are cast off, but the whole dwarf-shoot which bears them. In this case the sole office of the dwarf-shoot is to produce the two foliage-leaves, and when these have done their manufacturing work the shoot on which they - *** is dispensed with.

Th st ... of eaCh dwarf-shoot bears at ... ^ ^ ^ SCaleS, which COn-

The sheath.

stitute the so-called sheath th + ^Fig. 68^, and, above these, Z ^ T^ needles between which is last ^ ^ ^ . 8 ™ * * point. This • V orcllnary circumstances, remains S ^ ^ / ^ * ** *"* been rObbed for instanceUh ^ • ^^ ^ ^^ J n ... micros copic growing point needle ... , ^^ and produCe long for ... V6S, which aid in atoning ... nlUry done> The sheath of scales ... W^ ... **"* Part while the two needles kIT K / ^ emerging from the bud, and ... ubtedly devised to protect the young foZI^ T ^ ... round and over which ... Zdot th 7 " T ^ (Fig. 35). As the sheath ... ll ^ ^ . deVelOpil ... ^ the you ... PP ... in growth With ruptured^ en C l0Sed needles bu* is finally be ... a tue tip, after which, having browT T ? ^ ' ^ shrivels and becomes off ... uroW . Sheath does not fall ... it A ... uoes ... the Weymouth Pine (sec pa ... T ... TV.

The Branches.

best b arrangement of the branches may G understood if we examine the end of a twig in early spring, erow I TT- * before it has commenced to Jcall cZ ... There We see a terminal ra ... H ... estIng bud, and close beneath it, of ... ^J ... Stem, a drcle (false whorl) ... ural oneS, When the grOwing season ... the terminal bud sprouts forth ... ^"TrH ... long-shoot, on which are ^^ arranged scales, but not a single except' ... ^ axU of nearly all of these, ... erOwth a "^ the summit of the year's which '^T^ bUdS of the dwarf-shoots, in that th ... from ordinary buds on trees as th ... y grow out in the same season branches, and do mOt... r-shoot of which they are VMr ... "Ot remain for even one year as resting-buds. But as the long-

Fig. 66.-SCOTS *PIHE-PJNVS SYLVESTRIS.*

shoot ceases to elongate we see produced **at** its tip a resting-bud, and just beneath this, in the axils of a few scales, a. circle of similar large resthig-buds, which will not develop until th<i following year. These lateral resting-buds, immediately beneath the terminal one, behave just like the **latter,** even growing out in the same direction parallel to the main stem (Fig. 35). TMd oni.V subsequently bending down so as to stand out nearly at right angles. It will thus be seen that each year a false whorl of long-branches is produced, so that the age of a stem agrees with the number of **these** false whorls or their remains, so long as these are vi-ible (with one exception to be described in the sequel}. Only rarely do long-branches shoot out **from** p0sitiOT1s normally occupied by dwarf-shoots. It is svorthy of note thai when the terminal shoot or bud is injured, one or more of the lateral long-shoots replace it by growing upwiird in Jg direc·

**Fig. (rj. Bark of Scots Pine.**

Fijj, 68,—Twig and Buds of Scots Pine.

tion that would have been followed by the **injured** shoot. As a rule, one of the lateral buds in the false whorl does not shoot out with the others, but remains as a kind of reserve bud for future emergencies. Again, in cases of serious injury, a dwarf-shoot may develop and behave like a true terminal long-shoot, or even the colourless scales on both kinds of shoots may endeavour to repair the loss of green needles by becoming themselves green. Thus, by very varied devices the Scots Pine strives to substitute new leaves or shoots for those that have been destroyed ; and its powers in this direction are often called into play, because of the multiplicity of its sei'ious foes. On the other hand, in specially favourable circumstances the tree can take advantage of the opportunity offered, not only by more vigorous general growth, but also, when it is a young plant growing on good soil in open country, by sending forth additional long-shoots in place of certain of the dwarf-shoots. In such a case additional long-branches are inserted between the ordinary annual false whorls of long-branches. [The Larch normally {*see* page 84), and the Douglas Fir often, produce long-branches in simitar positions.]

The resting-buds (Fig. 68) are of an elongated egg-shape, clothed with many tawny, reddish or greyish scales, on and among which resin is deposited. The upper narrow triangular part of each scale is frayed out into fringe.

The Scots Pine in the open begins to produce flowers at the age of fifteen years ; but in close forest does not bear any considerable crop of seed until it is from thirty to forty years old ; or on moist soil, not before it has reached the ripe age of seventy to eighty years. Though bearing flowers every year, its good seed-years are separated by intervals of from two to four years. The flowers open in May or June,

The flowers are unisexual, male and female flowers nearly always occurring on the same tree.

Male Flowers.

The male flowers are yellow, egg-shaped, and small (only about a quarter of an inch long). They occupy the position of dwarf-shoots, and are confined to the base of the yearVshoots, where a number of them are grouped together to form an inflorescence (Fig. 34). Each male flower arises **in** the axil of a scale on a long-shoot : it has at the base about four scales, and above these many spirally arranged scale-like stamens which constitute the male cone. Each stamen has a very short stalk, a scale-like anther terminating in a shallow connective-crest, and bearing on its lower face two pollen-sacs. These open by longitudinal splits, and allow the sulphur-like pollen to escape. **With** the aid of a microscope it can be seen that each pollen-grain possesses two wing-like air-bladders whuh tender it more buoyant. As the male flowers fall off soon after they shed their pollen, it follows that in the succeeding year or years Hie regions where the male flowers were clustered will be marked out by patches of stem devoid of long-shoots or dwarf-shoots, so that if, year alter year, the same stem produces male flowers, the needle-byaring dwarf-shoots will present the appearance of being arranged in rosettes at intervals (this is shown in Fig- 34). On such twigs the life of a needle may be prolonged to eight or nine years.

Female Flowers.

The female flowers are lateral, but arise near the tip of the shoot produced during one season ; they occupy the positions usually taken by lateral buds destined to produce long-shoots. The bud of the temaile flower, unlike that growing out into a long-shoot, develops actively in the first year of its appearance. As the little cone-like flower is upwardly directed and attached so close to the summit of the young twig it presents the false appearance of being terminal (Fig. 35) ; so that the female cones art *in,* such a case often described as being "terminal," but we will more accurately refer to these as being " *sub-tcrminaL"*[1] Each stalked female flower is a globular scaly cone, about one-fifth of an inch long, and varies in colour from green to rod ; it is rendered more easily visible by the circumstance that it develops before the subjacent dwarf-shoots have sprouted, and thus stands out at the top of the silvery twig. Thy axis of the flower bears at the base some scales, and above these the spirally arranged scale-like carpels. Each carpel is characteristic in form and double, for it consists of a lower scale bearing on its upper face another scale, which in turn carries two ovules at the base of its upper face: the lower is the *carpdlary scale,* and the upper the *placcntal, ovitlc-teating,* or *se&l-bmrwg scale.*

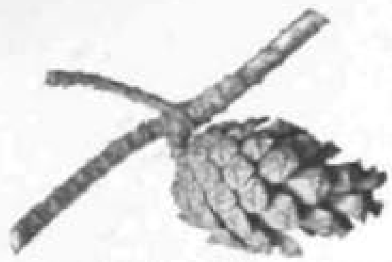
The Scots Pine i& wind-pollinated. Enormous quantities of pollen are produced wmrnm* and blown b? the wind- At the same time the axis of: the erect female flower has slightly elongated, so that the scales are somewhat separated, A polleu-graiu, alighting in one of the gaps between the sailes, rolls down a central ridge on the upper face of the ovule-bearing scale, and, in a manner that cannot be described here, reaches the ovule. into which it thrusts a tube.

Ripening of the Fruit.

'Die process of ripening of the fruit is a long one, requiring two seasons to accomplish. After pollination the stalk of the cone bends down ; the seed-bearing scales grt>w in length and thickness, becoming tightly packed, and in August have assumed a grey-brown colour. In the meanwhile the carpellary scales have not increased materially in size, nor do they ever do so. In this

Fig. tig,—Ripe Cones of Scots Pine.

condition the young fruit remains during its first winter, so that in the following spring it may be seen in the same stage- as is shown in Fig. 34. All the second season is taken up in the further growth of the cone, so that in autumn it is an egg-shaped oreonical body, one to twn and a half inches in length *(sen* Fig. 69). Sometimes in the October of their second year the brown cones open and shed a. few seeds, but



I-ig-. 70. Open tag Cone of Scots Pine.

usually no seeds are liberated until the following spring, that is in the third season after the **appearance** of the female flowers.

**The Mature Cone.**

The mature cone requires special description, as Pine-cones afford important means of identification. First U ,5 necessary t0 notice that the woody cone-scales visible are the enlarged seed-bearing scales. The portion of each scale which is exposed an the outer face of the closed cone is **greatly** thickened, and is termed the *apophysis ;* the possession of this thickened **apopnysis** is characteristic of Pines, and distinguishes them at once from Spruces, Silver Firs, the **Larch,** Cedars, and ottiers. The **shape** ol the upophysfs varies in the stirue cone, and very greatly in different specimens of this tree; it may be flat, or may project Uke ;i pyramid or even as a prominent hook. Oue feature to be noted is that the apophysis (and hence the cone) is dull, not polished, and varies in tint from greyish, to reddish brown. In the centre of each exposed surface (apophysis) of the cone-scale is a lump, or boss, described as the *umho,* which is continued into an evident transverse ridge, and often **into a less** obvious vertical ridge. The point to notice is that the umbo is *central, i.e.* in the centre of the apophysis; in this respect the cone differs from that of a Weymouth Pine, as will be **explained** later. As the cone dries its scales gape asunder, commencing ;it **the** top (Fig. 70), and permit the escape of the fertile seeds **which** are confined to the middle portion {Fig. 71). It should be noted: first, that the cone-scales do **not fall** off, but that the empty cone as a whole is detached later in the year (in October usually); secondly, that the cone is pendent: in both respects **the** cone agrees with those of the Spruce, Douglas Fir, and Larch, but contrasts with those of the Silver Fir and Cedar, which are erect and shed their scales separately. The Pine, then, **has** *persistent* cone-scales, hut **the** Silver Fir and Cedars have *deciduous* cone-scales.

Two winged seeds (Fig. 65, 1) lie on the upper face of each fertile seed-bearing scale.

Dissemination.

The length of the brown seed is about ¦„ in., and that of its wing about *I* in. The seeds are distributed by the wind. But incidentally they are conveyed by water, and by woodpeckers. After falling to the ground the wing is detached so that it largely loses its ]lower of transport through the air.

The seed includes a little embryo, with about six cotyledons, embedded in food-material *{endosperm).* Ongermination the root emerges and grows rapidly into the soil; the tips **of** tht: cotyledons remain for a time within the seed, sucking food from the endosperm. Tlie structure of the main **shoot** of the resultant seedling is quite different from that of shoots **produced** in later life. The seedling **at first** produces **solitary** long spirally arranged needles *{y* primary leaves "J, directly on its main stem. During its second year the little plant continues to produce these peculiar solitary leaves, which, however, gradually

**«k-mi in.-i 1 in 11.**

give way above to scale-leaves, the upper ones of which have in their axils the ordinary two-needled dwarf-shoots: and near the tip of this yearVshoot arises the first false whorl of resting-buds. In the third year these last produce the first false whorl of branches (so **that** in estimating the age of a young plant by counting the false whorls, two years must always be added). For the remainder of its life the Pine produces on the long-shoots only scale-leaves.

The timber of the Scots Pine is resinous and has a The red heart-wood. Timber. The tree may attain a great age, in fact one specimen has been estimated as being nearly six hundred years old.

The Scots Pine find* itself at home over a very wide area in Europe and North Asia, and at 70$^0$ N, extends to the limit of coniferous forest. It is essentially a lowland form, though in the Caucasus, in stunted and malformed shape, it ascends up to considerably over 8,000 feet, and to lower altitudes farther north. In our country, though liking a good soil, it can grow in dry sandy heaths or on wet peaty moors ; for its wax-coated **leaves,** its relatively slow transpiration, and its well-developed root-system enable the tree to live in these places where all roots find a difficulty in absorbing rapidly. In its more dwarfed forms (high up mountains or on bleak moors) the tree shows considerable likeness to the two-needled Mountain Pine {Pinns monlana), though it never assumes the peculiar, serpentine-branched, shrub-habit of the Alpine form of this latter Pine. The Scots Pine is a tree demanding a considerable amount of light, and if it be in a forest the rapid rate of growth of the stem during early life aids the tree in its struggle for light.

Fig. 71.—Fully-open Cones of Scots Pine.

## FINUS LARICIO *(Pair.)*.—AUSTRIAN PINE AND OTHERS *(Pinaceæ)*

Pinus Laricio is a species including several sub-species, among which are the Austrian and the **Cotsdcan** Pines. In this description the former sub-species, *Pinus Laricio,* var. *a-ustriaca,* will be particularly considered.

The species resembles the Scots Pine in many respects, but particularly in bearing its semi-cylindrical needles in pairs, in its sub-terminal female flowers, and in its somewhat conical cones. But it differs in the Qom^^ larger dimensions of nearly all ^&^ details (buds, needles, **maie** pjlie flowers, cones, seeds), in that the cones have a polished surface and usually stand out at right angles (instead of hanging down); in the longer life of its needles, which are not blue-

*green* ; Jind finely in the darker, usually blackish-grey, **bark** wliirh is fissured even up in the crown.

The root-system, though it can descend deep in loose soil, is marked by great horizontal extension of the lateral roots, **which** often run close to **the** surface. These may be exposed and extend actually over bare rock, here and there dipping into **Crevices,** and by their great development giving the tree snch a. **firm** hold **that,** unlike the Scots Pine in the same position, it is not easily blown down.

Tll« *tr6e* "^y attairt A height of one hundred feet, and its trunk **a diameter** of **a** yard. The **cylindrical** trunk retains its lower branches for a longer period than does the Scots Pine, and consequently has a larger crown in relation to its height. And this crown is dense because the long needles remain attached usually for three and a half or fonj- and a half years. It is of

**Fig. 73.-Bark of Corstcatl PJne.**

interest to note that this greuter longevity of the needles and main branches is associated with the character that the Austrian Pine docs not demand so much light as the Scots Pine; consequently the relatively dense shade of the upper parts of the crown or twigs does not so speedily **lead** to the death of the underlying branches or older needles. The usual occurrence of branches lower down the trunk than in the Scots Pine offers another means of distinguishing between the two species. At first the main stem bears long branches arranged in very regular false whorls, but in the full-grown tree the shape of the crown varies considerably in the different **varieties,** being broadly egg-shaped in tlie Austrian Pine until ripe age is attained, when the crown is more umbrella-like,

**Ftjj. 73.—Austrian Pine—*Plnus Larlcio.***

The bark at the base of the trunk is massive and deeply fissured *{sec* Fig. 72). The bark-scales remain attached for a

much longer time than in **the** Scots Pine, so that the trunk is of a dark colour through-
Ollt(

The long needles vary in length from **two** to more than six inches; they are dark green on both faces, with yellow ttps and tindy **saw-l&e** margins. Apart from these features they resemble those of the Scots Pine, and are ranged in pairs (rarely in threes) on dwarf-shoots (Fig. 75). They remain attached for periods varying from two and **a** half up to eight years, **butjusualfy** for about four years.

The arrangement and general structure of the dwarf-branches and long-branches are as in the Scots Pine. The long, con-

Fig. *7A'* **Corsican Pine—*Pinus Laricio.***

spieuaus sheaths of tlie former brandies do not fall off; but one characteristic feature of the long-shoots requires notice. On **these** each scale, instead of falling off as a whole, merely sheds its upper portion, while the lower portion remains attached to **a** prominent " leaf-cushion "; these persistent basal parts of the scales (Fig. 75) give to the stem a rough and furrowed **appearance** until the **formation** of bark causes the superficial rind to be thrown off.

Fig. 75. Twfg and Rest Ing-buds of Austrian Pine,

The buds destined to produce long-shoots are in all **conditions large.**

Buds.

Thii terminal **resting-bod** (Fig. 75) is about one imh in length, oblong, wry pointed at its end, glistening, and of H light **chfisfaittt** colour. Its fringed scales are veTy **numerous,** the lower ones being bent **backwards** and **outwards,** and tlic tipper ones lying flat (adpressed) and being cejnentcd together by rosin.

**The** Austrian Pine commences to flower in **the** open at an age of from

Flowering.

fifteen to twenty years. but in **the** forest not until About the thirtieth year. The general **structure** and arrangement of the flowers arc like those of the Scots Pino. Hence, in the descriptions of the flowers only the distinctive features will be mentioned lv«fe. The flowers open **Late** in May or early in June.

The bright yellow male flowers (Fig. 76) are cylindrical in shape, and as muclx as an indi in length. The connective-crest of the anther is large, finely-toothed, and **tinged** with **purple.**

The **bright-red** female flowers are sub-terminal (Fig. 77), and **have extremely** short stalks. After pollination (by the **agency** of wind) the young cones become blue-violet, and remain erect or bend down **Fax** li;ss than in the rnse of the Scots Fine, At **the** end of the first season th* y are about the sise of liasel-nuts. The **fruits** require two seasons **to** ripen, and the scales gape open **only** in the spring or early summer of the third season.

The cones when ripe are characteristic **in** pose, form, and surface. They are often

**Cones.**

grouped in pairs and paint out-**wardsj more** nr less at right angles to the stem (Fig. 78). Each **cone** has an

Fig. 76. Mnle Flowers of Austrian Pine.


Fig. 77.—Female Flower and Young Shouts of Austrian Pine.

than in **the Scots Pine. Each** grey-brown **seed is** ', *U>* \ in. lnng, while thr **wing** is **usually about one** indi in **I&ngtb (B5g. '»5)-**

The stnjctun.' ff the seed, its **germinatioji,** mid **the** f(»mi **and** be-**liaviour** of the seedling all differ so slightly from the corresponding **fear** tnres in the Scots Pine that detaik-d description here would be superfluous.

The timber of this long-Iiwd s]>r;cics b scarcely **distinguishable** from that of the Scots Pine.

**Compared** with **the** Scots Pine, till the varieties of *P. I.uricio* arc more southerly in distribution, as they are Daturaliy limited to **South** Europe (including Spain and Central Austria) and Asia .Minor.

The **Corsican** Tine differs **from** the Austrian in the tint and smaller size of its needles, which do not seem to form sudi large, dense tufts of dark green foliage. **Another variety, P.** *Laricio* var. *siricla,* seen in this country, is marked by the shortness, the regular arrangement a and prolonged retention of the **branches** on the mam stem.

almost imperceptible stalk, and is conical, being usually from two to three, never more than four, inches in length. The apophysis bulges, and has a transverse ridge as well as a central **nipple-like** nmbo, the pinkish-brown colour **of** which contrasts **with the** yellow-brown of the rest of the apophysis. The upper **apophysss** may be prolonged **into little spines.**

The two seeds lying on tin upper face *of* each fertile cone-scale are larger, heavier, and longer-winded

*Fig.* 78.—Cones of Austrian Pine.

## PINUS PINASTER (AIT.).—CLUSTER PINE (*Pinaceæ*)

The Cluster Pine agrees with the Scots and Austrian Pines in having its semi-cylindrical needles arranged in pairs, and in its some-

Fig. 79.—Bark of Cluster Pine.

what conical cones. In the dimensions of its detail, it generally exceeds both these species. It is marked by the [illegible] long needles are thick and distributed in clusters; the resting-buds are [illegible] show no resin externally, their [illegible] are all curved outwards at their tips; the large and brightly-polished cones are often [illegible]

The name "Cluster Pine" [illegible] arrangement [illegible] leaves.

The root system consists of a deep main

Fig. 80.-CLUSTER *PME-PtSUS PINASTER.*

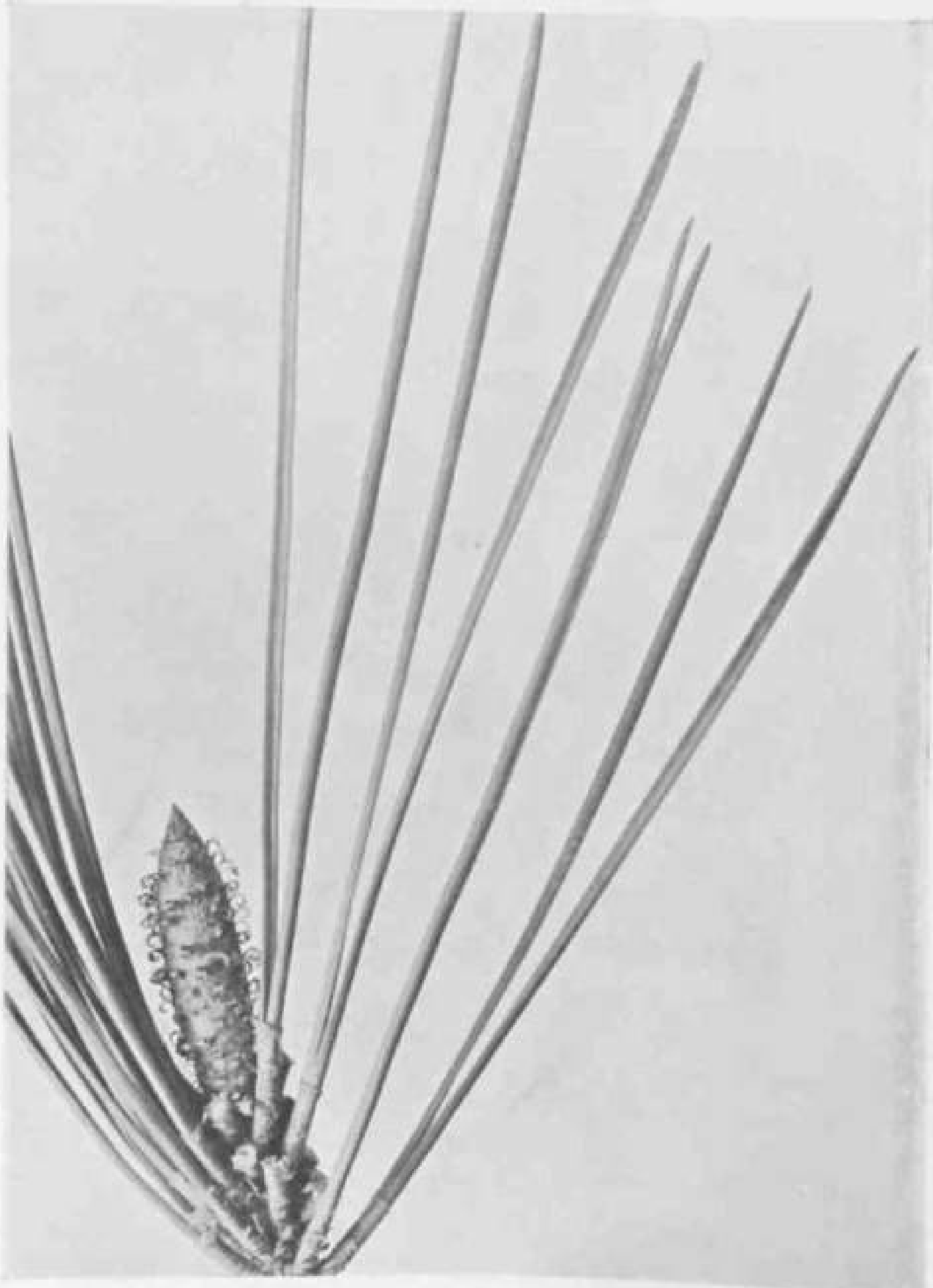


Fig. Si.—Bud of Cluster Pine.

root with many brandies, which descend deeply or mn near the surface. The depth of the root-system is associated with the youikg tree's exceeding rapidity of growth and with the faculty the tree has of growing on sand.

Root System.

The columnar trunk attains a height of from sixty to a hundred feet, and a diameter of three feet ; and the tree, even when old, the regular pyramidal shape of its c ion provide scarcely indicates the typical diameter of the tree.) The thi L dark grey bark is traversed by deep 2X y P ..gitudinal furrows (Fig. 79).

Trunk.

Tiie long pure green, often twisted, needles are arranged in pairs (or, oti young plants,

FI&. 8a,—Male Flowers of Cluster Pine.

often in threes) on dwarf-sli'jcits. They •rary in length from four and three-quarters to

Needles.

<-i^hl or even nine inches, and their tinusuaJ **width** is **associated** with marked silliness. The needles live fur three or four yeaj-?. Their clustered arrangement towards the end of the year's shoot is especially **noticeable** on the **shoots** that have borne male inflorescences (Fig. 82).

The large red-brown resting-buds vary in length from one to two inches, and at first

Resting-buds.

sight display two characteristic features—the tips of alt the scales are curled outwards (Fig-Si), and there is no resin cm the outside of the bud (contrast *P. Larkio).* The margins of the scales are frayed out into wliitt? cottony '* cilia :' **which interweave.** The bud is **rather** blunt at the tip, ;ind much less pointed than that of **die Austrian** Pine. Though **there** is no **external** resin, ***yet*** within tin: bud the scales are **cemented** together by this substance. The rtsting-buds frequently behave in ;< peculiar **manner* for the?** "fen sprout during the season of their production. TUesc precocious lauds shoot forth in late summer instead of **waiting** until the fall-, wing spring. Perhaps the sensiiiveness of the tree to frost is partially due to this habit.

The tree commences to flower at **the** age of ten or fifteen

Flowering.

yours ; indeed, even jn its fifth year of **existence** it may produce female flowers, but the cones **resulting** from these are sterile (similar sterile cones may arise **on** juvenile specimens of Scots and Austrian Pines). The **Bowers** open in April and May, and agree in **general** structure with those **of** the Scots Pine.

The **male** flowers are **arranged** in very large golden, broadly oval, **inflorescences**

Male Flowers.

situate at the base of the current yearVshaot (Fig. 82). The **oval** flower is up to three-quarters of an inch long ; and each **anther** has a **large, erect,** ruddy, connective-crest which is toothed, M. thm the young **flowers show a reddish colour,** since only these crests are visible from **the** out side.

The **stalked violet-red** female flowers are about h:ilf :m inch in length. They are

Female Flowers.

usually arranged in whorls of three or 7n (ire. The female **flowers** are close to the tip of the young twig, and the mature fruits are therefore only slightly, if perceptibly, below the false whorl of branches among which they occur (Figs. 83, 84); so that I do not regard this as a case in which the cones are lateral* though they are so described in various works.

Cones.

After pollination, which is accomplished in the same manner us in the Scots Pine, the cone requires two seasons to ripen. It becomes roundish-oval (Fig. 84, upper cones), and subsequently elongated-conica^ but is usually bent at its tip (Fig. tS4, lower cone); at thus stag*; the surface shines as brightly as if it had been polished. In its early stages the cone possesses a stalk of relatively considerable length, but the stalk elongates so slightly :is to be comparatively insignificant in the mature cone. The ripe cones, though gently inclined downwards, radiate from the stem in a somewhat *iar-Hke manner in false whorls. The mature cone is six or eight incites long and from tw<> 1 • > k>ur inches thick. Tlio apophysis projects and has a prominent transverse ridge: tin- n-ntral iimbo usually also projects strongly, is pointed, and continued out into a straight or hooked process. When the rone is ready to shed its seeds, in the autumn of the second seasmi or the spring of the third, it has lost something of its glistening appearance and is dull brown. and may remain closed fef years. Like those of most other Pines, the cones arc unequal-sided ; the face towards the stem being less prominent in all its features than the outer face that is exposed to „the light.

Seed.

The two seeds on each fertile scale are about one-third of an inch in length, while the wing is from three to five times as long (Fig. 65, 2). In the structure and germination of the seeds, and development ot the seedling, the Cluster Pino is so similar to the Scots Pine as to require no special description.

Distribution.

The Cluster Pine, like *P. Laricio,* naturally is mure southern in distribution than the Scots Pine. It occurs in the evergreen region of Mediterranean countries as well as in Portugal, More sensitive to cold and shade than the Austrian Pine, it demands as much light as the Scots Pine. Growing readily on sand, *vxty.ti* if this be dry and

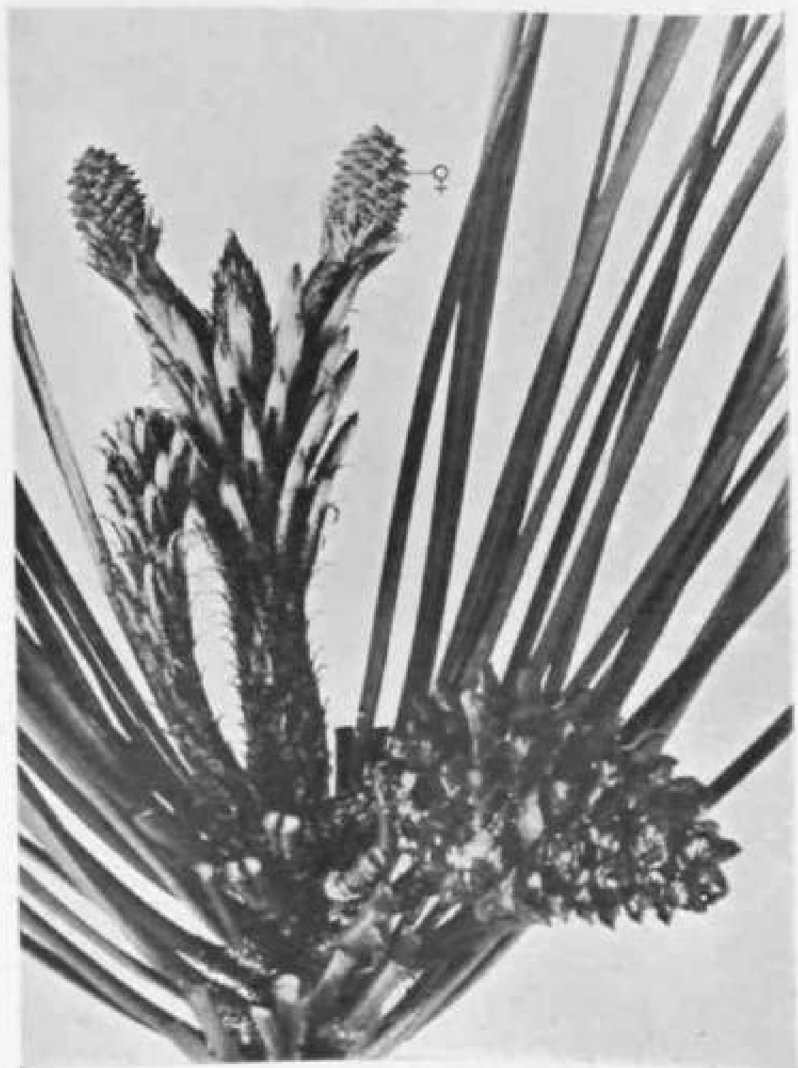



Fig. 83,—Female Flowers (¥} and Cono of Cluster Pine.

•ftcc the description o£ Fiau* miiri-Mi.i. p. *07,*

li.il- **84*** — **First and Second Years* Cones of** CJuster l'iiii.

**sterile** near **the surface,** so Jf>ng as there is moisture in the deeper **layers** to which the roots penetrate, **the** Cluster Pbie is the conifer which i* the bL-st. adapted in **w&nn-temperate countries for** the ;iljnr*st;iiii.n of s-indy plains and dunes.

As its forests are for the most part oil tin." OMISL ;ind ii^ ll)-- trir

**Habitat.**

**can** grow near the sea, it is **frequently** termed the "Maritime Pine"; but *{he,* needles art[1] easily **injured** by s:ih spray, and *P. pinaster* **perishes if the roots be laved** by sea-water, so that it can be stiid to scarcely **deserve** the name.

In contrast with the Austnm **Fine,** it can hardly endure a **chalky** soil: if it grows on such a soil, it remains wry stunted, and bears **needles** of **a** sickly yellow-green tint.

## PINUS MURICATA *(D. Boa* .—PRICKLE-CONE **PINE** *Pinacea)*

**The Prickfe-Gone** or Bishop's Pim- i- a nvu-i)i,i||i'il species: its prickly cones **arc*** arranged *m* false whorls between **the** ialse whorls of branches, and **remain** dosed **and** attached to **the** stem **for several years. These features** afford sufficient **means** of **identification.**

This Pine is cultivated only in **compara-tively** few gardens and parks in Great Britain, but is briefly described in this book because it **illustrates** two points of interest in reference **to** the corns.

Its **koine** is **in** California, where it be-comes a rough-barkod tree visually **forty to** fifty feel **in height,** but sometimes as much **as ninety feet Wln-n full-grown, in Cali-fornia, it ha* ;* compact rwod-topped crown,** so "tha ; **fee** illustration here given of ;l -p.! in<• **11 grown** in **England** can hardly be **regarded as typical**

**The** stiff **needles** (which are sometimes in tufts <if threes) are long, being usually four to six inches in length, and pinv gfieen, and are grouped into clusters **at tnten**als. Tl ley commence to fall in tlnir **second** year.

The resting-buds (Pig. 85) are very pointed, and coated externally with ICSIIK

The male **inflorescence** is **striking,** be-cause of its long and cylindrical shape (Fig. 86), as wull as its **distinctly** reddish-

FW. 8S. KtstinK-bud and Withered Mate Flowers of Prickle-cone Pine-

shoot, so that they occupy the positions of lateral dwarf-shoots. Sometimes two such false whorls are produced in one season (as is shown in Fig. 88),

The consequence is that the fruits are arranged, not in the same false whorl* as the branches, but (in the stem between two false whorls of brandies (Fig. 89).

Fru'i t.

Aiintlur peculiar character of the fruits concerns their behaviour. In place of opening, shedding the scud, and falling off soon afterwards, the ripe cones remain for years firmly closed and attached to the stem (Figs. 87 and 89). Similar behaviour is characteristic of some three-needled Pines, such *as P. nidiaia,* which, like the speck's here described, has unequal-sided cones. The prickly character of tin- ennind, glistening, brown .-uius (Fig. 8i)) gives ta the spt'fies (me of its popular names.

The seeds are winged, but how they naturally contrive to escape li

..t.ttige colour, The length of the inflorescence accounts for the separating successive groups of needle-tufts on stems that successively bear male flowers (Fig. .

Flowers-

But it is in the arrangement of the female flowers, and subsequently of the ,-unes, that this Pine h most interesting. The female fiowcra ace produced in false whorls considerably below the terminal bud of the years-

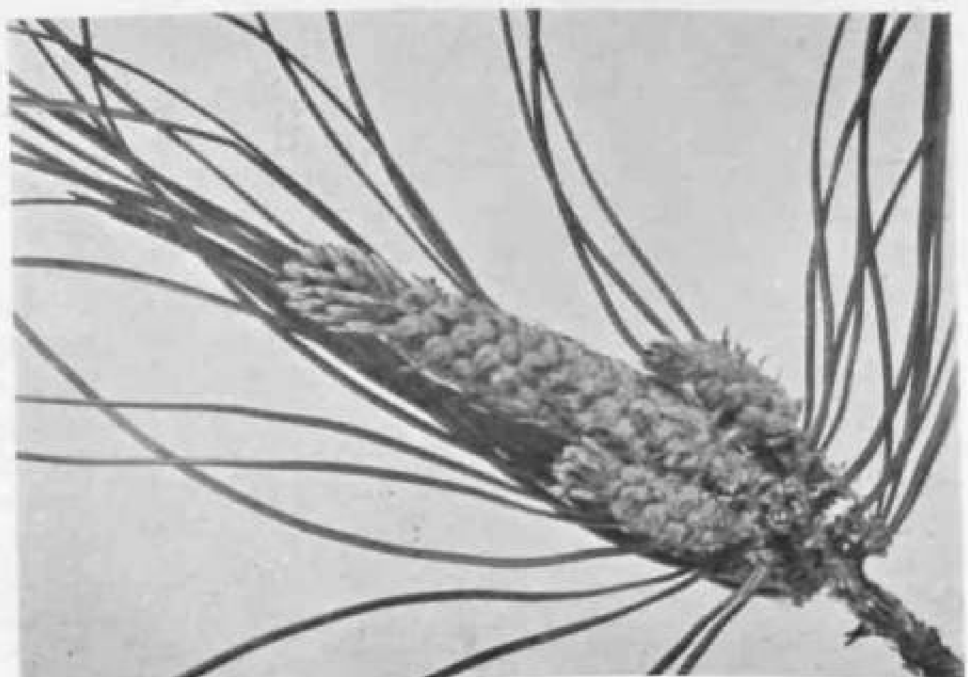


Fig. 86,-Male Flowers and Sprouting Shoots of PrkkJe-cone Pine.

Fig. 87.-PklCKLE-CONE P1NE-/VNI/S *MURICATA*.

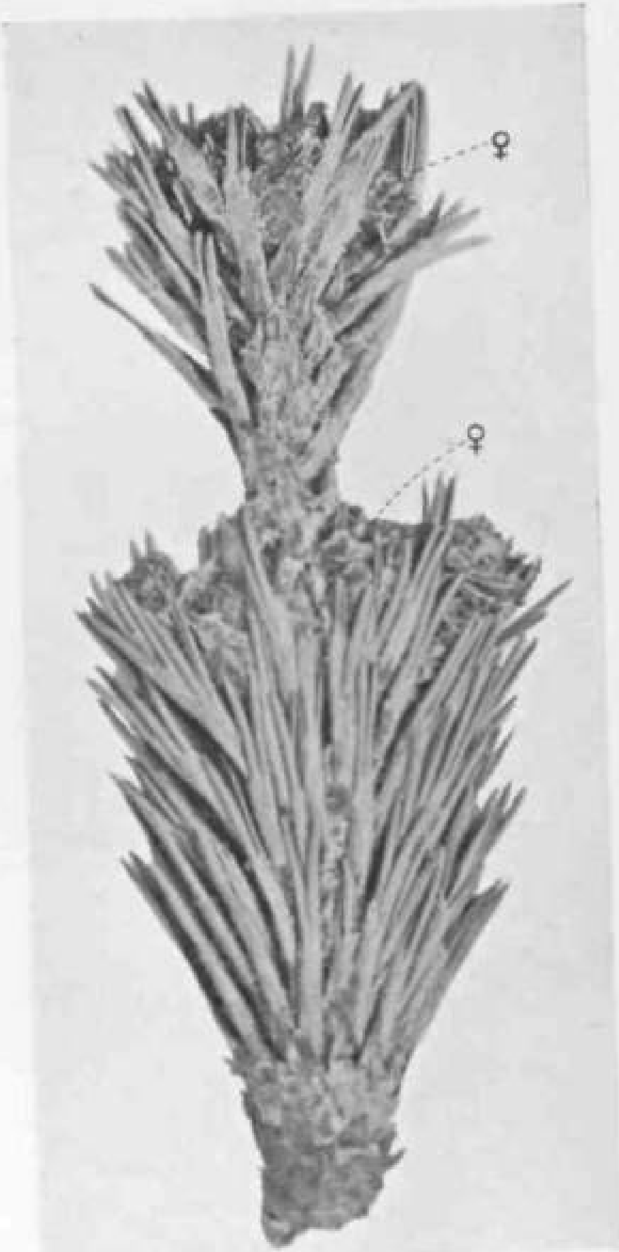



Fig. 88.—Two False Whorls of Female Flowers (♀) on Sprouting Shoot of Prickle-cone Pine.

**Similarity to P-ine**

In possessing prickly cones the **Bishop's Rhe** rather shows a similarity to three-needled species of *Piwts* which ^ apt U) ^^y spines or **h<wtoi** on their cones ; and the **likeness** is **intensified** when the Bishop's Pine acquires **shoots** with three-**oeedtatf** tufts. Yet even in this guise it can be distinguished by the somewhat dark hue of its not large cones, as well as by tlu:ir position and prolonged **attachment** in a closed **condition,** There are, however, two three-needled species that retain **their** cones in the same manner—namely, *P. radiata* and *P. insigttis.* But tin; cones of these are remarkable for their **extremely** unequal-sided shape and are relatively light in colour ; moreover, they are feebly or not at all equipped with sharp prickles.

**Bscape of Seeds.**

ll(pl htUy understood. It is, however, known that closed pine-cones of this type can be artificially induced to opeB by the application oi dry heat. Hence the sugges-tion has been made that they are **adapted** to provide for the continuance of the **sped*** after fire has devastated the forest.

*Fig.* **Sp.-Closed Old Cones of Prkkiecone Pine.**

**PINUS PINEA** ( *Linn.).*— STONE PINE OR UMBRELLA PINE *{Pinacea)*

The popular *mm of this tw&*ne&&&* **Pine indicate two of** its **distinctive** features **—the uiftbreHa-Kke shape of** the tree when mature, and the very large stony seeds ; **in** addition, the long paired needles, and, above all, the Justmus broad, almost globular, cones render the tree well-nigh unmistak-able.

**Fig. po,—Bark of Stone IMne.**

The *rough* -barked tree in its Mediterranean home attains a height of ninety **feet,** and when full-grown **has** a long trunk with a wide, flat-topped or umbrdla-Iikc crown, But the specimens occasionally seen in England arc much shorter, and possess a compact, **broad,** roundt-d **crown,** so that the comparatively small tree, **with** its strong, low-pitched boughs, often resembles an overgrown bush (Fig. 91).

The long, thick needles (Fig. 62) recall those of the Cluster Pine. The upper scales of the resting-bud are loose and curved outwards (Fig. 62).

The male and female flowers occupy the same position as in the Scots and Austrian Pines, so that the cones are sub-terminal (Figs. 62-4).

**Cones.**

The first point of interest is that after pollination the cones require, not two years, but three, to mature (*see* Figs, 62, 63), and shed their seeds in the spring of their fourth season. Each lustrous, brown, mature cone (Fig. 63) is broadly egg-shaped, or approaches a globular form, being usually four or five inches in length and three or four inches in thickness, and stands out horizontally or inclines slightly downwards.

Each large, bulging apophysis is marked by five or six radiating ridges, and capped by a flat, central umbo.

**Seeds.**

The very large, edible seeds are equal in size to a hazel-nut ; they contrast sharply with those of the Pines previously mentioned, not only in this respect, but also in the very feeble development of the wing which separates at once from the seed (Fig. 65, 4). This extremely short wing affords us an example of a functionless relic representing a structure useful in the ancestors, but now useless and degenerate. The seeds are thus not distributed by the wind, but probably are scattered by the agency of animals, though their seed-coat is hard and woody.

The large seedling has ten or a dozen bluish-green cotyledons.

In distribution the Stone Pine resembles the Cluster Pine, for its centre is the Mediterranean region, and it extends, mainly near the coast, from the Canary Isles to Asia Minor.

Fig. 91.—*STONE* PINE—*PINUS* *PINEA.*

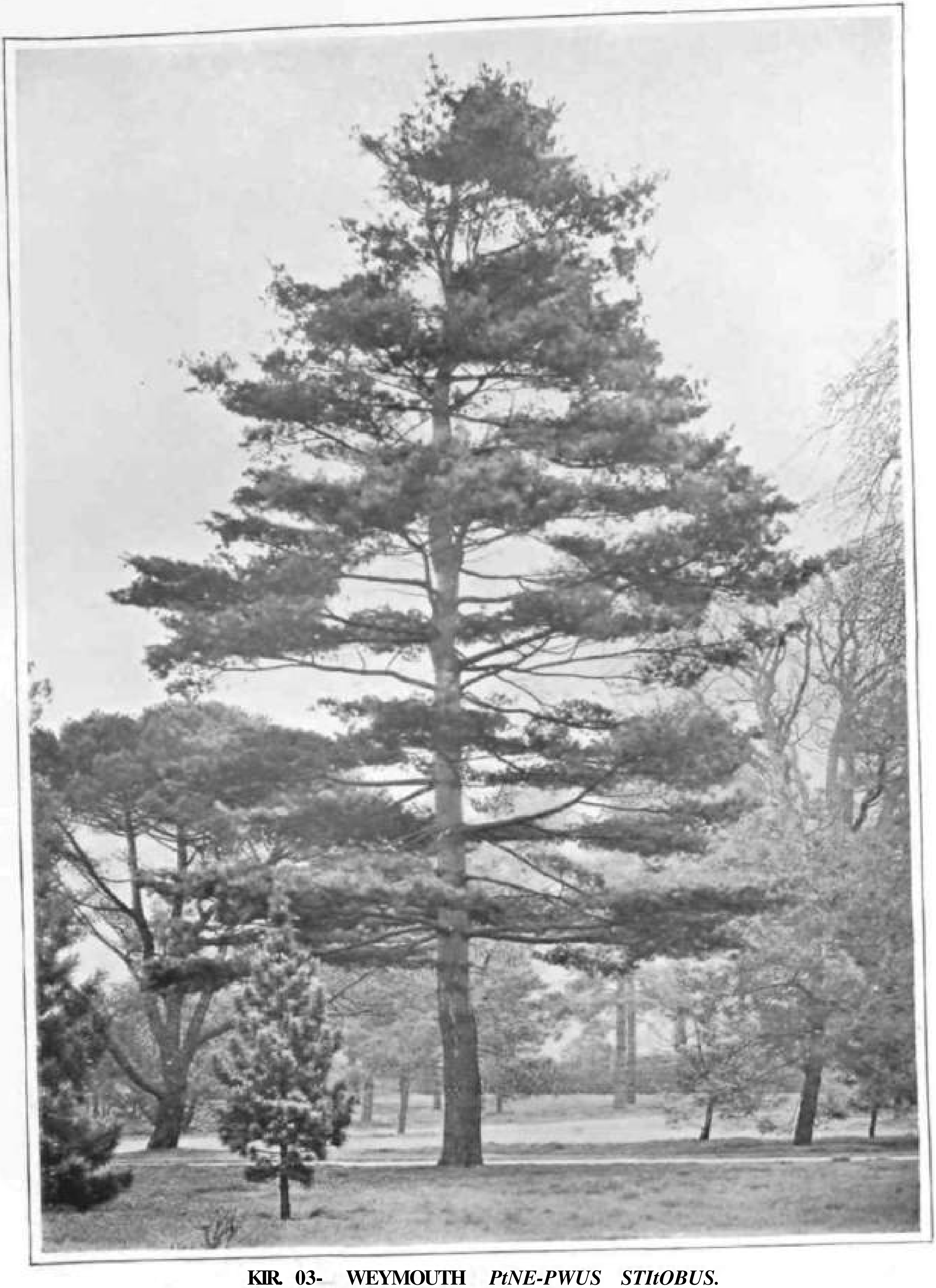
## **PINUS STROBUS** ( *.Linn,).*—WKYMOI'TH PINE (*Pinacea*)

The Weymouth Pine differs from all the Pines previously described in the following respects: the dwarf-shoot bears fiv*? needles, and sheds its sheath very early ; the cones are long and narrow, with thin cone~scaksT which are each capped by a *terminal umbo.*

The enormous root-system, with its deep main **root** and far-reaching **lateral** roots, is, no doubt, largely responsible for the varied situations in which this tree **can** grow.

In its youth *the* tree is very **symmetrical**

**Fig. 92.—Bark of Weymouth Pine.**



**KIR. 03- WEYMOUTH** ***PtNE-PWUS STItOBUS.***

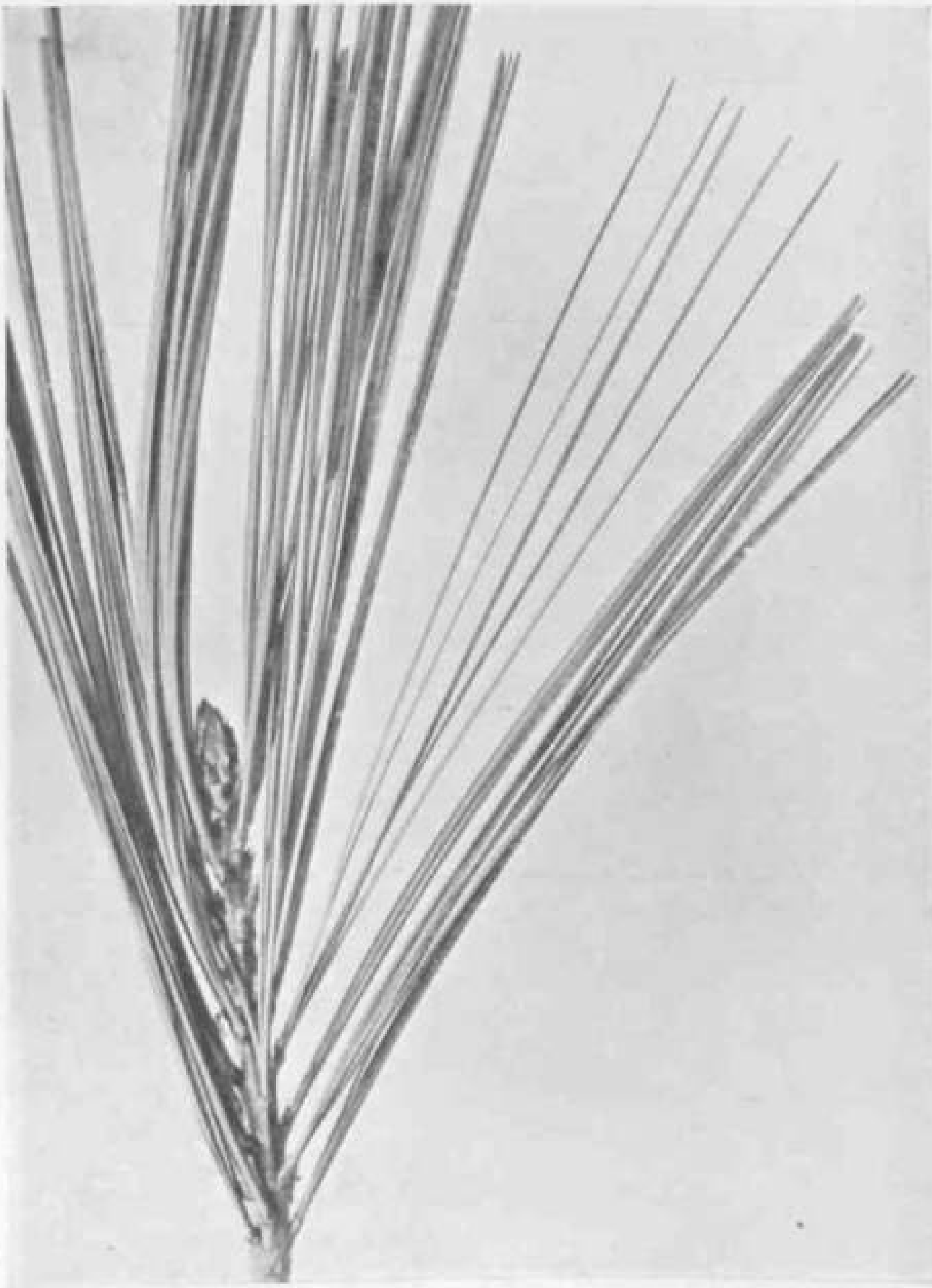


Fig. 94,^Foliage of Weymouth Pine.

in form, with **regularly** succeeding false whorts of "brandies, Those are retained for **a** long time, so that the regular pvramidal form of the tree persists for many years. Indeed, in the open country the Weymouth Pine may :ittain a height of ninety feet and bear brandies **right** down to the ground j no other common Pine shows such a power and habit. The very straight trunk often attains a height of 100 feet and **a diameter** of a yard ; but in its North American home the " White Pine " (as it is there named) occasionally towers head and shoulders above its fellows, with a height of 250 feet and a diameter of six feet.

Form and

The bark during the first twenty or thirty years is smooth, **bstrotis** and blackish - grey, but raised here and there into small blisters caused

Bark.

Fig. 95.— **Resting-bud of Weymouth Pine.**

by resin-tilled sacs lying tn the rind- **After** this the bark becomes longitudinally fissured, and has little scales firmly pressed on to the main ridges (Fig. 92),

The thin needles are grouped in rive* {rarely fours) on the dwarf-shouts ; liny **vary** in length from two and a **half** to four and a half (or more) **inches,** and are softer than those of the Pines previously **described.** But from **these** they differ in another and important **respect.** In order to understand **the distinction** in question, it must be remembered that when ill-- piue-needles of a single dwarf-shoot are young and enclosed in the **sheath** they are *all* parked **together** to form **a** cylinder. Hence, when there are two needles on the shoot, each is shaped like a half-cylinder, **and** the Rat faces of the two are pressed together in the bud, wldle the roundetl outer faces are in contact with the sheath ; when

**Needles,**

cut a<:xo;ss, therefore, earfi needle sliows a semicircular section, **the tnxter** face being flat and the outer rounded : such is the *form* of the needle in all the **two-needled** Pints previously dealt with. But if **there** be five needles to form the **cylinder, each can** only form **a** fifth of tliis, and, when cut across, must be approximately triangular in section, with two side (inner) faces where *t\\n* **contiguous** needles are pressed against it in the bud, and with one outer rounded face. Such is the form of the needle in the UVvmouth Pim-. On the two Hat faces the stomata arc ranged and their **presence** is **indicated** by wax, which lends a bluish tinge to the green ; while the convex outer (lower) face of **the** needle is of a pure, dark green. The margins have minute saw-like teeth which can be detected by rubbing the needle between the fingers in a downward **direction.**

During their first year the needles an* directed upwards at the ends of the **twigs,**

Fig. 96.—**Male Flowers of Wevmouth |Jlne.**

Fig. 97.—Female Flowers and One-year-old Cone of *Pin us excet&a.*

needles remain attached to **a** species of Pint- is no **criticaj** indication of the amount of light needed by that **species.**

Two characteristic features in regard to the dwarf-shoots deserve attention. In the first place., from the beginning they are more restricted in distribution than in the Scots Pine. They are limited to **the** upper (apical) portion of the year's-**S&oot,** because no dwarf-shoots arise in the **axils oi the tower** scales produced near the **base** of each season's twig (Fig. <fS) : only on some lung-shoots do these lower scales have **male flowers** in their axils. The second special **character** of the dw.trf-shoot is that **its** lustrous brown sheath is shed more or less completely in **the *Bist* season** of its existence (Fig, 94) instead of remaining attached till the fall of the dwarf-shoot; so **that** the sheathlfss dwarf-shoots contrast with the permanently sheathed onos of the two-needled species [ 1 v v 1 - n isly described.

**Dwarf-**
shouts.

but In their second season they spread out. In cold **weather** they move and tend to Þi' parnlk'l to the stem. This behaviour **may** partly account for the **111** Li*. injury done to the tree **when snow** threatens to **overload** it. but the danger is **guarded** against also by **tlie** short duration of the leaves, which usually live for only two years. The brevity of life of the needles is of special interest when it is remembered that the **Weymouth** Pine endures shade better than the Scuts Pine, whose needles are, **nevertheless,** lunger-lived. It is thus **evident** that the number of years during **which**

**Behaviour of Leaves.**

Apart from these features the branching proceeds on the pkn **described** in **connection** with the Scots Pine,

The orange-brown **rating-buds** (Figs. 94, 95) are nearly **hali an** inch **long,** ni **a narrow egg-shape,** and coated **with** resin.

The tree produces its first crop of flowers at 1 lie age of from ten to fifteen years **in** tlit- open, or from fifteen to twenty years within the forest. Rrcillv good seed-years seem to succeed at **interval** of about five years, though flowers and a,iu-: ;iiv produifd ;it shnrl<T int.:\a]-. It is of interest to note that in **the** United States in some seasons the tree **bean** many cones that produce no seeds capable

**FJ owe ring.**

of germinating. The flowers open in May or June, and their distribution on the tree \- as in the Scots Pine.

The egg-shaped Jittle male cones (about half an inch long) are grouped together in comparatively sm;dl numbers (Fig. 96). The connective-crest of the anther is erect and short.

The pink " bloom "-coated female flowers occur alone, or in groups of from two to five, at tit-- tip of the current ycar's-shoot (compare Fig, 97). They are cylindrical, alOMtet half au inch in length, and perched iij>on a relatively long stalk, which is clothed with narrow, /ringed scales,

The Confi requires two seasons to change from a flower to a ripe fruit. After pollination

**Development tif Cone.**

each seed-bearing (placental) scale grows equally on its upper and lower face, thickens but slightly, and therefore produces no thick shield-like apophysis such as is produced in ;tll the Pines previously described. The elongated scales are pressed fiat and close together. In the autumn of the fust year the young. ivilflish-brown cone is still erect and has grown to a length of nearly OBeiach, though it still remains slender (about a quarter of an inch thick). It is not until the following spring that the cone-si;! Ik bends downwards (Fig. <j8)j and the come commences to grow very rapidly. attaining maturity in August or September.

**kipe Cone.**

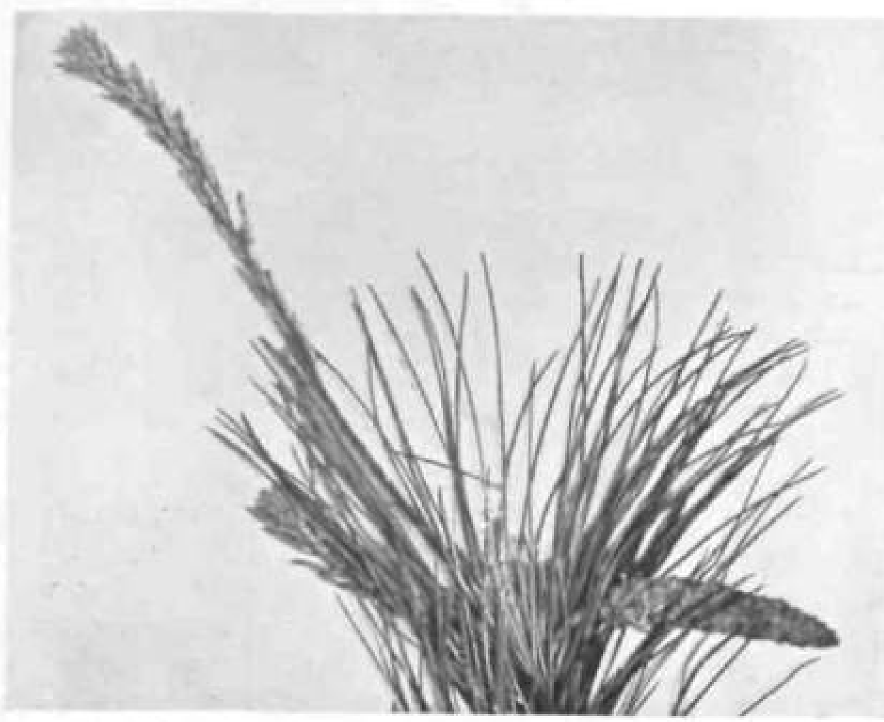
The **ripe,** closed tone (Fig, qo) hsngs down on a <li-- tmct, but rather short stalk ; it is narrow, being of a cytindric-spmdle shape, and varies in length from four to seven inches (or more) and in thickness from one to one and a half. Its duU brown surface is here and there flecked with resin. Each woody cone-seale is relatively thin, and, in place of showing an umbo in the centre of its exposed face, *has* an umbo at the tip. Thus the Weyimwtli Pine is distinguished from all the. two-needled pines in possessing u *fer-ttlinal* umbo on its cone-scale.

The cone dries and gapes open verv shortly after ripening, either in September or October (Fig. 99). The winged seeds art? *liberated, but the* empty cones remain attached for years. (This behaviour most not be compared with the retention of the dosei, seed-containing cones of the Bishop's Pine,)

The seed is about a quarter of an inch in length, and its wing four times as much (F»g- *$5>S)-*

The germination and form of the seedling (with from eight to eleven cotyledons) require no special description.

The resinous heart-wood is reddish in



*Figt* 98i—Vounj! **(Irowing Shout snd One-year-old Cone of Weymouth Pine.**

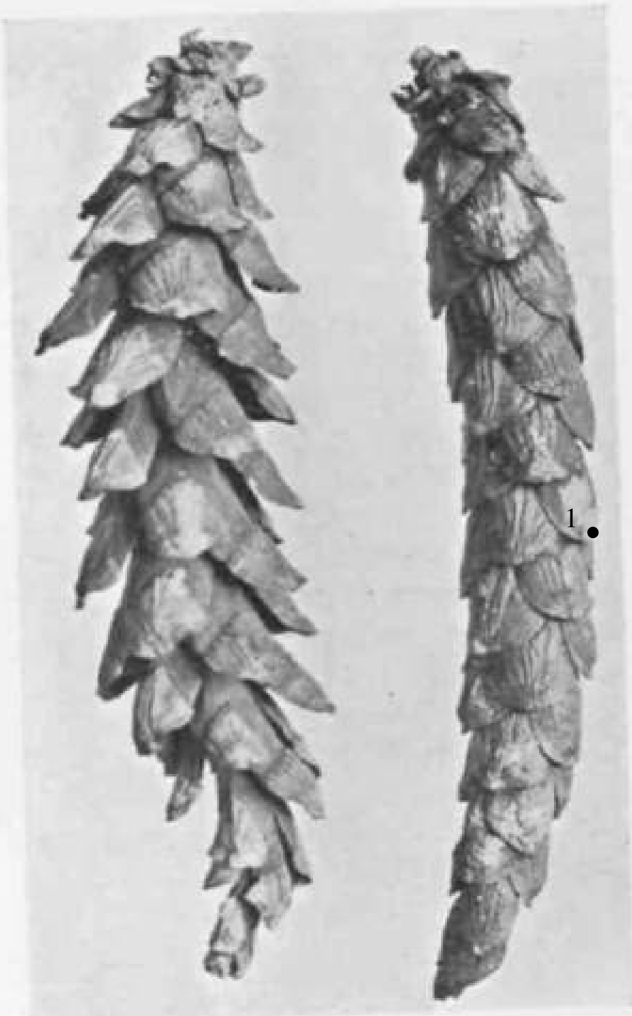


Fig. pO.-Open and Closed Cones of Weyniaulli *IHae.*

colour, and in **each** annual **ring** the liyht-coloured " spring-wood '* gradually shades into the red " autumn-wood."

The true home of the Weymouth Pine is the eastern part of North America (from 40° N. to 34U &f.). It lives on the plains, and as regards M⊳u is extremely accommodating. It demands but little light, and is not sensitive to frost.

Distribution.

*Phutx tJfceho* (Himalayan or Blue Hue) is a tree in cultivation that is exceedingly **like** the Weymouth Pine, from which it differs generally DO the larger dimensions of its details, and particularly in the longer stalk of the larger and relatively broader cone. The greater breadth of the ripe cone is already suggested by the one-year-old cone shown i« Fig. ojf when compared with thai to **Fig.** 98-

**Very** similar to ***Pimm*** *excelsa* is *P. Peuce.* which is, however, a shorter **tree** with much shorter leaves and cones and with almost **spherical rwting-budo.**

**Another Bve-ncedled** species not uncommonly cultivated in Great Britain is *P.* ***Gmibra*** **(Caftbrui** Pint), which rather recalls *P.* ***Peuce*** in Mineral habit. But it **contrasts** sharply with all three oi the above species in the shape of its cone, which is short and plump, has thick scales, each possessed of a terminal umbo. and encloses wingless seeds.

## **LARIX** EUROPJEA *(D.C.)*— **LARCH** *{Piuacae)*

The Larch is easily recognised by reason of the following characters : (i.) Its dwarf-shoots bear tufts of numerous light-green, **deciduous,** flat needles ; (ii.) even in winter the leafless dwarf-shoots are conspicuous on the twigs; (iii.) its general form is that of a coniferous tree, but the main branches are not regularly disposed in false whorls; (iv.) its branchlets hang down and bear purple female flowers or small woody cones, which nevertheless point upwards.

The root-system has **no** true main root, but consists of numerous lateral roots, some of which descend suddenly, others only after extending horizontally for a long distance. The Larch can thus grow on rocky sites or stony slopes **without being easily uprooted** by the wind,

The tree may attain a height of 160 feet, though it docs not commonly exceed ninety or one hundred. The tapering tnmk ^ I0Ij ^ straightj KIV|, ^ unf,lv:)Urilhj,e circumstanceSj when it becomes bowed. The crown is slender, loose, and fresh green in hue; the main boughs, which are not arranged in regular false whorls, are relatively thin, extend horizontally or incline downwards, but sweep up at their ends ; while **the** swaying branchlets mostly hang **vertically** downwards. The lightness of the crown and the early death of the boughs below it harmonise

Dimensions and Form.

with tUo intense **demands** for light made by the Larch, though it is true that trees grown in the open retain their branches low down the trunk (Figs. *101-2).*

Needles.

face); they are therefore easily distinguished from the darker, stiller, four-sided, evergreen needles of th.- Cedars, which show a similar **distribution**

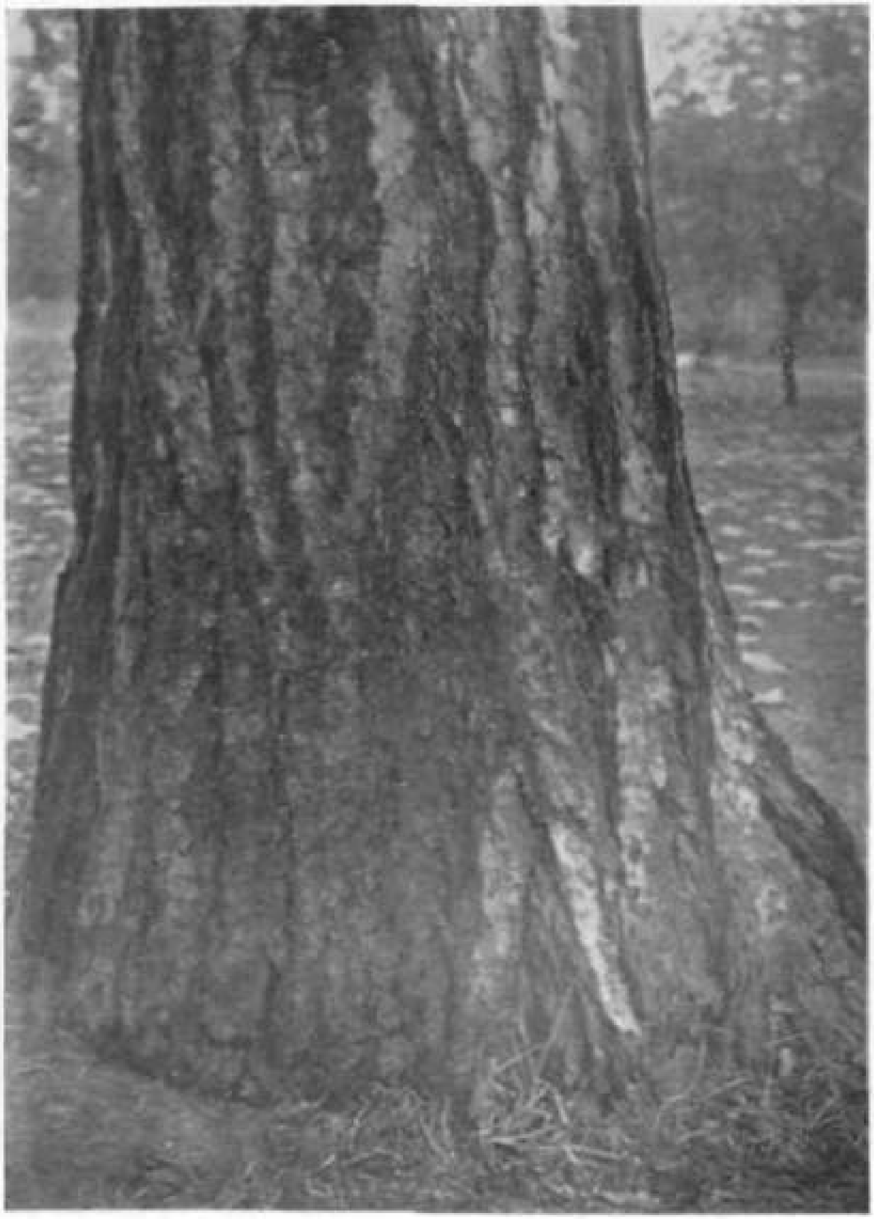


**Fig. 100.—Bark of Larch.**

Tin: mature bark (Fig. roo) is thick and scaly, **sometimes teaversed** by very deep fissures; its tint is a **dark,sometimes** reddish, grey except for freshly-exposed red patches.

The light-green needles, which become golden and fall every autumn, are soft and flat (though slightly keeled **on** the lower

on the tree. On **the** long-shoots they are more pointed, solitary, and spirally arranged; but on the dwarf-shoots they are longer, also narrower, and form, tufis, including from twenty-five to sixty needles.

**The** structure and mode of growth and branching of the twigs show many [joints

Pip. *toi.-LAKCH-LAttIX* EUROPÆA *i* WINTER.

Fig. 101.-LARCH—*LAKtfX EVROPJEA:* SUMMER.

Fig. it>3-
Twig of Larch
in Winter.

of interest. If we examine the part of a long-shoot llmt has concluded its first. \\-n r*s growth, we note its terminal, bluntly egg-shaped resting-bud and, in the axils of only some of the needles, hemispherical lateral buds (Fig. 103). Thus, unlike **the Pines,** the **Larch** has no dwarf-shoots with tufted needles on the long-shoots of the current season. The surface of this twiu. \> raised into ridges which are the leaf-ciushions, as each continues **into** the stalk of the leaf (Figs. 103 and 104). As the twig slowly thickens in **sufeequsiii pears the ridges** become distorted and sinuous, but still **can he** traced upwards to the **persistent** projecting leaf-scars. In the spring of the twig's second **season** <f existence all **the** buds that awake into activity, and are destined to **become yeg*d itive brand** sprout in **the same manner,** giving rise to close tufts of **needles,** as if they were dwarf-shoots. This tufted condition **lasts for** about a month, after which **tfas** terminal bud •r lateral ones

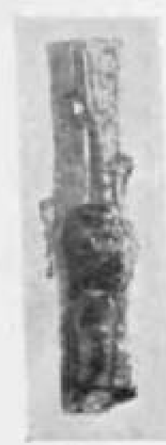
voung brands remaui as dwarf-shoots (Fig ia6). In the third acUve season the bud, of this shoot **behave as** before, **at** hrst **bating** the young tufted appearance; su?s que'tly the terminal buds on **the** mam shoot 1IU1 on the hteral long-shoots grow u vigorously, as also do the buds o some o t l 0 dwarf-shoots, whirl, thus develop so to speak, into belated long-shoots. These never afterwards develop so vigorously as the other long-shoots; they ramify but slightly, live for a shorter time, and may bear male flowers. But there still remain on this three-year-old shoot some lateral dwarf-shoots **that** continue to act as such. Thus, year after year, dwarf-shoots may live, **each** year **showing** an additional ring **of scale-scars** (as the scales of **the** rest ing-bud fall off) and producing **a** fresh tuft of needles, but remaining short After from ten to twenty years they become overgrown by the rind of the stem bearing them, and thereafter act as resting-buds ; and it is to **the** possession of these buried buds that the Larch owes its power of shooting forth branches from **old** parts of the trunk. Thus the dwarf-shoots of the Larch differ from those of the Pine in having a growing point that is **regularly** active year after year.

**The** resting-buds (Fig. 104) are resinous and clothed with glistening brown scales, which have fringed margins.

**Flowering.**

Flowers occur when the Larch has attained an age of fifteen years in the open, or from twenty **to** thirtv **years in the** forest, though precocious individuals may produce cones with sterile seeds. **The** purple-red female and yellow **mate Bowers** occur on the same tree, and open in early **spring, when the Leaves** unfold. They arise from buds **externally** like purely vegetative buds, and may be close t<jgolhoi- on the sides of the same slender hanging long-shoot. Each :irises 35 the termination of **a** dwarf-shoot.

The male flower (Fig. 105, *X)* in the season of its production is preceded by no needles on its axis. Unlike the male flower of **the** Pines, this sulphur-coloured **little cone stands alone,** it always points more or less upwards even when borne on a hanging branchlet



Pig, 1U4.
Westing-bud
of Larch-

(Fig. 105). In structure the flower is essentially like that of the Scots Pine; but a most interesting difference presents itself in the structure of **thfl** pollen-grains, which have no balloon-like little bladders to assist them in Moating in the ;iir. ***Tim*** fact musl, **perhaps,** be correlated with the occurrence of female flowers low down the tree or among the **very** numerous male flowers, and be contntsU-d with the generally higher position of the iVmale flowers in Pines, Silver Firs, and Spruces, whose pollen-grains possess bladders.

The dwarf-shoot ending in the pretty female flower, on the other hand, shoots forth a rosette of needles (Fig, 105, $ ), Thus we see on the dwarf-shoot, in succession, an envelope of bud-scaks, a rosette of needU-s. which gradually give way to bract-scales, above which ts the purple-red flower itst.-]/.* The plump, egg-shaped flower always i> erect, as is the ripe cone, whatever the direction of the branch bearing them may be {Figs, 105-7), as the flower-stalk executes the necessary curvature. In general structure the flower is like that of the Scots Pine, in so far as it consists «f spinilly-itrranged double-scales, each of which lias two ovules an the upper face. But there is this essential difference ; the large-scale is the purple-red carpeUnry (bract) scale, which alone is seen from **the** outside, and has a long, slender tail; while the small seed-bearing (plaeental) scale is only just large enough to bear on it the two downwardly directed ovules.

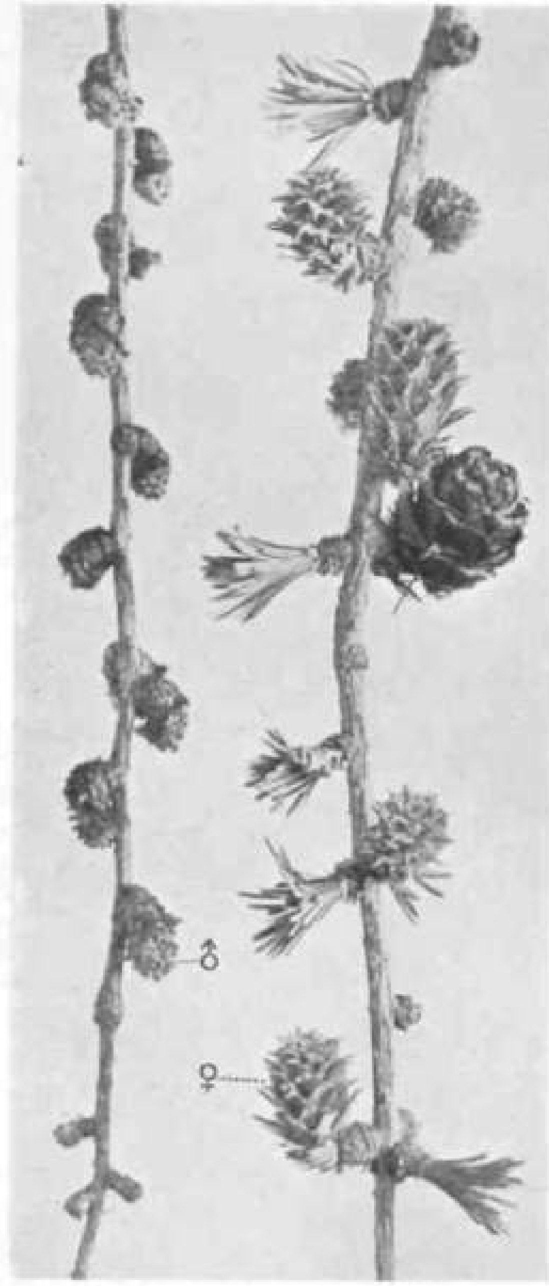



*Fig.* 105.-Mate *(i)* and Female.(i) Flowers of **Larch.**

Pollination by the agency of the wind takes phce just as in Pines, except **that** the large carpeUary scale guides the pollen-grain to the ovules. The erect position of the female cone is therefore a matter of necessity. It lias been observed that nbso-**lutely** isohited Lfirch-trees do not **produce** fertile seed ; this probably indiaites that, to secure proper seed-formation, the female flower must be pollinated by **pollen** from another individual

Cones.

After pollination the carpcllarv **scales** (as in the Pines) remain small and dry up, but the seed-bearing scales grow vigorously, close together, and become woody but not thick m>r possessed of

• **It is not mi! 'minion fr.ir ttic stem of** the crme to **go** oa **growing as a long-shoot ami bear foliajjc-ltaves,** so that vu & suns* tlm flower **continues** as a **vtgeta-**tive branch. And, contrary to tiie stntuments usually made, the female flower occasidually teimtuaU-s a long-shoot.

an apophysis. The cone, unlike those of the Pines, ripens in its first season, and when mature in September it has not greatly enlarged, being only about twice the size of the Original flower (Fig. 106). The mature cone is oblong or egg-shaped, light-brown, and about one inch or one and a half inches in length. It does not open until the following spring, when its scales gape asunder and do not fall from the cone. As the cones are still erect (Fig. 107), the seeds are not easily dislodged from the niches in which they lie ; some are blown and shaken out by the wind, others disturbed by birds and squirrels which peck the seeds or gnaw the cones ; but seeds may still be found even in old cones. This at once shows the effect of the pendent position of Pine-cones in facilitating the dispersal of seed. The Larch-cones remain hanging on the tree for years, but such old cones are easily distinguished from the recent ones by their darker colour, just as the older twigs in winter are distinguished from the lighter straw-coloured recent ones.

**Fig. 106--Closed, Ripe Cones of Larch.**

The little seeds are, in design and structure, like those of the Pines, each having a firmly attached wing, and containing an embryo enveloped in food-material.

The seedling, which usually has six (four to seven) cotyledons, is most interesting in one respect: it is partly evergreen. During the first four years it produces needles, of which the uppermost live through the winter and part of the following season. This peculiar feature may be an instance of a plant preserving in its youth an ancestral character that it loses later in life; for undoubtedly the ancestors of the conifers were evergreen. Another point worthy of note is the very rapid growth of the main stem of the young plant: this behaviour must be associated with the urgent demands for light made by the Larch.

The resinous red heart-wood is very like that of the Scots Pine.

**Distribution.**

The Larch, though so widely cultivated in the plains and hills of Great Britain and Europe, is really a mountain plant whose centre of development lies in the Alps of Central Europe (Switzerland, Austria, etc.). It reaches an altitude of 7,500 feet, where it marks the limit of tree-growth, and is reduced to a grotesque dwarf. But in the plains the

Larch can be widely cultivated, partly because it can grow on various kinds of soil and can endure extreme cold ; indeed, in its mountain home the tree even shoots forth leaves while the soil is covered with snow. Having a small crown, find being leafless in winter, the Larch docs not suffer from being overloaded with snow. Even when disturbed by the storm of wind it can recover itself- But it is extremely exacting as regards supply of light, for it demands more light than any other forest-tree grown in this country, **with** the possible exception of the Birch ; and its seedlings can practically endure no shade. Its light crown, rapid growth in height when young, and rough bark all denote a light-loving habit.

The Larch is subject to a number of serious diseases in its lowland situations. Larch-canker is caused by n fungus *(Dasyscypha calycina),* which enters by a wound, locally kills the living part of the bark and the creative layer responsible for **the** production of new wood, ;md gradually extends its attack round the stem. The disease reveals itself specially in the form of cracks, cankers, and depressions in the bark-dud stem ; and on the diseased spot may be seen the liny, **fiery red,** saucer-like fructifications of the fungus. Another disease is caused by a small moth *{Coleo-•phora taricella)*, whose caterpillar tunnels the leaves, and causes them to turn brown and die. Finally, an insect *{Ckcrmes viridis [Ratz]),* related to common Green-flies, does damage by piercing and sucking the needles ; but, as its life is partially passed on the Common Spruce* its history will be briefly described in connection with that tree.

**Diseases.**

**Fig. rt»7.—Half-grown Canes and Open Old Cone of Lnrirh.**

## CEDRUS.—GEDAHS *(Piuacea)*

A Cedar is recognised by its dwarf-shoots, each bearing numerous tufted needles, which are **darker and** stitfer than those of the

**I i-r. i*O*&.-Bark of *Cedws A Hunt lea.***

** The characteristic cones are erect, p L n with' **densely-**,** thin scales, which ... off separately and liberate the broad-tall on sepauuwy winged seeds.

In this country the Cedar is represented by three introduced varieties or species—the Deodar, Cedar of Lebanon, and Atlantic Cedar—whose general shapes will be described subsequently.

The bark * rough (Rg. 108.).

The boughs, though clothed in youth with

Fig. 109.—CEDAR OF LEBANON—*CEDRUS LIBANI*,

*Fig.* **no.-Shoots of Atlantic Cedar.**

**I'.r.-ilulling.**

spirally-arranged needles, have their lateral long-shoots approx- . . . imately in one pi.ine because they branch particularly from the flanks. The fcliaged dwarf-shoots spring from the upper face and llanks of the sloping Jorjg-shoots and incline upwards, thus rendering tl it-lower face of the **branches** devoid of tufted needles, with which the upper face bristles. The boughs are not arranged in definite falsr-whorls.

**Needles.**

The solitary needles spirally arranged on the long-shoots are longer than the numerous ones tufted on the dwarf-shoots (Figs. I io and i n). The growing point of these latter remains **active** year after your, and gi **yes** rise either to long-shoots, dwarf-shoots or terminal flowers. But so long as the dwarf-shoot behaves as **such** its growth in kngth is **extremely** slow ; in addition to lengthening by growth **at** ii* tip, the stem **elongates** at its base, which lies within the parent stem, and in this way avoids bring completely buried within the **latter-** On **the** long-shoots **each** needle may be seen to consist of a four-sided green upper part, and a pallid short basal part, which remains attached to the stem after **the** green portion has fallen off. Thus the leafless twig is **studded** with small lt:af-cushinns and **re-calls** that of the Spruce, which, **how-ever,** bears no tufted needles. **The** leaves of the Cedars live and remain attached for three, four, or **five** years.

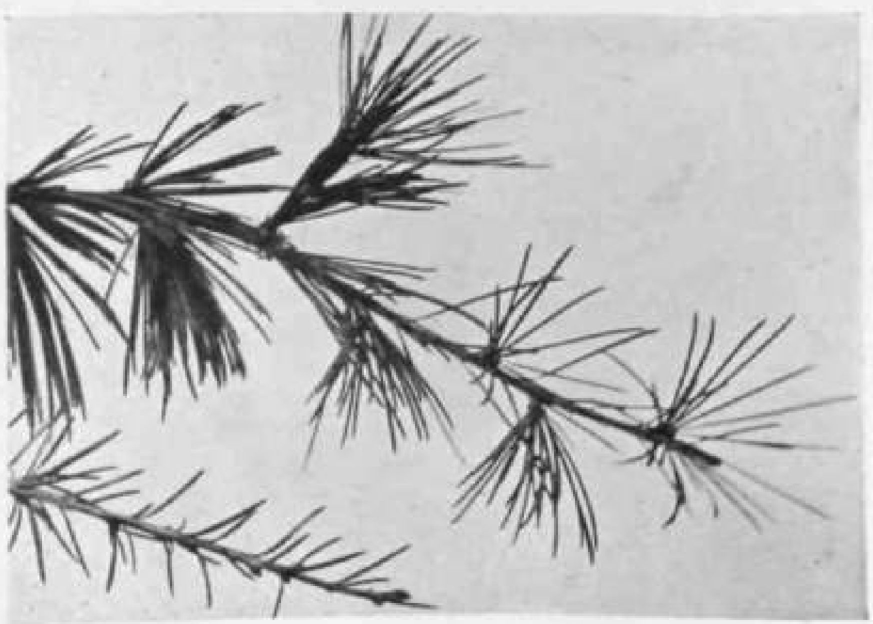
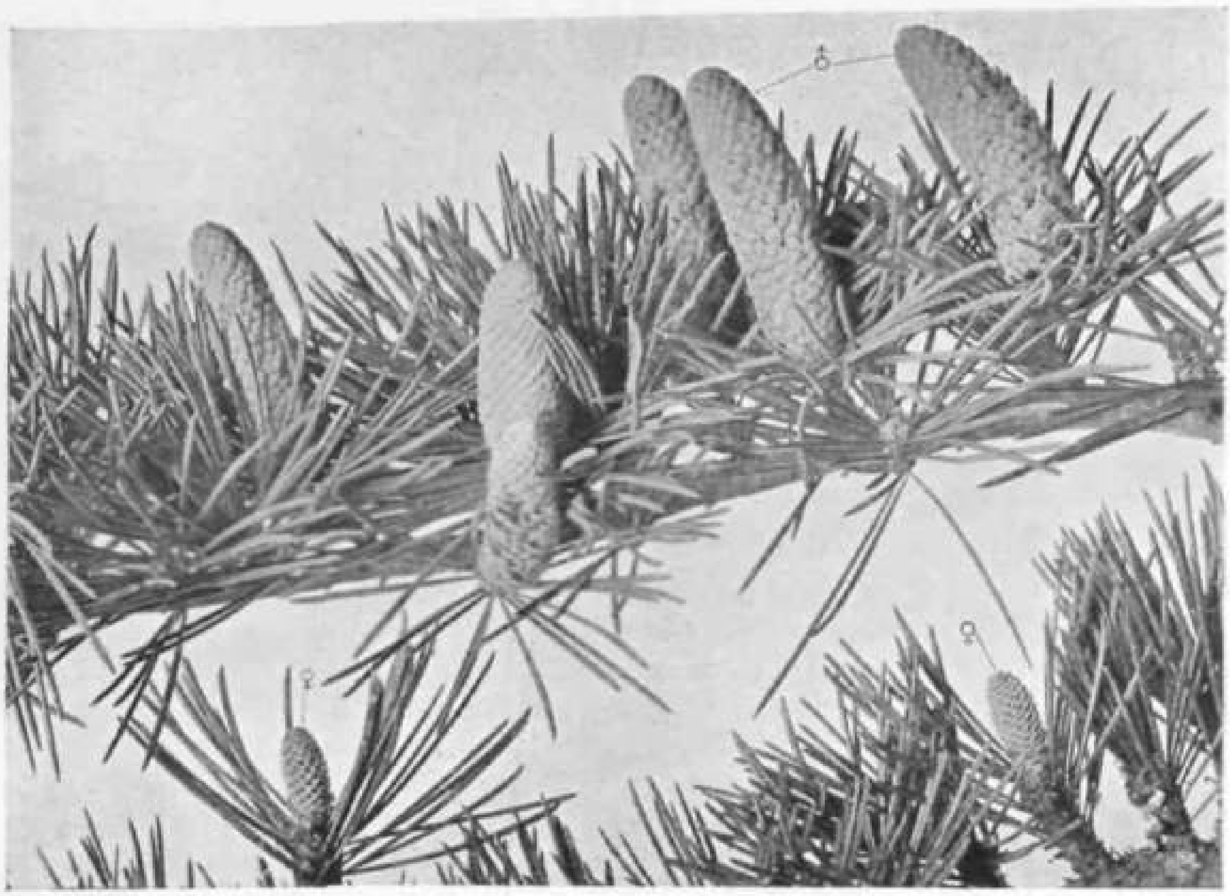


**Fig. in.—Shoots of Deodar,**



**Fljj. U2.— Male (rf) and Female (v) Flowers of Deodar.**

The flowers do not open until September or October. Both kinds occur on the same individual, and are solitary, erect, elongated, egg - shaped cones terminating foliaged dwarf-shoots. In general structure find in mode of pollin-atitm the flowers agree with those of the Scots Pine.

Flowers.

The yellowish male Bower (Fig. nz, £ ) is about two inches long, and each anther is tipped with a well-developed connective-crest.

The similar female flowers [Fig. 112, $) are generally inserted somewhat higher up the tree. The cone-scales are double.

After pollination the carpellary (bract) scales remain small and are ultimately invisible from tlie outside, but the seed-bearing scales enlarge and become broad, **thin,** hard, and very closely packed together. The rones require between two and three seasons to ripen, by which time they have attained a length of from two to J i - i ,, hve inches, and a thickness of from one and a half to three inches (Figs. 113-4). The mode of release of the seeds is quite different from that prevailing in the Pines a-nd Larch, but is very similar to that characteristic of the Silver Fir; for the cone-scales loosen and become detached from the axis of the cone, leaving this erect and bare on the branch {Fig. 113).

**Cones,**

In order to gain an insight into the construction of the closed Cedar-cone, one does not endeavour to cut it open, or to cause the separation of the cone-scales by the application of dry heat (as in the case of most cones), but one immerses the ripe cone in cold water for twenty-four or thirty-six hours, after which the cone-scales readily fall apart.

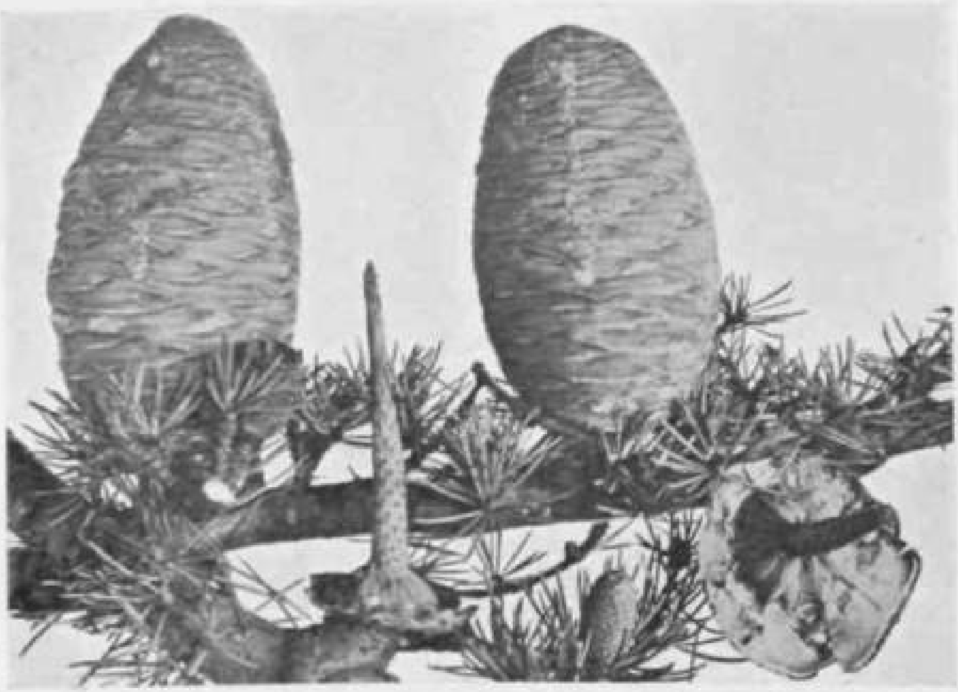


Fig. i IJ. -Cones of Cedar of Lebanon before add after fail of Cone-scales.

**over,** even in young trees the main stem soon bends to one **side.** The d<:nse, dark - lined foliage casts a deep shade, and **die needles** are shorter than in **the Deodar,** This Oxlar occurs on Mount Lebanon, as **well** as on mountains in Cyprus and Asia Minor generally.

**Cedar of Lebanon.**

The **Atlantic** Cedar(C. *Lib a n i,* var. *atlantica)* approaches the preceding om: in shortness of the **needles** (Fig. no), and usually in the dark tint of the foliage.

**Atlantic Cedar,**

The **seed** is about half an inch in length. and has a large, **broadly-triangular** wing twice as long. The embryo possesses from eight to ten narrow cotyledons.

**Seed.**

The reddish-brown heart - wood is fragrant, and, unless diseased, is devoid of resin passages.

The **Cedar** of **Lebanon** attains :L very great age—possibly **two** thousand years.

The distinctions ordinarily drawn among the three kinds of Cedars are not wholly satisfactory, a? Ihry depend upon comparisons made between trees at different ages and places, and **partly** upon insufficient examination of the cones.

Kinds of CeJars

**In** old age, at least **in** forest, all **three kinds** <f **Cedar** *may* have the fiat-topped cro*tm* **that** is often regarded as **distinctive** of the Cedar of Lebanon, but in **this** country the younger specimens of **the** other two are more pyramidal in crown (Figs. 109, 115-6),

The Cedar of Lebanon (C. *Libani* **[Barrel.])** has long, far-stretching, horizontal boughs, and **a** more or less flat-topped crown ; **more-**

Fig. 114. Cones or Atlantic Cedar.

Pig, US.— DEODAR- *CSDItUS DEODAR A.*

Fig. 1(6,—ATLANTIC CEDAR—*CEDRUS ATLASTICA.*

But in this country the boughs usually incline sharply upwards, and the main stem remains erect to its very tip. The home of the tree is on the Atlas Mountains in North Africa.

Deodar.

The Deodar (C. *Libani,* var. *Deodara)* has the longest and lightest-coloured needles (Fig. 111). The boughs are usually more horizontal than in the Atlantic Cedar; and the branches differ from those of both other forms in that their ends droop, as do the young little twigs. The Deodar differs from the Atlantic Cedar also in its sensitiveness to frost and (at Kew) in the date at which its buds sprout. The Deodar is the Himalayan Cedar.

It will be noted that the three kinds of Cedar are naturally restricted to mountains, and that each kind is confined to its own narrow area of distribution. If they be regarded as belonging to one species they provide an admirable example of a single species with a discontinuous geographical distribution, since it occurs only on mountains separated by vast stretches of country. Some time in the distant past the common ancestor of the three occupied a continuous area on plains in the Northern Hemisphere, but stress of competition and climate have driven its descendants to their separate highland homes, where they have acquired slight differences,

All three kinds of Cedar show their own varieties as regards length and colour of needles, and pattern of growth,

Column-shaped and weeping forms are met with, as are cultivated varieties with light-green, bluish-white, or even variegated foliage.

[In various books it is stated that the cones of the Deodar are smooth, and not hollowed at the top ; while those of the other two are stated to be slightly hairy and depressed at the top. Furthermore, the Atlantic Cedar is described as having the smallest cones. But these distinctions can hardly be upheld, though they may indicate tendencies.]

## ABIES PECTINATA (D.C.).—COMMON SILVER FIR *(Pinaceae)*

Distinctive Features.

The Silver Fir differs from Pines, Cedars, and Larches in having all its evergreen needles solitary and arranged in distinct spirals, and none in dense tufts. The needles are flattened and have two white lines on the lower face; and on the horizontal branches their stalks twist and cause them to form apparently two ranks of leaves with the under surfaces facing the ground. When the leaf falls its scar is flat or concave (contrast the Spruce). The ripe cone is erect, and its scales fall off separately, releasing the winged seeds and leaving behind the upright bare axis (contrast [illegible] Larch, Spruce, and Douglas Fir), Finally, the bark remains smooth for a long time, and is usually light in colour, while the main branches are arranged in false whorls.

Dimensions and Form.

The height attained is great—sometimes as much as 150 feet (or rarely 200 feet), and the thickness of the trunk six feet (or even nearly double that), On the straight, tall trunk the boughs are arranged in false whorls; they remain attached for a long time, and in the open may extend almost to the ground, as the crown changes from a pyramidal to a cylindrical shape, which it retains very late. The retention of the branches agrees with the character of the Silver Fir as a tree capable of enduring much shade. When it has attained full height the Silver

Fig. 117. — Bark of Silver l-ir.

Fir produces at the summit a collection of branches whidi together form a largo nest-like complex, in the centre of which the end of the main stem is concealed. (This is already denoted in the tree represented in Fig. 120.) On the boughs the branches and branchlets are arranged in a horizontal plane, so that tin- ti.iliktr disposition of tin.- boughs is very evirU-m.

**Bark.** The bark remains smooth for from fifty td one hundred years ; this again suggests the- shadc-bcariny < hanuior of the tree. The colour of the bark varies, but is often light, because it is Encrusted by certain lichens. On the smooth surface of the stems three sets of markings are visible ; elevations caused by resin-bladders, r.iistid circular scars due to lentieels, ;md leaf-scais. Eventually the hark heroins divided by longitudinal and transverse cracks, and produces thin scales {*Vig.* 117).

The needles are flattened, with a slight ked, half to one inch in length, and possess a short stalk, which expands be-low into a disc. The leaf-tip varies from a single sharp point to an indentation

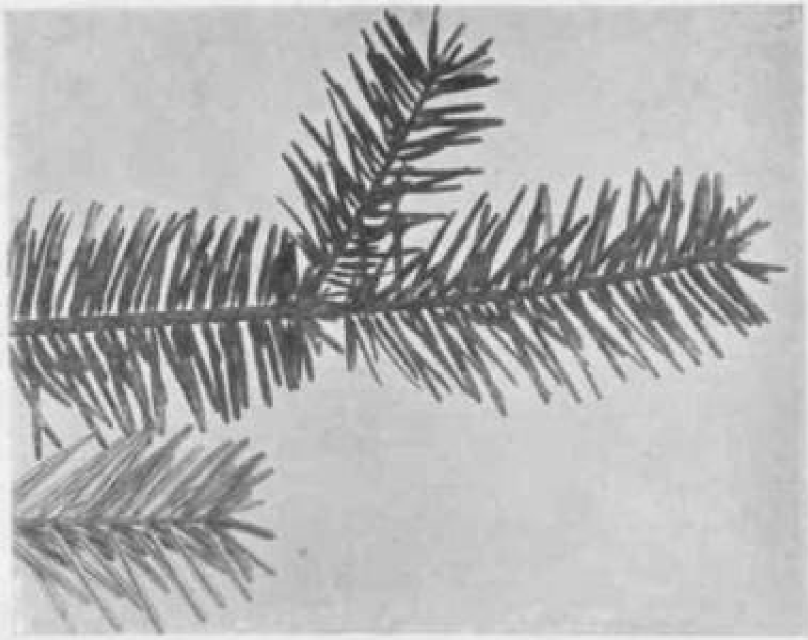
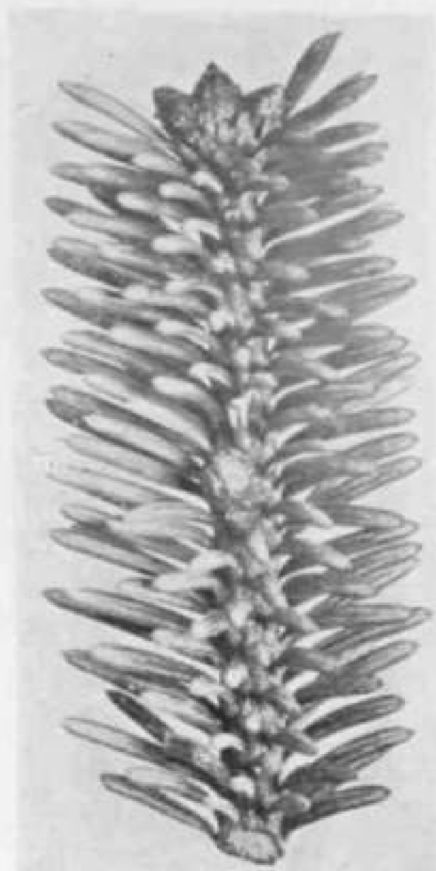


Fig. 118.-Brunches of Silver Rr. seen from above and from below.

(Figs. C18-9). The **needles** aresolitary and spirally arranged ; on erect stems they are disposed equally round **tin- aad** ; but on tlie horizontal stems their **stalks** twist and cause them to be arranged in double comb-like pattern on **(the shaded;** branches (Fig, 118), and to be **inclined** upw.irds on the more exposed **branches in the erown, where they are also thicker** and **bave broader** white bands (Figs. 119, 122, 124). On the **branch** there is a **remarkable difference in the** sixes **of** the **leaves,** those on the upper **face being** shorter **than those** on the lower face, where[1] they may be twice **as** long (Fig. 118). The **upper** face of **the needle** is **of** a rather dark green, but the lower face **has** two long, white stripes of wax **that** indicate the distribution of the stomata. Tin needles are long-lived, usually remaining **attached for** eight or ten years (or even fifteen), so that the **Silver** Fir may cast a relatively deep shade. This **longevity** of the needles is yet another sign of the shade-enduring quality of the Silver Fir. **The** fallen needles **leave flat,** or even concave, **circular** scars (Fig. 121), **so** that **the** smooth twigs **contrast sharply** with the very rough ones of the Spruce.

Needles, , f , , ' ,

In its general scheme **of** production of ilu-lung-shoots the Silver Fir mm*** **imVh** ti».



**Flfr MQ.-Exposed Branch, with Restinjr-buds, *at* Sliver Kir.**

Mfc. 12O.-COMMON SILVER \'\H~ABtES PECTtNATA.

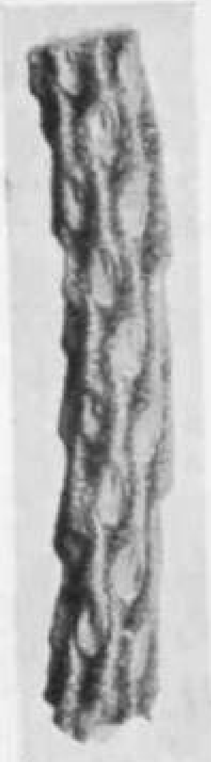


*Fig.* 121.—Stem of Silver Fir showing Leaf-scars.

Scots Pine. At the end of each season's growth the stem produces

**Branching.**

a terminal bud, and, close to this, two or more marked lateral buds arranged in a false whorl (Fig. 119). In the following year the latter buds grow out to produce the long-shoots, on the horizontal branches these lateral buds, often two in number, are mainly on the flanks, so that the branching is in one plane. But, in addition to these buds having this arrangement, there are others lower down the year's-shoot in the axils of some of the needles. These grow out into much more slender dwarf-shoots (whose leaves, however, are not tufted). The dwarf-shoots may develop subsequently into long-shoots, **especially** when the tree is well illuminated. There are still other resting-buds that remain inactive for years and provide for future emergencies; indeed, all the different kinds of buds, lateral or terminal, can remain for years in a quiescent condition. When the main terminal bud is injured, several of the topmost lateral buds develop into erect shoots, or one alone may behave thus, and in this way replace the missing "leader."

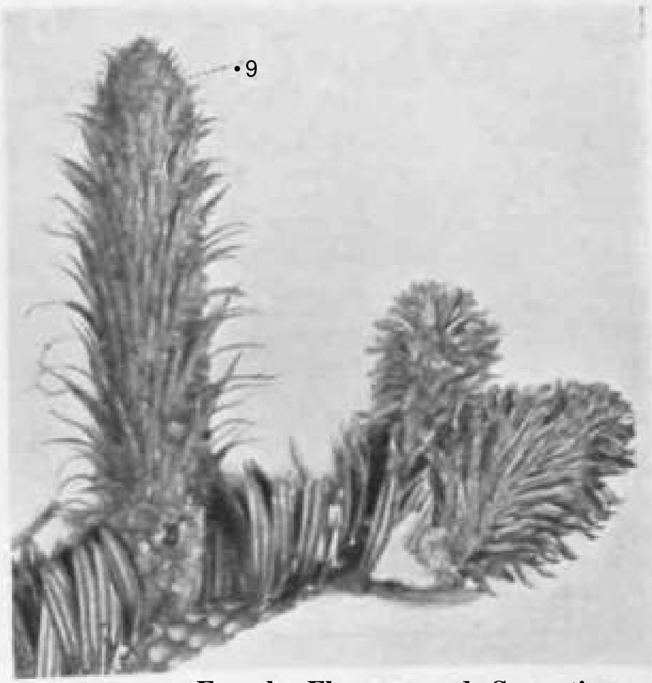


Fig. 122.—**Female Flowers and Sprouting Buds of Silver Fir.**

**Buds.**

The **resting-buds** (Fig. 119), which are not resinous on the outside, open simply by the scales gaping asunder and remaining attached; whereas in the Spruce the scales break at their bases and, glued together by resin, are lifted aloft by the developing needles.

**Flowering.**

The tree does not commence to flower until it has reached an age of thirty years in the open, or of sixty to eighty in forest. The male and **female flowers** occur on the same tree, but on **different** twigs, and open in April or May.

**Arrangement of Flowers.**

The **erect** light-green **female flowers** occur as dwarf-shoots on the upper fact of twigs high **up** the crown. They are situated on the shoot formed during the **previous** year, near its tip (Fig. 122). The male flowers are at the same height up the **tree** or lower down, and appear

**Fig. 123.—Male Flowers of Silver Fir.**

**from below.**

crowded together near the base of the previous year's-shoot, but are mainly on its under side, or at least lie under tin* leaves (Fig. I2j), This arrangement riuiy serve to protect **the** pollen from rain. Thus the open flowers are on stems one year older than m the rase of the Scots Pine. But there is one feature common to both kmds of trees, namely, that the **male** flowers are near the base and tile female nearer **the** tip of the year's-shoot.

Male Flower.

The yellow male flower (Fig. may be an inch **or** less in length, **and**' is **surrounded** *nt* its base by **a** rosette of little **brown** sralcs which remain **attached** like **a** •cup evt'n after the finwt-r h,ts **fall**e**n**. The structure of the flower is murh like that of the Pine, but the numerous club-like anthers burst open transversely.

Female Flower.

The slender, graceful female flower (Fig. 122) assumes the form of a light-green erect cone more than two inches long. It agrees in main structure with **that** of the Pine, but the carpel-Jary (bract) scales are larger than the entirely concealed seed-bearing **(plflcental)** scales. Each **carpellary** scalu is prolonged into a **tail-like** awn. while each seed-bearing scafc lias **two** ovules on the upper face of its base.

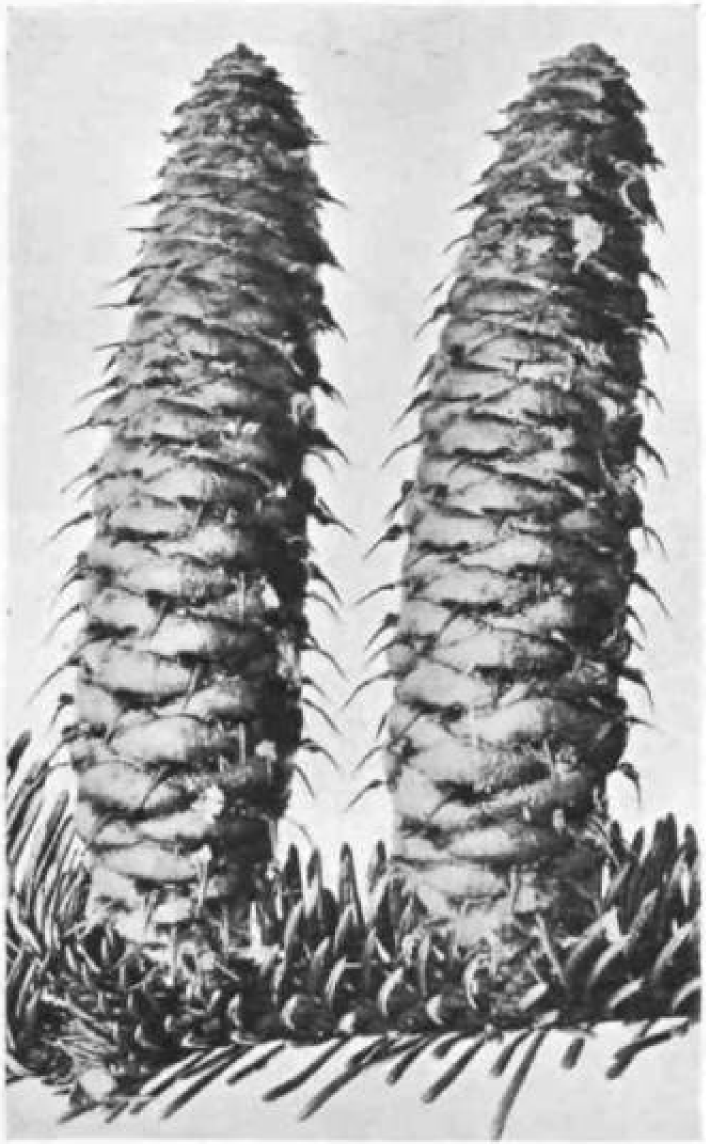


Fig. *124.* Closed Ripe Cones of **Silver** Fir.

Pollination.

Pollination takes place much as in the Pine. Tin- jw>Uen is produced in enormous quantities, so that near forests of Silver Fir it may be carried down with the rain and give rise to the **phenomenon** of *yd*low "sulphur-rain." Each grain is buoyed **1l**p by t**w**0 air-bladders.

Cones.

After pollination **the** female cane grows rapidly, **be**-1'nines a **mature** fruit. **and** shi-ds its **seeds** even **before the** winter of tin-same year. It remains erect, and as **both** kinds of scales enlarge and **cause** the cone **to** beenm**e** "closed," they change in tint from **green** to brown. Th<; rijx- **cone** is **cylindrical** or **narrowed** above, with :i blunt apex; it varies in length from three to seven or even more inches, and in thickness from one and a quarter to two inches (Fig. *&4).* The thin seed-bearing scales aresome-wh;U **woody,** but devoid of any **apophysb;**

P%, 05.-Cones of Silver Fir showing Cone-scales commendtifc to fall, also completely shed.

while projecting between them are usually the awned ends of tin: still thinner membranous carpeHary scales. Soon after ripening, in September or October, and especially after the first frost, the scales loosen and fall off separately, carrying with them tin- winged seeds (Figs. 125-6); while the erect, bare, woody axis of the cone (Fig. 125) may remain on the tree for years.

The seed is sr nn<-what large, irregular, and possessed of a firmly attached wing (Fig. 65, 6). Its embryo is surrounded with food-materia] (endosperm).

When it germinates the seedling lifts above the ground usually live (four to six) narrow cotyledons, which are succeeded by a whorl of five short primary ni.-cdlcs. The. leaves produced in the second year are spirally arranged, and gradually pass over into ordinary needles. The first branch is emitted in the third or fourth year. The young tree reflects its shade-enduring quality in its slow rate of growth in height.

(termination.

This introduced tree has a greater power than any other conifer in this country of bearing shade, and vies with the Beech in this respect. In fact, the Beech and Common Silver Fir often battle with one another on hill-sid. 5.

Fig. 126.—Cone of Silver Fir with Cone-scales half-fallen.

## PICEA EXCELSA (Link).—COMMON SPRUCE *(Pinaceæ)*

**Distinctive Features.**

The Spruce, like the Silver Fir, has all its needles solitary and spirally arranged, and is thus distinguished from Pines, Cedars, and Larches, which have tufted needles. But the Spruce differs from the Silver Fir in that its fallen needles leave behind them prominent projections which cause the bare twig to be like a very coarse file (Fig. 130). In addition, *Picea excelsa* differs from *Abies pectinata* in that its needles are not flat, but four-sided, with white markings on all four faces. Its pendulous, long cone, with persistent scales, is somewhat like that of a Weymouth Pine, but is devoid of apophyses, and contrasts sharply with the Silver Fir's erect cone, whose scales fall off separately.

The root-system has no deep main root, but consists chiefly of far-stretching horizontal roots which send finer ones deeper into the soil. Thus the Spruce can grow on shallow, rocky soil if there be sufficient moisture, but cannot live on dry, sandy soil.

**Dimensions and Form.**

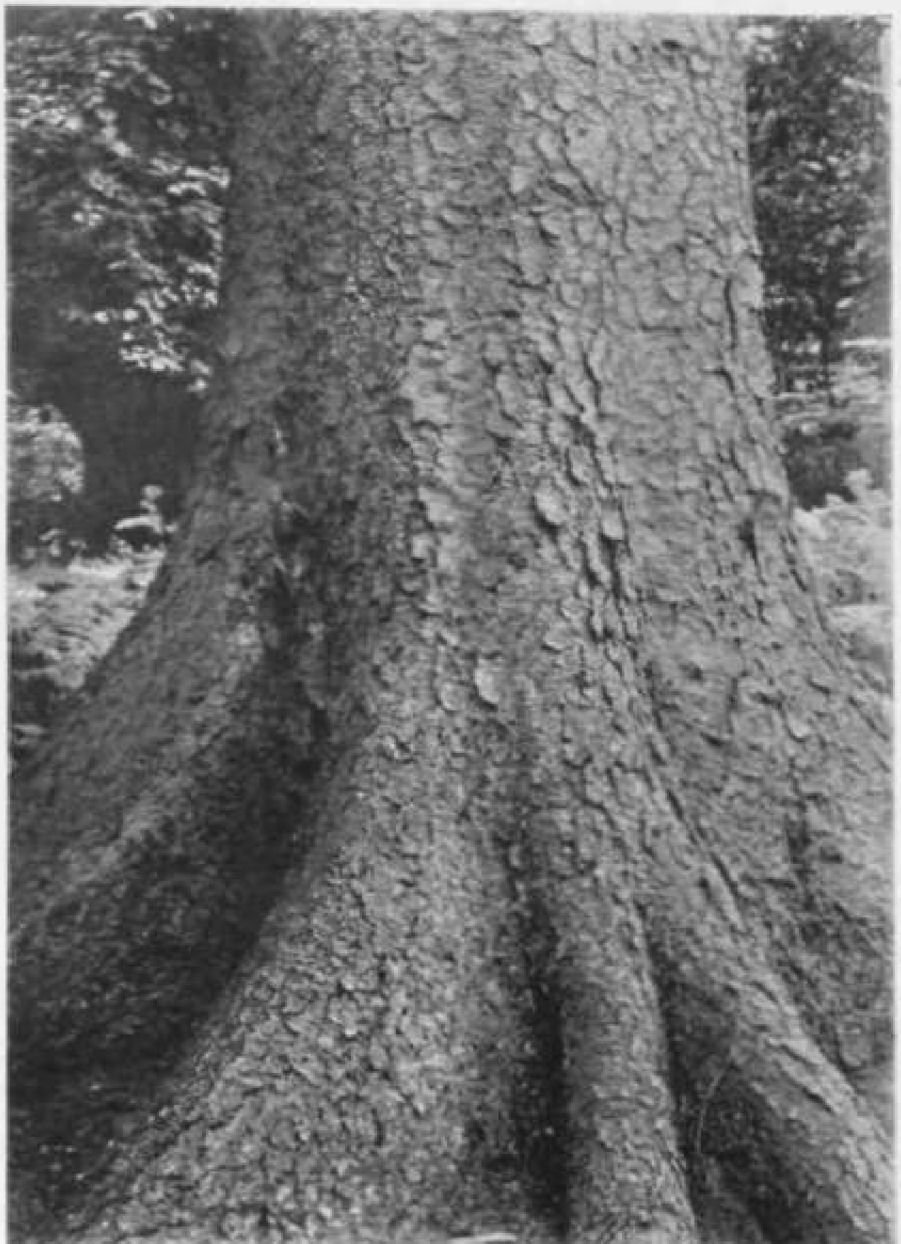
Its straight trunk attains a height of 150 or even 180 feet, and a thickness of from three to six feet. One marked feature is the great vigour of the main stem, which even when at its full height does not allow itself to be overtopped by the adjoining branches, so that the Spruce forms at its top no nest-like clump of branches similar to that of the Silver Fir. Yet if the end of the main stem be destroyed, the buds or younger branches near it grow upwards, and thus produce one or more leading shoots. The relatively weak boughs are arranged regularly in false whorls ; they either slope gently downwards, are horizontal, or incline upwards ; and these three poses may often be seen succeeding one another up the trunk, but the young terminal parts curve upwards. The boughs remain attached for a considerable time, even when dead, so that, especially in the open, the tree is deeply branched, and has a long, rather narrow, pyramidal crown. The duration of the branches suggests what is the fact; namely, that the Spruce can well endure shade. On the boughs the branches and branchlets incline or even droop downwards, and not only add to the characteristic habit of the tree, but also provide full shade.

**Bark.**

The bark, which sooner or later acquires a reddish-grey tinge, remains very smooth up to the age of twenty years ; and even for a further period of twenty or thirty years it is relatively smooth, showing only thin scales, which thereafter give way to coarser ones (Fig. 127). But, again in conformity with its shade-enduring habit, the Spruce never produces a thick, dead bark. And this independence of strong light is also reflected in the slowness of the growth of the tree during its first ten years of existence.

**Needles.**

The green needles vary considerably in length, but are usually one-half to one inch long, and terminate in hard yellow points. They are always four-sided, but may be somewhat flattened vertically or laterally ; on the four faces are lines of stomata whose presence is revealed by minute white dots of wax. Traced downward, each needle has a stalk which continues into the projecting peg-like tip of the leaf-cushion, which in turn is prolonged downwards along the stem into a narrow ridge ; so that the rind of the twig seems to be partly constituted of numerous leaf-cushions separated by narrow furrows (Fig. 130). The needles, when dried either on the tree or on a plucked twig, easily fall off, and thus leave the bare twig beset with sharp little pegs (Fig. 130). Yet ordinarily

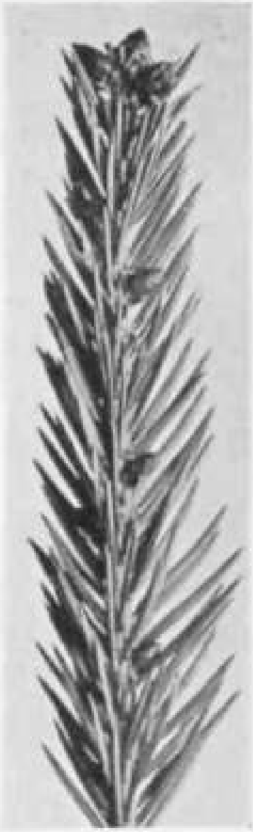


**Fijj. i *rj.*—iUrk ol Spruce.**

the needles live on the tret' for **Hght** to nim- (or even twelve) **years,** and thus **effiphasfee the** shade-bt;aring ca parity of the Spruce.

The needles are solitary, and spirally arranged, but the clue **to** their precise pose is to be found in the occurrence of the stomata on their four faces. The Silver Fir has flat needles with stomatu only on the lower face, so that it arranges its needles horizontally by flat branching and appro- priate twisting, The Spruce requires other devices. On vertical shoots the needles pre- serve **their** obvious spiral dfepusitinn, and are **inclined upwards** (Fig. I2Cj); on wd**i**-hghted **twigs that** are **indiaed or horizontal** they curve from the **tower face** and are directed obliquely upwards {Fig, M i ); but on horizontal shaded branches they bi-nd so as to be aggregated towards the upper face of the branch, thus forming half a cylinder {though not showing the char, **Comb-Eke** arrangement of **the Silver Fir), with** the needles truly belonging to the **upper faee** distinctly shorter than the others {Fig. 132).

Fig. nS.-COMMON *SPRVCE-PICEA EXCELSA,*



Fijf. 129.—Foliaged Twi^ and Restinjt-buds of Spruce.

Kranching.

The Spruce agrees with the Silver Fir „ .. in its general scheme of branching. Each season the twig produces at its end a terminal resting-bud, **and** dose **beneath** it **a false whorl** of lateral resting-buds; **lower down,** near the middle of the year's-**ahoot,** are about sue irregularly - arranged buds m the axils of some needles ; but the lowest portion of the yearVshoot bears no buds (Fig. 129}, In the following year the **terminal** bud and most of the Literal buds **Close** to it grow out to long-shoots (tlniH **producing** a **false** wlmii). **while** some of the lower **buds develop** into shorter dwarf-shoots, and the remaining buds continue to rest. In Inter years the dwarf-shoots mav. if **called** upon, develop vigorously iiit'. ]«int,'-shoots, the dormant buds may shoot forth, and even in the axils of the lower leaves on the year's-shoot there may subsequently arise " secondary " buds that enable the Spruce to replace buds or branches destroyed by hostile agencies. On shaded branches the lateral shoots **spring** lYnin the flanks, but there does not arise a regular flat system of brunches as in the Silver Fir, because the branchlets and twigs incline or droop downwards. On well-lighted branches ramifications also occur on the upper and lower faces.

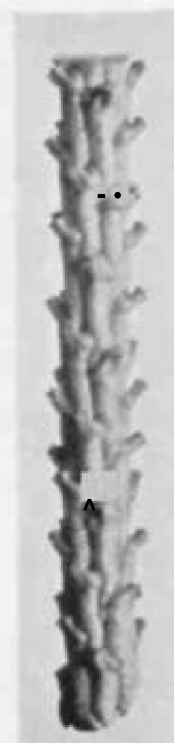
The conical **resting-buds** (Fig. 129} are clothed with membranous yeltow-brown scales, and are not externally coated with resin. When the bud opens, its upper and middle scales break off at their bases ;ind» glued together, they arc lifted aloft by

Buds

llir enKırSing needles, over **which** they form a protective cap (conti;\-*i* the Silver Fir)*;* whereas the basal **scales** re-main attached for a long time. One interest-ing point in the behaviour of the buds **is** that the lateral ones sprout earlier in the season than **do** the **terminal** r>m>s; there-suit is that l.itt- **frosts** may kill all the young **lateral** twigs, but leave the more **tardy,** still **protected, terminal** bud **uninjured.**

Flowering

The Spruce commences to product; flowers at an age of thirty or forty years in the Opea> bllt llot be*ore seventy years in dense forest; yet 00 poor, sun-bathed situations stunted trees may bear female flowers in their **fifteenth** year of existence, but the resultant seeds are mostly sterile. The flowers **open** in April or May, just when the **young needles** are emerging, and when, too, the **chief** full of the **old** n.rdles is setting in. Both **male** and female flowers may be on tin- s;imi> twig, but the latter occur more abund-antly on the higher branches. The flowers are already recognisable in the season before they open, the female ones as terminal buds and the male flow, is chiefly as lateral buds pro-duced **during that** season. Hence, when **they open,** the flowers are attached **to twjga** formed during the immedi-ately preceding season.



n g. ,30. **Twi^** of Spruce show-ing Raised Leaf-scars.

The male flowers (**Fig.** 1jr, *f)* before opening are pretty, red buds, **reminding erne** of strawberries. Whether they point downwards or not, as their axes elongate they bend upwards and may be-come perfectly erect; and as the pollen becomes visible their red **is** fieckod with yellow. In general structure each agrees with the male (lower of the **Pine,** *the* red colour being due to (lit' erect connective - crests of the stamens. The pollen - grain has two air-con twining bladders, so that the pollen may be carried in vast quantities for miles, and cause the phenomenon of " sulphur-rain."

The pretty, purple - red **female** flowers are cones nearly two and a half inches long (Fig. **I3i$_t$** ¥). In design each is like that of the Pine, with which it farther agrees in that the large scales are the seed-bearing (placenta!) ones, while the small concealed scales arc the earpellary (bract) scales (contrast the Silver Fir), The oval seed-bearing scales hiive their exposed terminal parts sharply bent down and purple-red in colour.

After **pollination,** which takes place as in tlie Scots Pine, the cone ^ dun-,. soon bends downwards, its scales close together, and it acquires a greeri or some-times a purple-violet tint. The sced-be;iriiii: **scales** grow vigorously, but the c;irpelkirv scales remain

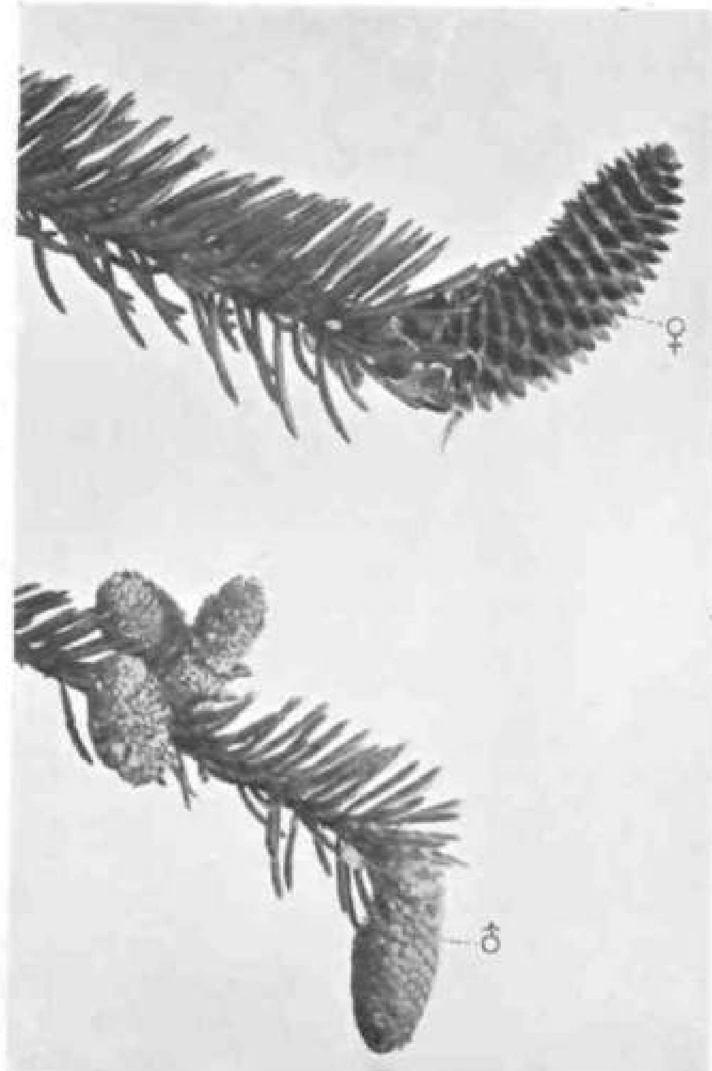
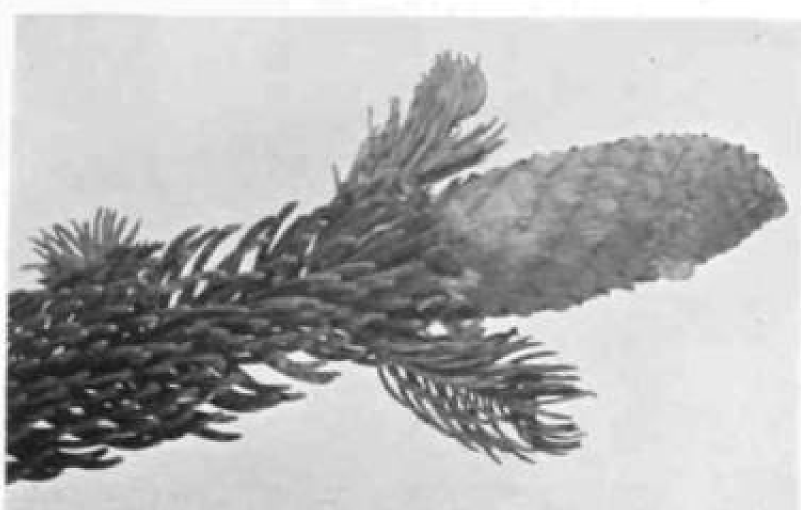


**Fig. 131.—Male (4) and Female \?) Flowers of Spruce.**



**Ffg. ijz.— Half -grown Cone oJ Spruce.**

**insignificant.** The (run- is ripe in the **October** of the same year, and is cylindrical, its usual length being from four to six **inches, and** its thickness slightly over or under one inch and a half. Though somewhat like the cone of a **Weymouth** Pine in genera] shape, and in **the re-lative** thinness of its **woody** scales, these latter differ in having no apophysts. The lower and uppermost scales of the cone are sterile, but the middle ones (usually in the

*Fig.* 133-—Ripe Cones of Spruce.

following spring) gape asunder and allow the escape of the winged seeds. **Within** a year **the eatfpty** <<>ne falls off as a whole, with its scales still attached to it.

In general structure the winged seed **agrees with** that of the Pine and Silver Fir.

Seed* And the germination closely resembles that in the latter plant, the **optytedOBS** numbering from eight to ten.

Though not a British tree, the Common Spruce is extensively grown in Great Britain.

Distribution. It **naturally ranges** from <>;ntral & northern Europe, going as far north **aa** Lapland, and extends **into** Asia. In its northern stations **the** Spruce belongs **to** the plains, whereas in southern localities—in Switzerland, for instance—it is a mountain tme. **Though** incapable of existing on very dry soils, it can **live** in soaking swamps. Not only **is** it found growing in the open, but its great shade-bearing capacity adapts it for its usual life in the **shade of forest.** With its~wid.- **range <f country and** station, the Common **Sproce displays** exceeding **variety** of shape and >t;mtre. Two extreme forms **may** *bv* **briefly described.** Far north the 1 'iinnum **Spruce assumes** the shape of a **dense,** |>w bush with a flat top extended liki- **a table; the ueighi of** the tree **is** determined by tlu- drptli oi **the** snow in winter, as **all** the twig* **projecting above the** snow an.- dried up **and killed by** H<- icy wind. The bush, nevertheless, has a main **stem,** and **Its lower** brandies creep over the **surface of** thr **soil, into** which they send **numerous roots. Btri in** its most extreme form this **tree recalls** our own tiny Alpine Willows, **and** is swn fin tin: tundras of **Lapland. Biere the Spruce-forest** has dwindled **to** form 'meadow/' over which **one** can walk. The pygmy Spruces funning the "meadow" **have** no main **stem,** but consist of many prostrate branches creeping among lichees and emitting roots **at intervals.** The habit of giving off roots from the **branches** is not confined to these stunted forms of the Common Spruce; for **the tall** tree can trail its **lower blanches** over the ground, and **these** may **give** off from **their** under surface roots, and from **their** upper surface erect shoots which grow like individual trees, so that the whole plant

Fig. 134.—Open Spruce n;lls (Stage II.).

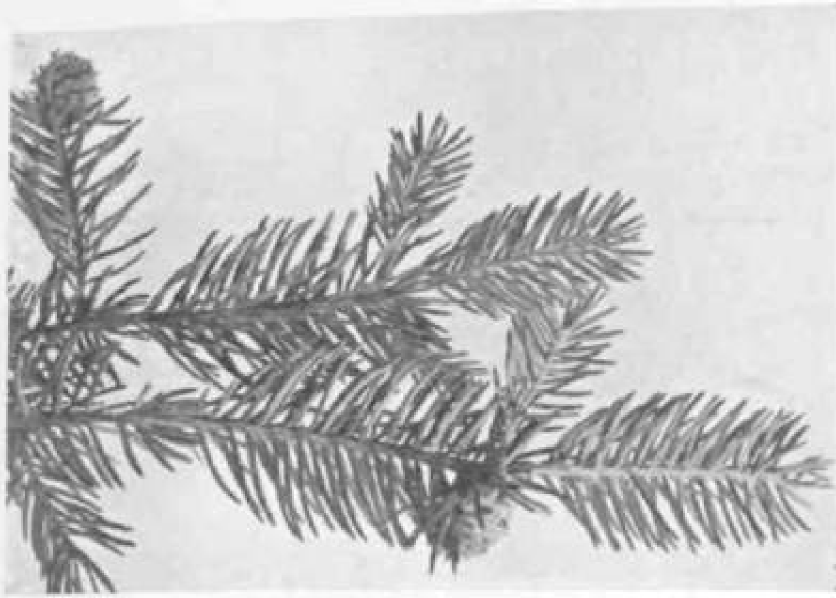


Fig. 135.—Still Closed Spruce (jnlls (Stage I.).

resembles a "family" with the offspring ranged round or near the parent trunk.

Sprice. Galls. Characteristic cone-like galls (Figs. 1,^5, 134) very frequently occur on the Common Sprrice. These are produced by a species of *Ctermes*{allied to "Green-fly "), Llit- laxv*e of which suck at a. Spruce-bud, causing its leaves to be deformed and to remain closely packed, so that the analogy between these galls and cones is close* The tiny larvae are concealed in spaces between the gall-Jcavcs, which eventually gape asunder and permit the escape of the winged insects (Fig. 134). One species, *Chcrmos viridts* {Ratz.}. spends some «f its generations on needles of the Larch, so that it alternates between Spruce and Larch, just as some parasitic worms pass different stages of their lives in carnivorous and herbivorous animals respectively, or as certain parasitic fungi require two host-plants (say Grass and Barberry, or Groundsd and Scots Pine) to complete their life-histories.

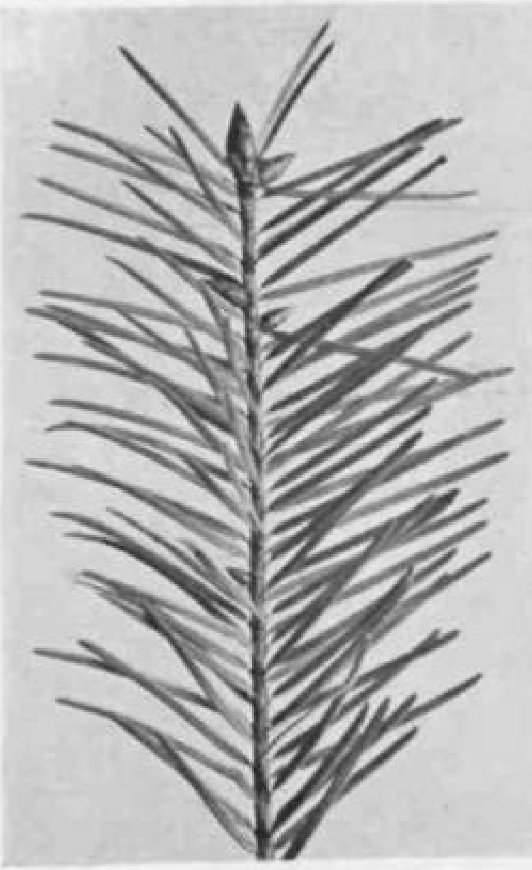
## PSEUDOTSUGA **DOUGLASII** *(Carr.)*.-DOUGLAS FIR *(Pinaceæ)*

The Douglas Fir has all its needles solitary **BBd** spirally arranged. As in the Common Silver Fir. the needles are flat and have **two** **white** lines on the lower face ; but when **they fiill** they leave behind them a scar on a distinctly prominent leaf-bast[1], though these projections are not so long as in the Spruce. Most **characteristic** are the pendulous fruit - cones, which show narrow three - **pronged, membranous** (carpellary) scales projecting from between the persistent woody scales,

**Fig. 136. —Bark of Douglas Fir.**

The bark becomes rough, thick, and deeply furrowed (Fig. 136). The stem frequently

Fig. I37.-IWUOI.AS F'R-*PSBVDOTSUdA DOUGLASII.*



Ftjr. 138.—Twig and Resting-buds of Douglas Fir.

a tut ins 11 height of from eighty to a hundred feet and a thickness of two feet in England, while in favourable situations iaitsNorth American home the Douglas Fir towers up to 300 feet. The slender boughs tend to be arranged in false whorls, but from the intervals between **these** there spring many smaller branches that obscure the tiered pattern of the ramification on the main stem. Grown in full light, the young **tr**ee often shows a loose,

Dimensions and Form.

pyramidal crown **teaching** nearly to the ground (Fig. 137); but in shady forest the tall tree usually has a long, bare bole capped by **a** narrow crown. On the boughs the branches largely arise from the Hanks and go to form a flat **horizontal** system, from **which** the braiichlets and 3'oung twigs incline or hang downwards and **impart** a Spruce-like pattern to the sprays.

The solitary, spirally-arranged needles are flattened, and display ;i white band of wax on each side of the prominent midrib on the lower face (Figs, 61, 142). They are short-stalked, from three-quarters of an inch to one inch and a quarter in **length,** and spread out well from the **stem.** ( in shaded brandies they twist and arrange themselves in *a* double comb-like matmi.-r with the stomata {and white lines) faring the ground ; and the needles springing from **the** upper face of the twig are shorter than the others. But on erect shoots tin-needles art; arranged all round the stem, **white** on well-lighted inclined branches they approximate to this disposition. Though **relatively** delicate in texture, the needles usually live for eight years. When they

Needles.

Fl«. 139--Opening Buds of Douglas Fir.

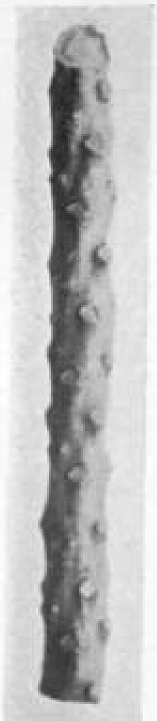


**Fig. 140.** Twig of Douglas Fir showing Leaf-scars.

are shed they leave behind them tiny peg-like eminences (Fig. 140), so that the bare twig is, as regards roughness of surface, intermediate between those of the Silver Fir and the Spruce.

Branching;.

The mode in which the buds **behave** (Fig. 139), and the resultant scheme of branching, are on lines so similar to those in the Spruce **that** readers are referred to the description of that tree (on page 104); but in the Douglas Fir dwarf-shoots more frequently develop into long-shoots, which are thus inserted **at** intervals between the successive false **whorls** of still larger branches.

Buds.

The glossy, chestnut-coloured resting-buds are narrow, taper to a fine point, and show no resin on the outside. The terminal one is considerably larger than the lateral ones close beneath it (Fig. 138).

Flowering.

Tiic tree produces flowers, if not before, at the age of twenty-five years. These open in April to May, at the same time as the foliage-buds are sprouting, and are **arranged** much as in the Spruce, save **that** the female flowers may be abundant also on lower parts of the crown. Both kinds of flowers are solitary and inserted *on* twigs produced in the previous year ; the red-flecked female flower arises from the terminal bud, or from one of the lateral buds near this ; while the orange-red male flowers are grouped in larger numbers near the middle of the year's-shoot (Fig. **E41).**

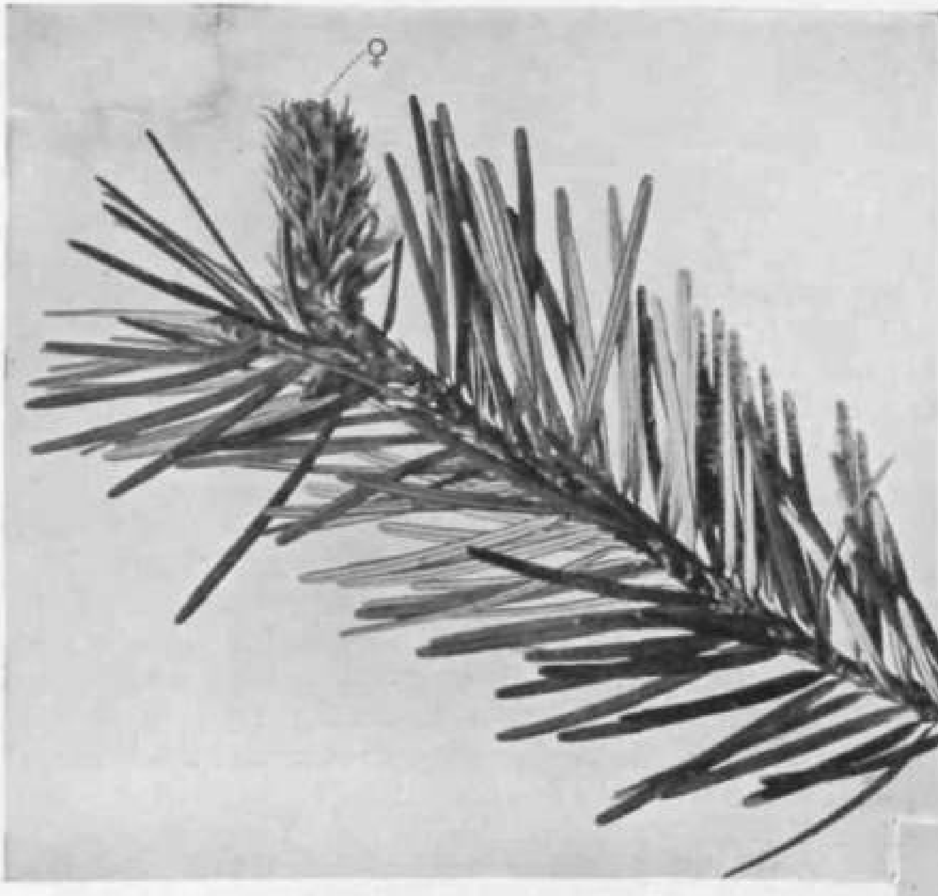
Male Flower.

The cylindrical male flowers *in* general structure agree with those of the conifers previously described : the connective-crest of each anther ends in a short, narrow, peg-like process. The pollen-grains have no air-bladders to aid their flotation in the air. This is perhaps **to** be associated with the fact that the female flowers often occur low down the tree as well as high up.

Female Flower.

The cone-like female flower (Fig. 142) agrees in general construction with the types previously described, but owes its peculiar appearance to the long, narrow, three-pronged, carpeltary (bract) scales, which greatly exceed in length the little, concealed, seed-bearing (placental) scales that bear two ovules each. It is interesting to note at the base of each cone the series of leaves

*Fig.* 141.—Mate Flowers of Dougias Fir.




Hjr, 142.—I L-in;ili Flower of Douglas Fir.

transitional between narrow needle-like green leaves ;un| the green three-pronged scales.

The pollen conveyed by wind to the crevices of **the** female cone mils down, and **reaches the** ovules. The fruit gradually bends over and ripens in the same **year,** its seed bearing scales growing vigorously, and the thin three-pronged airpelkry scales more than beeping pace with them.

The light-coloured ripe cone is from two to **four** and a **half** indies in length, and is shaped like a **long**
Cones. **narrow** egg (Fig. 14.}). In the autumn **of** ihe same year the persistent cone-scales **gape** asunder and allow the winged triangular seeds to fall out of the pendulous fruits, **though** the empty cone is not detached until after winter.

The seed **includes** food-material (endosperm) and an embryo which possesses from five to twelve **narrow** cotyledons.

Among the several varieties of *P. douglasii,* one has larger cones with **ttaefcscales** that project to a less extent, and leaves tinged with greyish - blue ; this form is often **regarded** as a separate species, P. *macrocarpa.* In another form **the** needles are very **glossy,** though pure **green,**

*[Tsuga* {Hemlock S] truce J has little **canes like** those **of** tin Spruce, but in the species more **commonly** cultivated in this **country** the needles resemble in type and arrangement **those** nf the Common **SUver** Fir.]

Fig. M3.—Cone of Douglas I-'ir.

## TAXODIUM DISTICHUM *{Rich,).*—MARSH CYPRESS *{Pinacex)*

The Marsh Cypress is (with the exception of *Pseudolarix,* which is randy seen in this country) the **tree** most like a Lurch in general appearance, for it has soft, light green, deciduous needles, a tapering straight trunk, and somewhat irregularly-arranged slender boughs; but it can instantly be distinguished from the Common Larch by its lack of **the** cones and of numerous hanging twigs that characterise the latter tree,

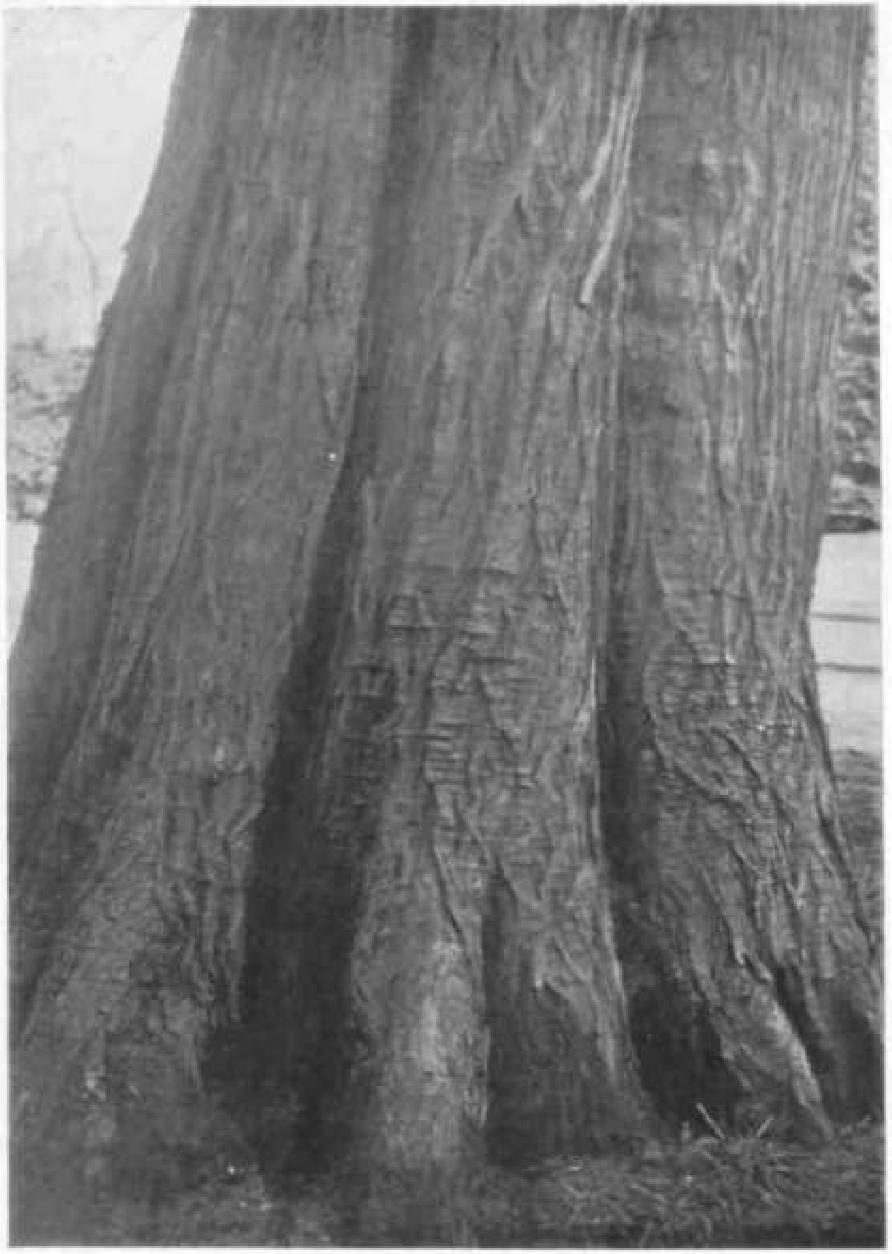
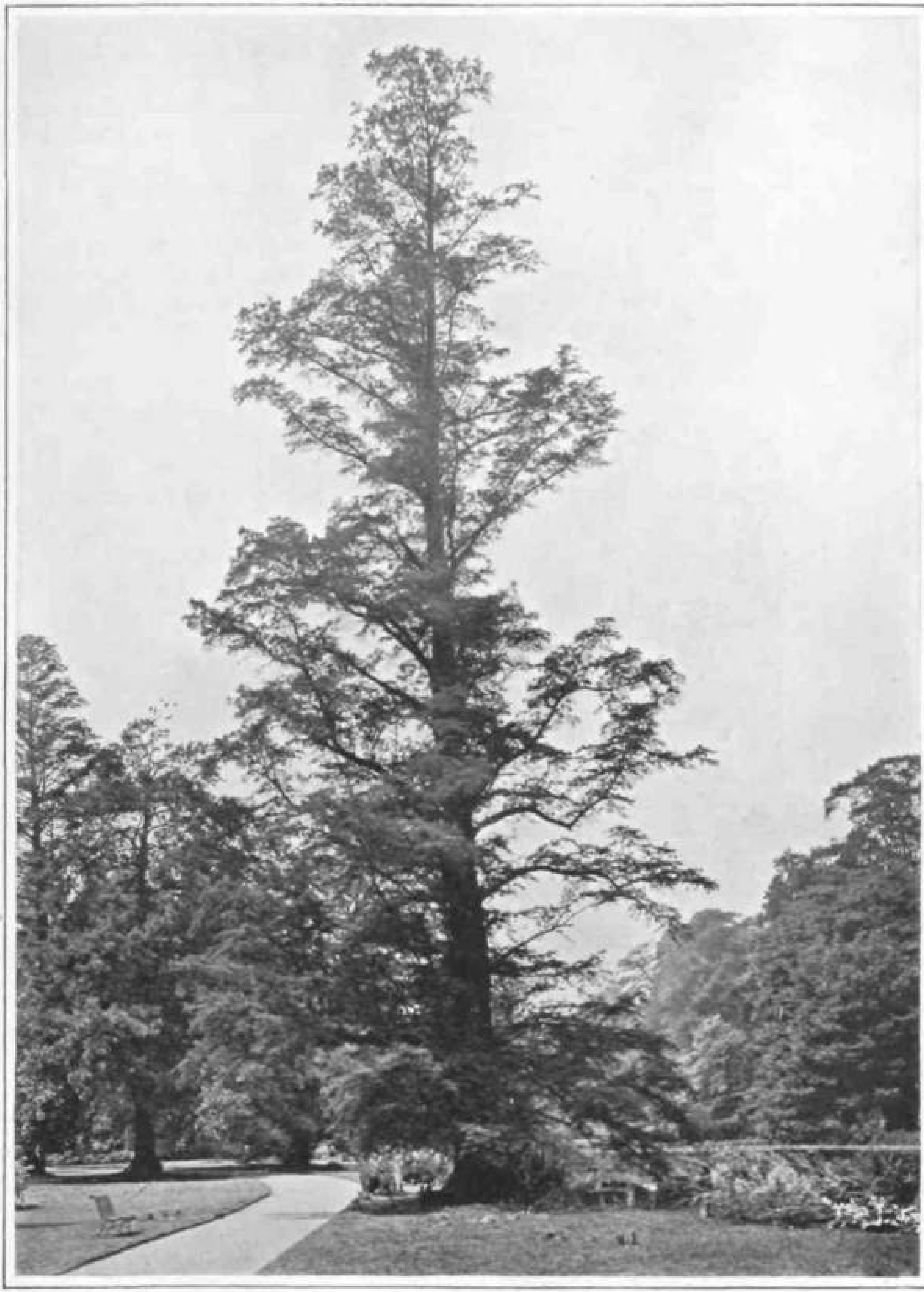


**Fig. 144. Bark of Marsh Cypress.**

^Istinctlve Fea ures,

***Taxadium,*** though not very commonly met with in England, is described here because of two interesting **features—the** habit of annually shedding its foliage, and the production of **remarkable** respiratory roots

Fig- 145—MARSH *CYPRESS-TAXODIUM D1STICHUM:* WINTER.



Fi*. 146.-MARSH CYPRESS-T*AXODIUM DISTICHCM:* SUMMER,

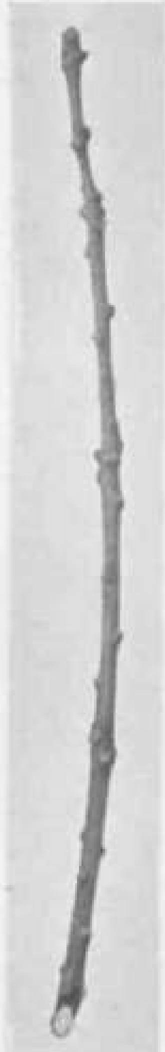


Fig. M7-Twit: of Marsh Cypress in Winter.

The significance of the **latter** becomes dear when it is remembered that the **natural** home of the tree lies in swamps and wet places in the United States. In such soaking soil there is difficulty in providing **the** roots with the necessary supply of air ; and to meet **this** danger of suffocation the Mnrsh Cypress, like certain trees in mangrove swamps, **sends** up into the air erect, i; knee-like[M] roots, whose **peculiar** structure adapts them for absorbing oxygen from the air, and conducting it to the long> shallow roots **that** run horizontally in the mud. The " knee-roots " (Figs. 9, 149), which may be a yard or more in height, **are** not always present, probably being absent especially when the soil is not very wet. But this arrangement for providing the subterranean roots with air is perhaps supplemented by a peculiar **structural** feature in the stem which is about to be described.

Trunk and Hark.

The tall trunk tapers often to a height of 150 feet. Its buttressed base (Figs. 145-6) is frequently very **thick,** sometimes twelve feet in diameter, though more commonly less than half this. The base of the trunk is hollow, and perhaps acts as an air-reservoir upon which the roots can draw for supplies of oxygen. The reddish bark is furrowed (Fig. 144). **The** relatively slender boughs incline upwards to **a** greater degree than in the Larch.

The tree has two kinds of shoots—long-shoots, which persist for years, and foliaged dwarfs-hoots, which are shed in the autumn of each year. The soft, flat, light green needles are shaped somewhat like those of the Yew *(Taxua),* hence the name *Taxodium.*

Shoots.

Upon the erect long-shoots they are arranged all round the stem in a spiral, and often are directed more or less parallel to the stem. But on the dwarf-shoots the spirally arranged **leaves** are posed in a double comb-like fashion along the two flanks of the stem and arranged in a **horizontal** plane, so that they resemble compound **leaves** {Fig. 148). And this likeness is increased by their behaviour, for in iiiitiirnn they are bodily shed with their burden of **warm-brown** dead needles. Thus the Marsh Cypress, or, as the Americans style it, the "Bald Cypress" sheds not its leaves alone, but its foliaged branclUets.

The scaly resting-buds are extremely small and rmindi'd (Fig, 147).

As flowers, fruit, seeds, and seedlings will be available to very few of our readers, it

Pig- 148—Foliaged Shoots of Marsli Cypress.

will suffice to say that male and ft-male flowers may occur on the same tree, the former being grouped into slender, branched inflorescences, and the latter giving rise to globular woody cone-fruits which recall those of true Cypresses.

[That the knee-roots of *Taxodium* serve to supply oxygen to roots lying in the mud is suggested by three sets of facts. First, analogous roots on trees occur only in connection with species growing on mud; for instance, in mangrove-swamps some kinds of trees have knee-roots, or serpentine roots that dip in and out of the mud; other kinds send up erect asparagus-hke rootlets which project into the air. Secondly, such roots, in place of being coated with an envelope of cork, are clothed with a rind that has numerous openings by which air can pass into the air-containing rind and thence to tiie roots in the water-logged soil. Thirdly, experiments have proved that these roots do absorb oxygen and exhale carbonic acid in large quantities.]

Fig. 149.-Knee-roots of Alnrsh Cypress,

## SEQUOIA GIGANTEA *{L'md. et Gord.)*.—WELLINGTONS *(Pinacea)*

This tree is recognisable by its characteristic leaves, bark, and cones ; but detailed description of these is given below.

**Dimensions and Form.**

The mighty stem attains a stature only exceeded by the gigantic Australian Gum-trees, and perhaps rivalled by some less-known Malayan trees. The trunk may be 320 feet or more in height, and thirty-five feet in thickness. It is powerfully buttressed at the base and fluted higher up. The crown of the young tree is pyramidal, and in the Open may extend down to the ground (Fig, 151). One of the most striking characteristics of the full-grown tree, which has a more irregular crown, is the remarkable disproportion between the great length of tin- towering trunk and the shortness of the thick horizontal branches composing the crown, below which there may be a bare branchless bole 150 to 200 feet in length.

The reddish-brown bark (Fig. 150) is rough and often extremely thick, and peels in stringy bands.

**Leaves.**

The leaves are spirally arranged. Eacli is shaped like a narrow, shallow. but pointed, boat with a prominent keel on. the lower face; and it is prolonged downwards into a ridge running along the stem, so that the latter presents the appearance of being completely concealed by leaves. Some of the leaves are wholly pressed close against the stem, but others have their sharp ends spreading out* (Fig. 152). Dots of white wax on the upper and lower faces of the leaves mark the positions of the stomata.

The small resting-bud is " naked "—that is to say, it is invested by little fcliage-leaves and not by scales.

The male and female flowers, which occur on the same **individual,** are minute and solitar.V- **WhfM** open in springtime they are seen to be attached to the summit of shoots produced in the previous year.

Flowering

• The tree that is cultivated in tins country and has" shoots most similar to th«ie is *Cryptontivia japonica,* wliiclrfs distinguish^! )jy the *much,* greater *laagth* of its somewhat curved needles, the serpentine bqnd of its boughs, the larger number of mule flowers near the twig-euda, and the couspimous little spines ami books un **its** cone-fruits

*Fig.* **150.—Bark of Wellington^.**

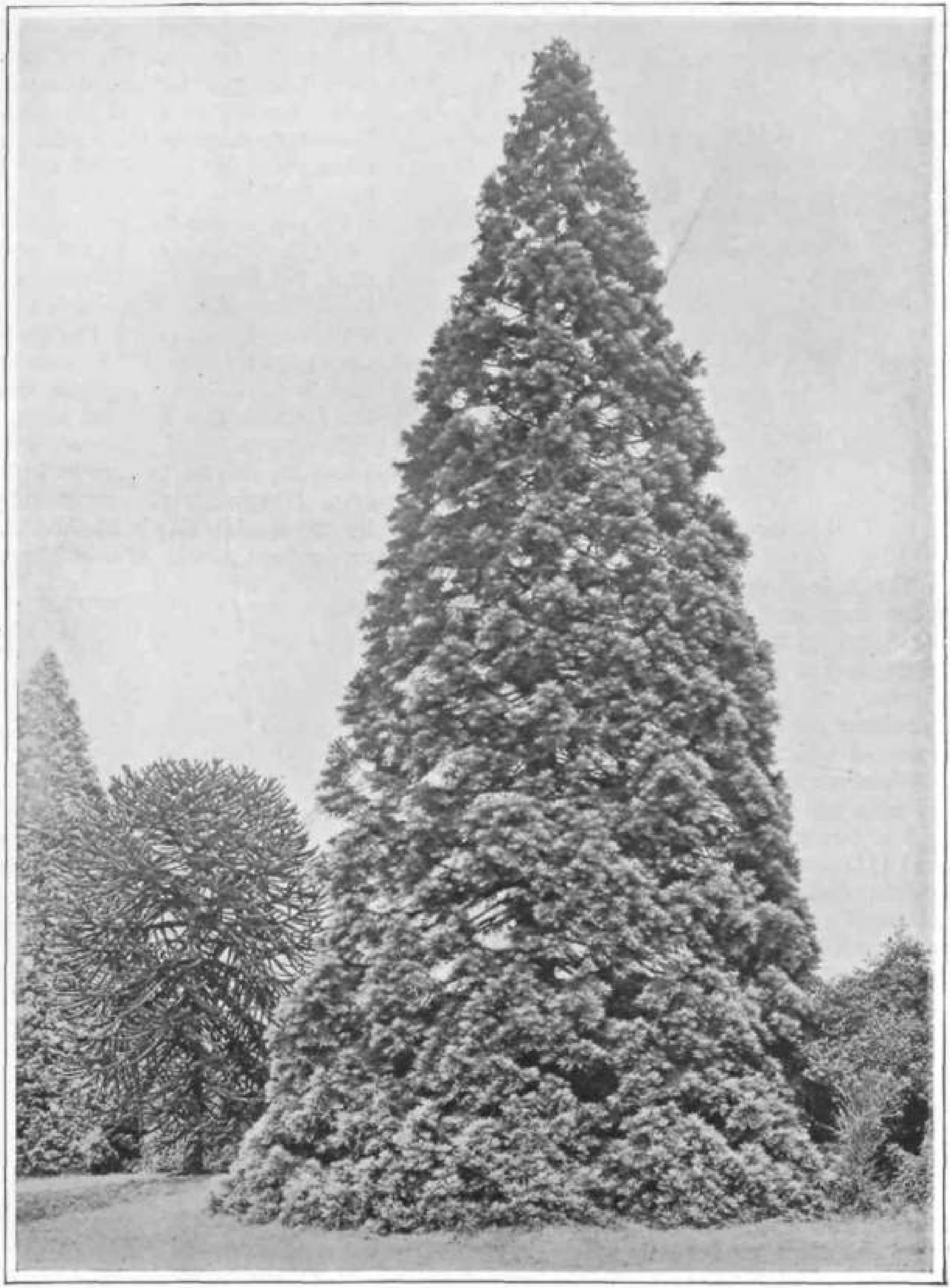


Fig. 151.—WELLINGTONIA—*SEQUOIA GIGANTEA*.

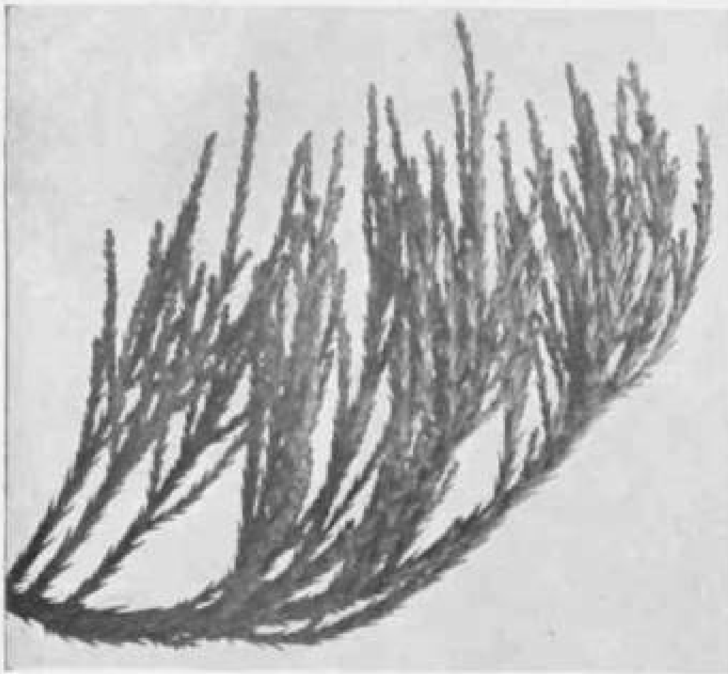


Fig. 152.-Shoot of WelUrtjjtonia.

end, and marked in the centre of its exposed face by a pit, and also sometimes by a distinct prickle; it bears *from* four *to nine winged* seeds. These drop out from the pendulous cones **when** the firmly-fixed scales gape apart.

Judging by the somewhat unsafe i-viden.ee of thickness of trunk and number of " annual " rings of wood, it **has** been estimated that this tree attains an age exceeding two thousand years ; and it will be safe to assume that *Sequoia gigantea* can **live** for at least a thousand years.

The genus *Sequoia,* **though** it was widely distributed in past geologic ages, is represented now merely by two species, S, *giganiea* and 5. *sempervirens,* both oi which are

The male flowers are single, or there may be two or three close together (Fig. 154 J ). The **eotte-Jike** flower has at its base a rosette *'f bracts, and bears 011 its axis *A.* number of spirally-arranged stamens, each of which shows beneath its distinct connective - crest a **cluster** of from two to five pollen-sacs.

The terminal female flower (Fig, 154 % ) is preceded on the stem by a number of short bracts. Its spirally-arranged carpel-scales give no clear evidence of any double nature. To every scale there is attached a double row of from two to live ovules.

Cones.

After pollination, by the agency of wind, the cone does not ripen until the second season. Nevertheless, when mature, the oval fruit is relatively small, from two to three and a half inches in length and one and a half to two and a quarter inches in width {Fig. 153). Each woody cone-scale is broadened at its thick shield-like

Fig. 153- -Ripe Cones of Welfimtlonla.

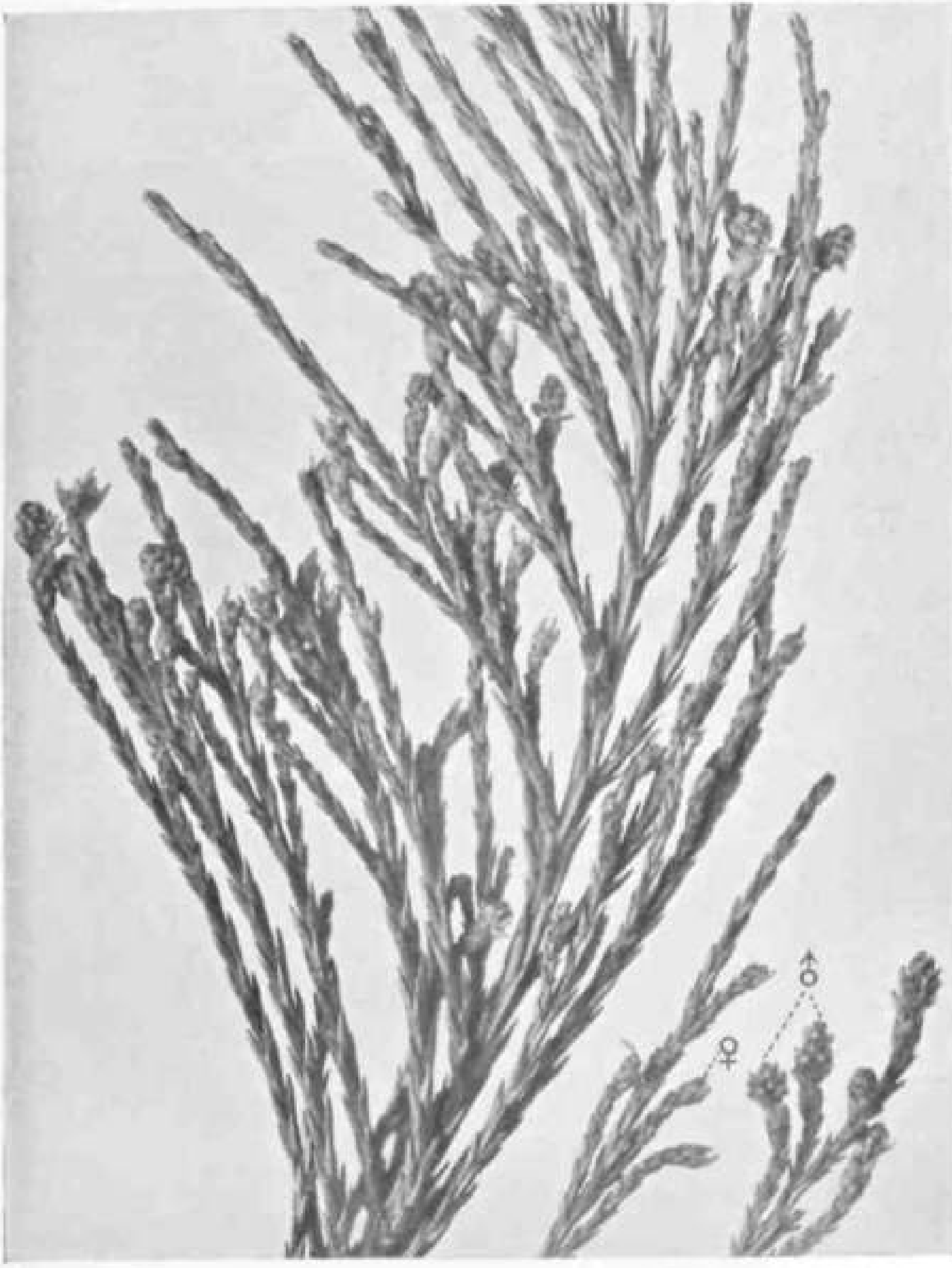



Fig. (54--**Male** (4) and **t-emalt;** [9\ (lowers of Wtllinjtlonia.

naturally confined to **mountain** districts of California,

*Sequoia sempervi-retts* (Ret! Wood Tree) attains similar colossal dimensions, and lias similar ilowers and fruits, but its foliage assumes the form of flat needles which twist themselves into two comb-like series on the flanks of the horizontal twigs and give to these ;L Ve«'-like appearance. The leaves very dislimily show a gradual increase jiud decrease **in length** when Lraced from the base to the tip of each year's-shoot. The restin^-buels **show** a few true scales on their exterior.

ARAUCARIA IMBRICATA *[Pav,).*—MONXET-PTOZMS TREE *(Pinacta)*

This tree is **tendered** unmistakable by its unique habit, as the boughs stand out in false whorls at right angles to the main features of the tree are easily seen, only few words will be devoted to this striking tree.

**Fig. 155.—Bark of Monkey-Puzzle.**

stem, and the broad-based, sharp-pointed leaves are arranged in close spirals so as to conceal the stems.

As the flowers are not abundantly available for examination, and as the main

In this country the tree, grown in the open, may often be seen to retain its more or less horizontal serpentine branches right down to the ground (Fig. 156); but in its Chilian home, where the Monkey-Puzzle tree

Fig. 156. "MONKEY-PUZZLE *TRE£-ARAUCAR/A IMBRICATA.*

forms forests, the crown of the full-grown tree is limited to the upper part of the trunk, The thick leaves remain living and attached for many years, and completely ensheath the stem in spiny armour (Figs. 59, 60). The resting-buds are devoid of scales.

**Flowers.**

The uncommonly large male and female flowers are usually on different individuals, and show very pointed spirally-arranged stamens or carpels. The male cones are the narrower (Fig. 60), and include many stamens, each of which possesses from eight to fifteen slender pollen-sacs. The egg-shaped female flower (Fig. 59) shows many scales, which bear only one ovule on the upper face of each, and are apparently not double. (The only possible trace of the double nature of the cone-scale in the genus *Araucaria* is provided by a minute membranous outgrowth on its upper face, situated higher up than the ovule.)

When the fruit is ripe the winged cone-scales fall separately and hold the seeds firmly attached to them.

## CUPRESSINE^E.—CYPRESS AND JUNIPER GROUP {*Pinacece)*

With the Cypresses and Junipers we come to a group of conifers contrasting with all the types previously described, as their foliage and floral leaves are arranged, not in spirals, but in true whorls. A number of trees and shrubs belonging to this group have characteristic twigs, as these are covered with little scale-like green leaves that are closely pressed against the stem (Fig. 157). To distinguish among all the species with this cypress-like foliage requires experience, and often the use of a microscope ; but the fruits at once allow us to range them into two sub-groups. In the Juniper the fruit is fleshy and berry-like (Fig. 168), but in the Cypress sub-group (including Cypress and Arbor-Vitae trees) it is a scaly cone (Fig. 159). Another confusing feature is due to the fact that both Junipers and Cypresses may have spreading narrow leaves in addition to those already described ; in such cases, on the spreading leaves the white wax is confined to the upper face in the Juniper, but occurs on the lower face in the Cypresses. The spreading foliage is particularly apt to occur in juvenile stages or on vigorous shoots ; but it, and no other kind, occurs on the Common Juniper throughout the whole life of the tree.

**Fruit.**

**Leaves.**

In the Cypress sub-group the leaves are nearly always opposite, with the successive pairs standing at right angles to each other, and the buds are scaleless. This sub-group may again be distinguished into two sections according to the fruits : (i.) Cypresses have a rounded fruit, whose cone-scales merely touch at the edges, but do not overlap, and are shaped somewhat like thick-headed hob-nails or wedges (Figs. 159, 164). (ii.) The species belonging to the Arbor-Vitae *(Thuya)* section have more elongated fruits, whose scales overlap at their margins and are of ordinary shape, and not nail-shaped (Fig. 165).

**Fruits.**

## CHAMJECYPARIS LAWSONIANA *(Parl.)*.—LAWSON'S CYPRESS {*Pinacece)*

This tree is a native of North America, where its main stem attains a height of 200 feet and a diameter of 12 feet, and acquires red-brown, thick, furrowed bark. In this country it is seen as a much smaller tree with the lanky end of its stem drooping to one side, its pyramidal crown often extending down to the ground in open places, but with the branching in the higher parts of the tree looser than below (Fig. 158). The horizontal or drooping boughs are repeatedly branched in a horizontal plane, as the side-shoots spring from the flanks of the successive generations of branches.

The leafy branches forming these flat systems are themselves flattened from above downwards, and are paler in colour on the under surface. The scale-like green leaves are closely pressed against the stem, and overlap regularly; being opposite, with the successive pairs at right angles, they ranged in four ranks. As the branches are flattened the leaves are of two kinds ; those on the flanks are narrow, more sharply curved round the narrow edge of the stem, while those on the upper and lower faces of the branch are flatter and broader. Looking at the upper or lower faces of the branches, and especially

**Branches and Leaves.**

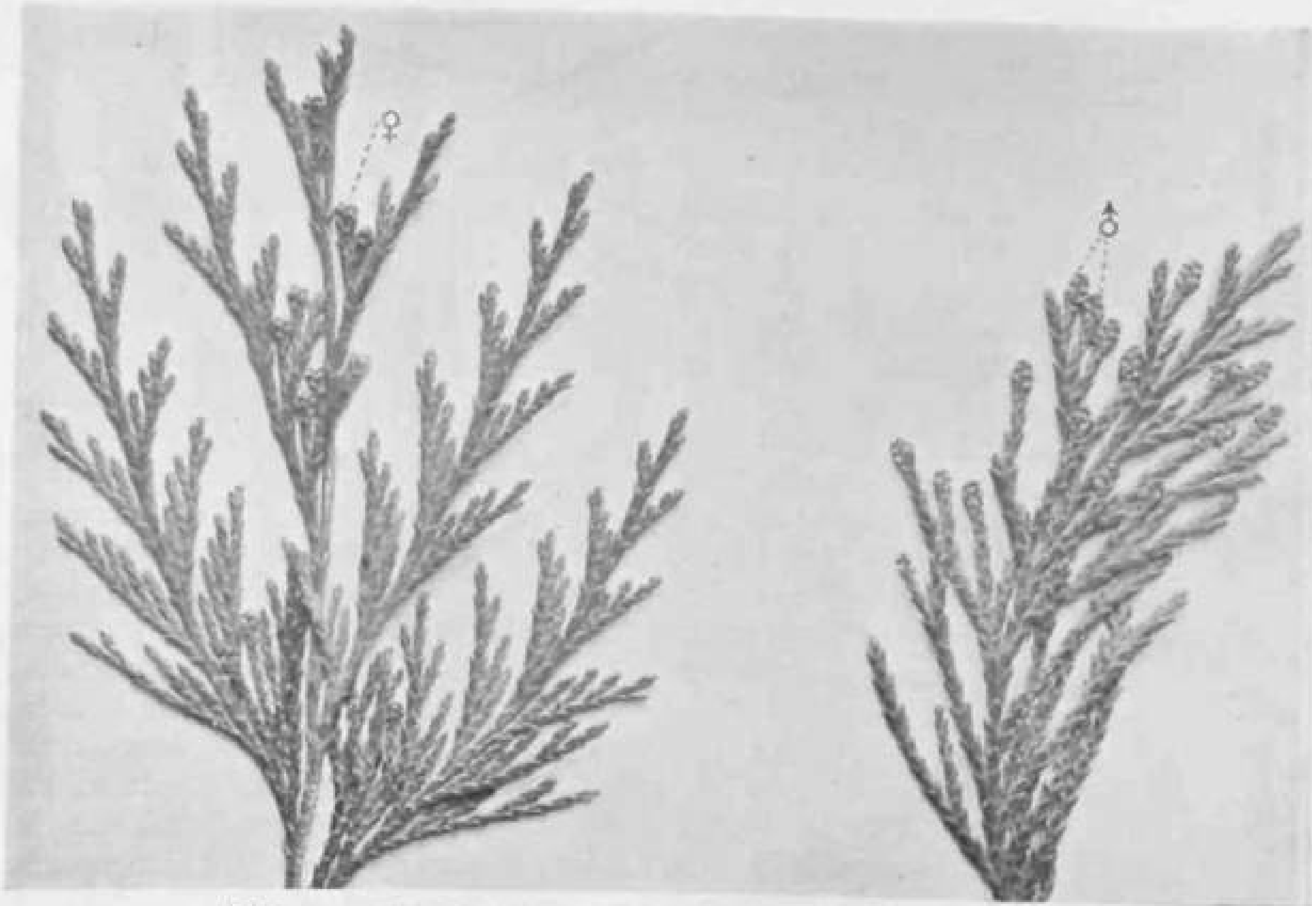



**Fig. '57—Male** ***is; and*** **Female 1*7 Flowers of Lowson's Cjpress.**

of their younger shoots, we see that the white wax gives rise to characteristic V-, Y-, or X-shaped markings (Fig. 157), because the wax is most abundant along the lines of contact of the different leaves; we also see in thu centre of each leaf an elongated, translucent, resin-gland lying in a little furrow traversing the middle of the leaf. Each **leaf** is continuous down the stem with a ridge, so that the stem itself seems to **be** visible only in the furrows between these ridges, and the leaves are often described as **being** "fused" with the stem. The inter-11 odes of the long shoots are longer than those of the very numerous dwarf shoots that build up the foliaged "spray," so tnat they show the leaf-ridges distinctly. The leaves remain attached for years, and, before being shed, become brown in tint and woody in texture.

The resting-buds are "naked,"—that is to say, devoid of scales.

**Flowers.**

The very small male and female flowers occur on the same individual, which may be only twelve years old. **They** open late m March or m April, and terminate in twigs produced during the preceding year. The two kinds are, however, ranged on different branches.

The male flowers (Fig, 157 £) are red, owing to the colour of the young pollen-sacs. The stamens are in opposed pairs, so that they are ranged in four vertical ranks, as may easily be seen by observing the greenish-brown connective-crests. Each stamen is short, and bears beneath the connective-scale two or three pollen-sacs. The pollen grains have no air-bladdors.

The female flowers (Fig. 157 ? ) are bluish-green or steel-blue, with patches of waxy yellow. The short, broad scales are relatively flat and pointed. Like the stamens and leaves, they form four series, because they are attached in opposite pairs. Each

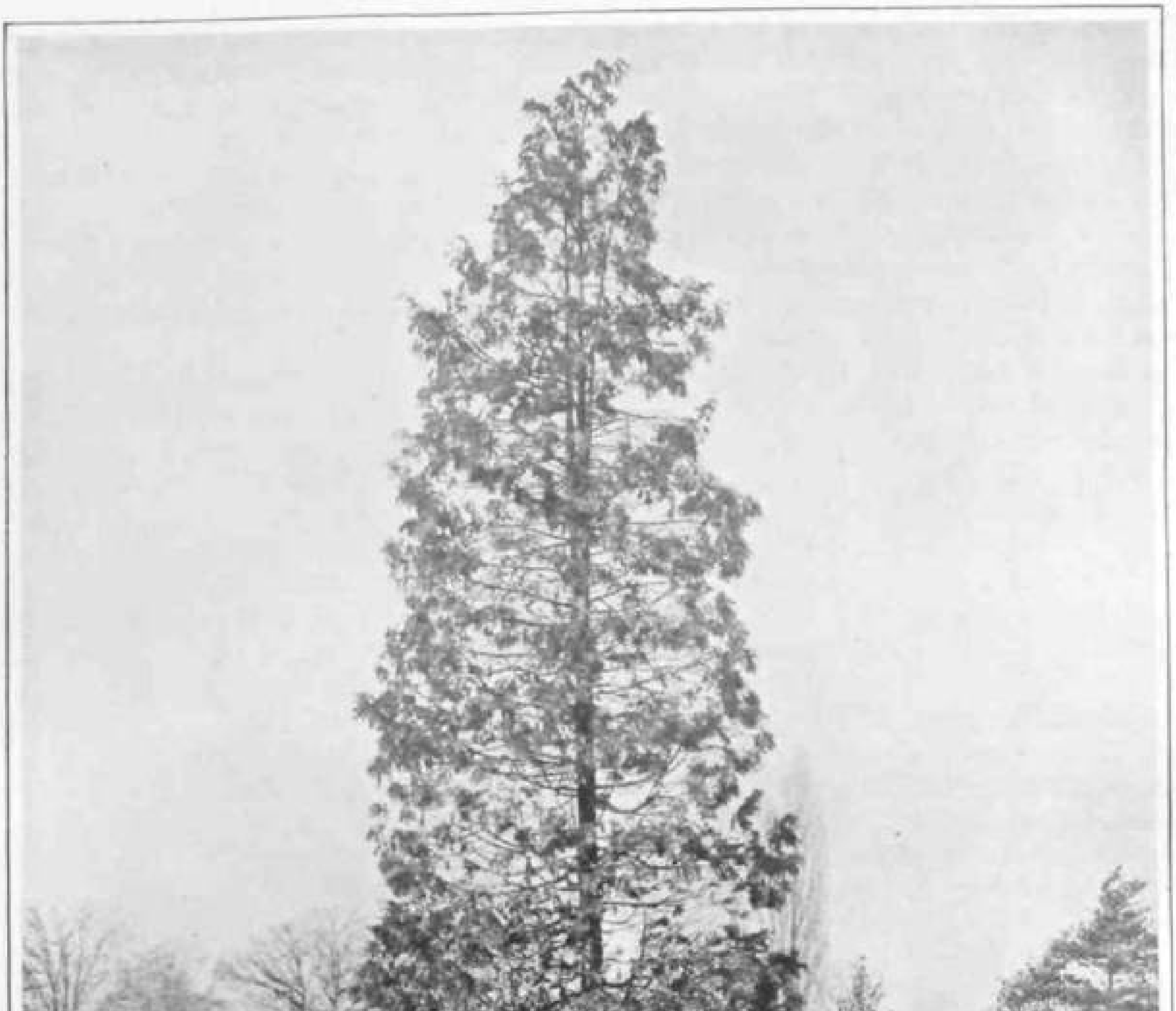


Fig. 158,—LAWSON'S *CYPRESS-CHAM&CYPARIS LAWSOMANA.*

bears near its base a row of from two to five flask-lite ovules, which direct their open mouths upwards.

Pollen is conveyed to the female flowers by the wind, but it is usually stated **that** the scales do not guide the grains to the ovules. Yet if the scale be examined it will be seen to be convex along the middle of its inner (upper) face, and when the **flowers** are erect this cushion-like swelling must help to direct the grains to the ovules **Standing** on each side near its base. **Sfeny** of the **female** flowers, however, are not erect.

After pollination, the cone grows and is ripe by September or October, even open-

Fruit. ing and shcddm g lts ^ d s dll™S

**the** same season. The spherical fruit is only one-third of **an inch** m diameter, and is partly incrusted with wax. whidi gives to it a bluish-green tint before maturity, and is visible as whitish " bloom " on the red-brown ripe cone. Each cone-scale is of **a** shape very different from its original (lattish scale-like form; for it *is* like an inverted pyramid, with a thickened terminal shield which is angled because of the pressure of the contiguous shields. The exposed face of **each cone-**scale (that is. **of** the shield) shows slightly above its centre, a pointed scale-like projection or boss, the point of **which** is the true original tip of the **scale.** Each cone-sc;il.' bears at its narrow base from two to five flattened, winged seeds which are shaped like tiny elm-fruits. The seeds escape by tlie gaping open of the persistent **scales** ; but the **open** cones (Fig. 159) remain attached until the following spring, when thej- often still contain some seeds.

The seedling has two narrow cotyledons, and at first produces whorls of spreading (" **primary** **) leaves utterly **different from** the scale-like leaves of the ordinary shoots.

[**It** is interesting to note that, in **a** number of Cupressine*, this **juvenile** condition can be artificially prolonged by means of cuttings, which may give rise to **large bashes** with spreading **needles** in place of adprased green scales. Such persistently juvenile forms, generally known under the num.- >f *Rainispon,* consequently differ in their appearance **very** widely from their natural parents.]

**this** hardy American tree is widely cultivated in gardens, and its garden varieties show **wonderful** diversity of shape, si*e and colour. Pyramidal, pillar-like, spherical, flat-topped, and weeping forms occur These vary in stature from tall trees to prostrate shrubs; while their tints may be green bluish-green, steel-blue, silver white yellow' **golden,** or variegated **combinations** of these,

Fig. **159.-Open** Cones of Lawson's Cypress,

## CUPRESSUS SEMPERVIKENS *(Linn.)*.—CYPRESS *(Pimaa)*

This description of the Common Cypress will *be* mainly confined to pointing out differences between it and **Lawson's** Cypress, The tree in Mediterranean countries may

Fig. **160.—Bark of** ***Cuprt$sus sentpenirens.***

attain a height of 150 feet ; but **in this** country it generally assumes the form of a bush perhaps fifteen feet tall. The main stem is always relatively \-igorous, and the crown reaches low down. The most familiar form is the *pyramidal* variet}', in which the crown is narrow and conical (and much like that of the familiar pyramidal Poplar} because the branches are nearly or quite upright; but in **the** *horizontal* variety the branches are horizontal and produce an utterly different wide pyramidal crown.

J

Fiji- 161.—Shoot of *Cupressus sempervireas.*

The bark is thin, but becomes furrowed lengthwise.

Twigs and Leaves.

The twigs (Fig. 161) are four-angled, not flattened, :ind the leaves cm **the** flanks **are Eke** those on the other two faces. The scale-like green leaves show no clear white waxy markings.

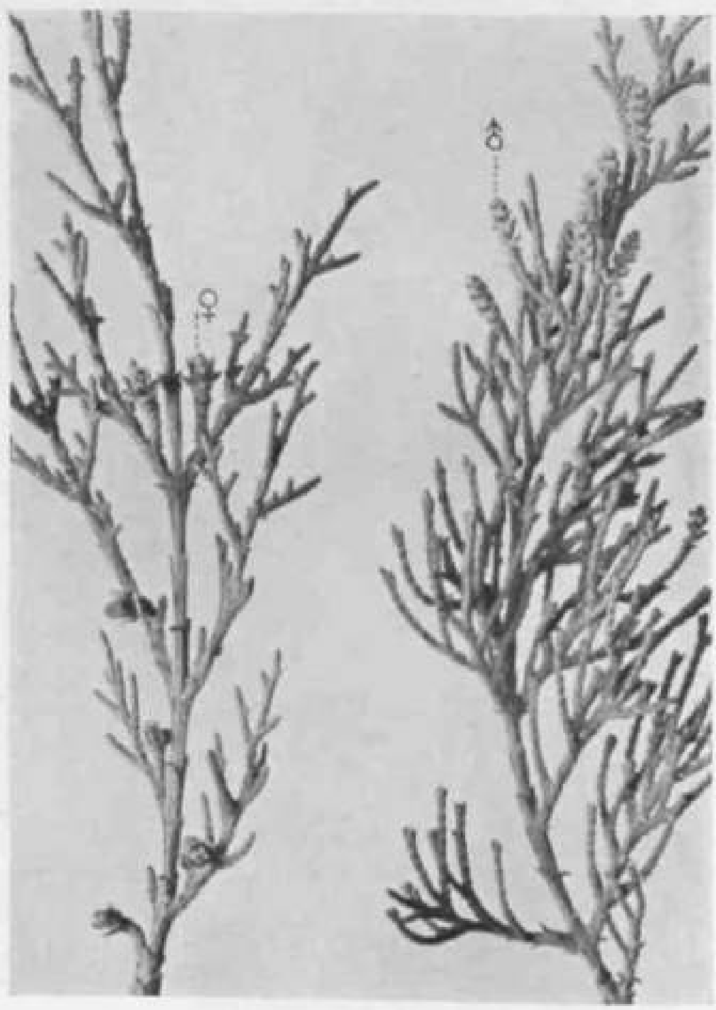
Flowers,

The flowers open in spring, and may occur on ;i tree that is only six years old ; the male flowers (Fig. 162, £ ) being cylindrical and yellow, the **Female** (Fig. r62, ) **brownish-green,** They agree in structure and position with those of Lawson's Cypress, but the pollen-sacs are usually in fours. :uid **the** mules on **each** snile are numerous.

Fruit.

After pollination **the** fruit pre-sent* the **appearance** of imi **ripening** until the following y< iir, so that in nearly all books it is described as ripening in two years. But the truth seems to be **that** the fmit ripens either in the **winter** after pollination or in the **succeeding** spring, though it dues not **open** until **the second** autumn. Thus, **although** the **maximum** time required for ripening appears to be one year, the cones remain closed and attached to th<; tree for considerably longer — so that two crops of closed cones may be seen on the tree. The spherical or oval fruit (Fig, 164) is much larger than in the **ta wson's** Cypress, being often the size of a small walnut ; each woody scale **bears** from eight to twenty **Battened** seeds, which have very small wings.

A tree liable to be mis-taken for C. *sempervirms i>*



lijr. 161.-Male [.}) and Female tv) Flowers of *Cupressus sempervirens.*

Fig. 163.—CVPRESS-C^PffEi'SL'i* S£/MP£*V7*£JVi».

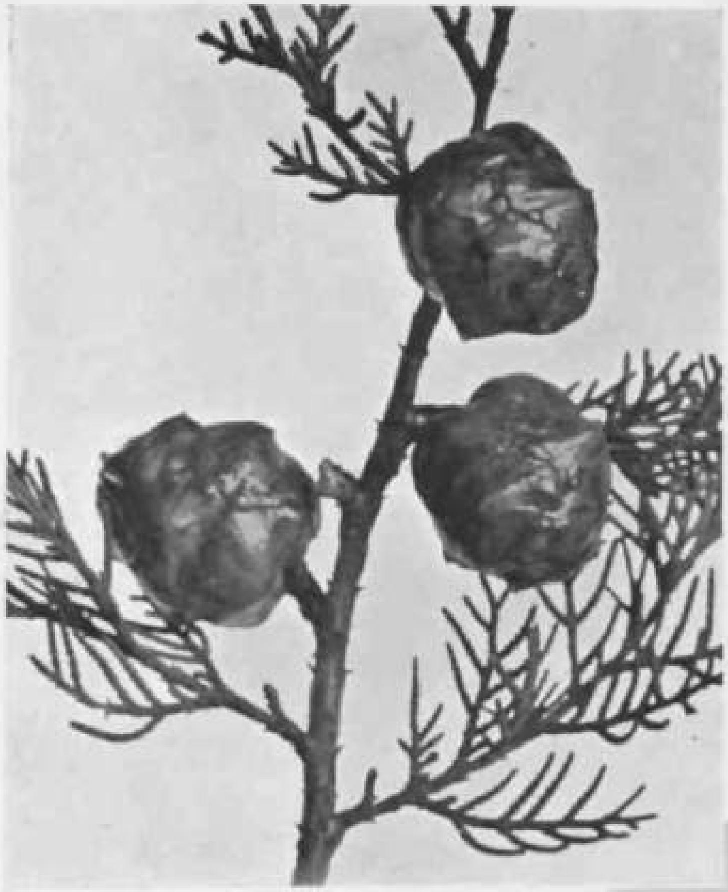


*Fig.* **164.**—Cone of Cypress.

vertically stratified ; its cones (Fig, 165) have six large recurved horns, and remain fleshy for a. considerable time ; moreover, its seeds are wingless. *Enthuya* has its branches repeatedly ramified in a transverse plane so **that** it is **horiajntally** stratified; its cones (Fig- *i&5)* have only tiny points (no hooks) ;md become woody **very** early; and its flat seeds art- winged.

*Biota orientalis,* a very common garden shrub, has leaves that are **grwn** throughout ; each leaf on the broad face of the stem shows in the **middle** of its outer face *a.* furrow-like rcsin-gland. In *'Uinya uciiftenttitis.* also common, the **leaf** b dark green on the upper face and light green on ttie lower % moreover, the resin-ytanil jn the centre of the outer face oi the broader leaves is spherical and bulges out *{set* Fig. 165).

*C. macrocarpi.* But the leaves of the former are blunt at **the** tip, while those of the latter are prolonged into a sharp point.

*Thuya.*—.4 *rbor-Vtice*

There are some other coniferous genera which **have** cypress-like foliage and **flattened** twigs, but possess fruit-cones whose scales overlap and are not nail-like nor inverted pyramidal. These include *Liboccdnts, Thuyopsis* **(with** very broad flat twigs and white markings), and the much more common *Thuya* (Arbor-Vitae). *Thuya* can, then, be distinguished from the Cypresses instantly by its cones; but it is divided into two sub-genera, *Biota* and *Euihuya. Biota* has its branches **ramified repeatedly** in a **vertical** plane, so that the bush is

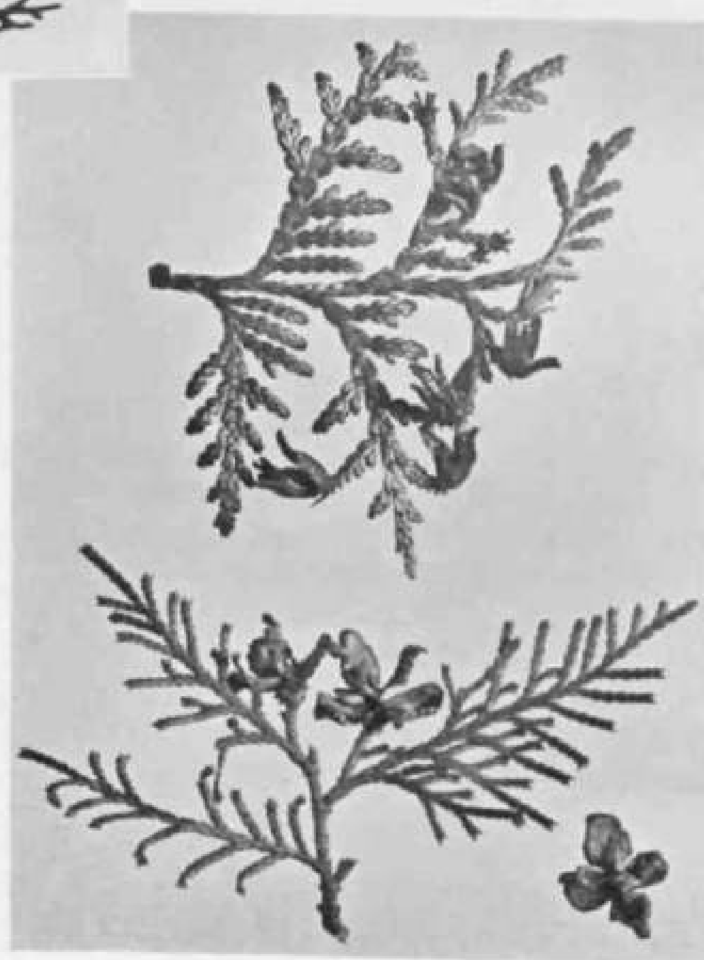


Fig. 165.—*Thuya occidetitatis* (above!, and *Thuya* (*Biota) orientalis* '.belowi.

## JUNIPERUS COMMUNIS *(Linn.)*.—COMMON JUNIPER *{Pinaccce)*

The Common Juniper is a shrub, less commonly a tree, recognisable by its narrow, sharp-pointed leaves arranged in whorls of three, with their upper faces white in the middle ; also by its bluish-black berry-like fruits, which are coated with " bloom."

*Juniperus communis* occurs in two wild forms—the ordinary variety and the dwarf variety. We shall first describe the former, and subsequently mention the points of difference shown by the latter.

**Dimensions and Form.**

The Common Juniper is either a tree or a shrub, occasionally from twenty to thirty feet in height, but much more commonly only a quarter as much. In the tree form the trunk, which rarely exceeds one foot in diameter, soon ceases to be distinct, so that the short, bare bole is surmounted by a crown that is very variable in form, as the branches may spread out or ascend sharply. The shrub form is equally diversified in shape; indeed, high up mountains or far north it dwindles to a prostrate, spreading pygmy. The Juniper owes its habit to slow growth, early cessation of predominance of the main stem, and to the fact that the branches are emitted irregularly from indifferent parts of the year's-shoot.

The stringy, red-brown bark (Fig. 167), clothing the coarsely-ribbed base of the stem, flakes off in long papery strips.

**Leaves.**

The narrow evergreen leaves stand out from the stem in whorls of three, and the successive whorls are separate by distinct internodes. Each leaf is awl-shaped in outline with a long, hard, and sharp point, and has its concave upper surface lined with white wax. (The limitation of the white wax and thestomata to the upper surface of the leaf enables us at once to distinguish Junipers from juvenile shoots or cuttings of *Thuya* or *Cupressus* which may possess somewhat similar spreading leaves.) The needle is jointed at the base, but has no marked leaf-cushion. The young leaf-bearing twigs show three angles and three flat faces. The angles, when traced up, are continuous with the three leaves at a whorl. In the middle of each flat face of the stem is a furrow which, traced upwards, leads to the gap between two leaves at a node.* As the leaves at the successive nodes alternate, so likewise do the angles and flat faces of the successive internodes. The leaves remain attached for from five to seven years, and in winter show change of tint.

The resting-buds are transitional between scaly and naked types; for the leaves towards the summit of the year's-shoot decrease in size, so that those encasing the resting-bud are relatively broad, short, pointed, green leaves. Yet in the following season a number of these leaves can be seen to be brown and dead, although much older foliage-leaves are still green and living ; thus these annual leaves are transitional between scales and foliage-leaves.

**Flowers.**

The Juniper has its male and female flowers (with rare exceptions) on different individuals. Both kinds of flowers are initiated in autumn in the axils of leaves near the middle of the current year's-shoot, but they do not open until the following spring (April to June).

The little yellow male flowers (Fig. 166, $ )

* The leaves are usually described as not being "decurrent," that is to say, as not being prolonged as ridges down the stem, and are contrasted with the "decurrent" leaves of some other Junipers. But such a purely "descriptive" account must not be taken as indicating any wide difference between the two contrasted types ; for, if we imagine the furrows in the centres of the three fiat faces only a fraction of an inch deeper, the leaves would be described as " decurrent" despite of the joint at the base of each.

Fig. i66.-MaIe (i) **and** Female (?) Flowers of Juniper.

are oblong, and consist of a few whorls of stamens, arranged in threes like the foliage-leaves. The stamen has a distinct connective-scale and bears from three to seven (usually three or four) rounded pollen-sacs, except near the summit of the flower, where the scales dwindle and pollen-sacs decrease in number, untU the topmost stamens are represented soldy by solitary pollen-sacs attached directly to the stem.

Mate **Flower.**

The bud-like little female flower (Fig. 166, ? ) shows several whorls of scale-like leaves, but only the topmost whorl of three is fertile. These three little fleshy scales act as carpels; for directly above the gaps between them stand three erect, projecting ovules, which are close together and form the summit of the flower.

Female Flower.

The three carpels are united at their bases by a ring-like ridge, which after pollination grows vigorously and forms acuP~^e envelope round the three fertilised ovules, which also grow vigorously. **The three** carpels grow strongly on their inner faces and, pushing back their real tips, eventually grow completely over the young seeds, which are thus entirely dosed in. The real tips of the carpels are recognisable as three lit!le proK-rtions mar the summit <>{ the "berry." Inside the "berry" the three ovules become three (or one or two) separate seeds, which are encased in hard, bony shells. These changes require two seasons after pollination to be completed. The " berry " remains green and by no meant; juicy during its first year, and until the autumn of the second year, when it becomes fleshy, bliu>-l>lack in colour, though covered with waxY " bloom." The " berry," which is now nearly rounded, and from **one-Sbrth** to one-third of an inch in diameter, may fall in winter or remain attached for one or two years longer.

Fruit.

These fleshy fruits are adapted **for** dispersal inside animals. Hence while they are unripe, being green in colour, they do not attract notice, and being disagreeable in **flavour** as well as lacking in juiciness, they do not invite fruit-eating animals. But when once the seeds are ripe and protected by bony armour, the blue-black colour advertises the fruits, while their juicy nature and agreeable flavour render them appetising. Several kinds of birds peck the fruits and bolt **the** seeds, which pass through their bodies uninjured, and are thus disseminated,

Di5persal.

The seedling has only two cotyledons.

The Common Juniper 1ms an immense area of distribution and occupies wonderfully diverse situations. It ranges from Mediterranean countries, Persia, Afghan-

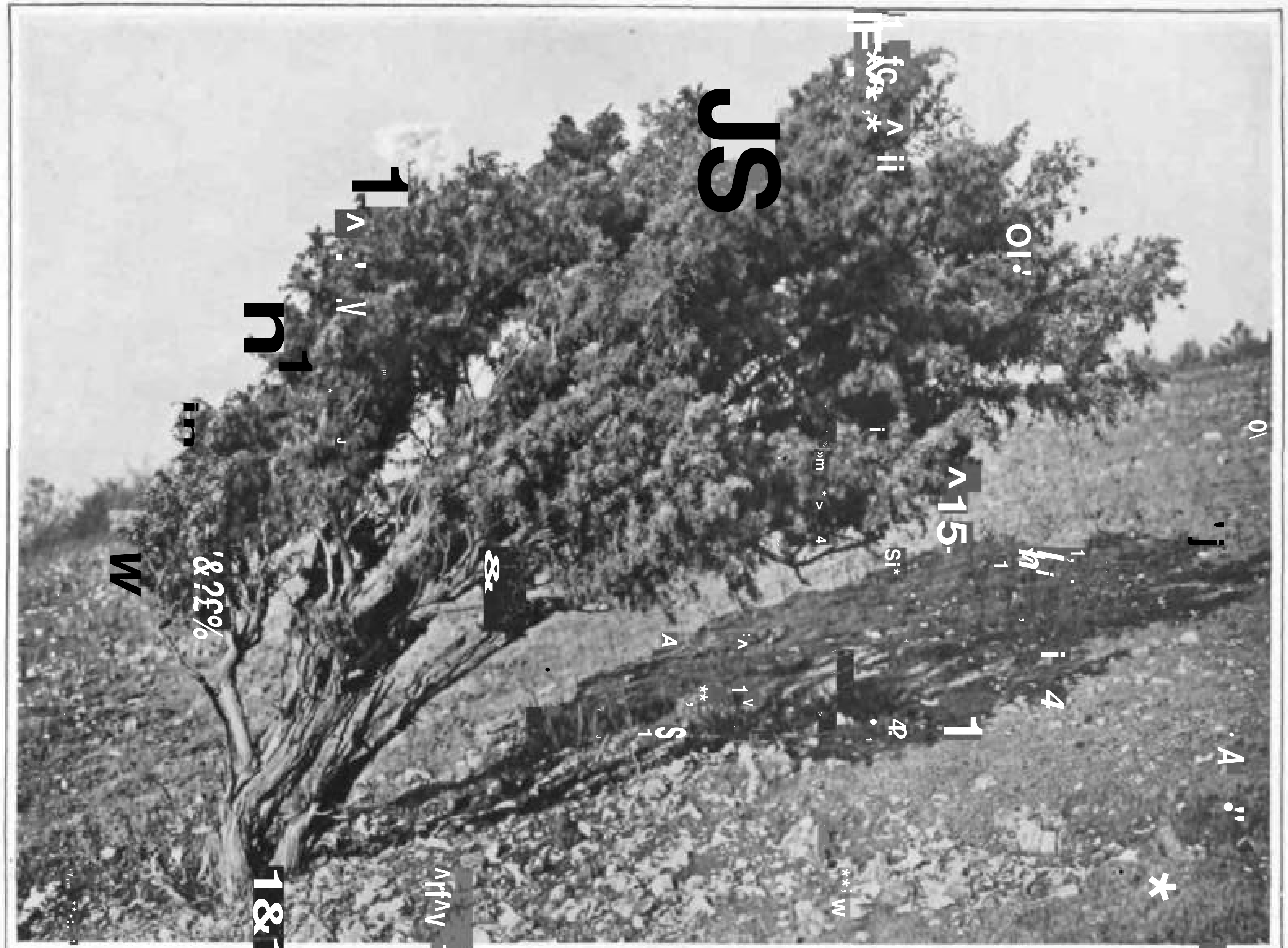


Fig. 167.—COMMON JUNIPER—

istan, and the Himalayas, up to northern Siberia, Lapland, Scandinavia, Iceland, and thence into North America. Distribution. R ^ ^ moiratains going up to nearly 8,000 feet in the Sierra Nevada, and to decreasing altitudes as the situation becomes more northern, until, in Lapland. 680 feet registers its highest climb. Its habitat varies equally. Usually it seems to be at home in dry and sunny, open situations on arid sand-dunes, rocks, or luMths; yet it can grow in soaking moors in the midst of bog-mosses. Nor does the Juniper shun shady places, for it thrives in moist forests near the coast, where fog and rain are rife, or as undergrowth in less humid Pine-woods and even shadier Beech-woods. It lives on various soils, calcareous or not, fertile or sterile. Thus the bush resists alike scorching drought and freezing cold, the full blaze of sunlight or the comparative shade of forest.

Its variety of home Ls reflected in diversity of form, as it shows all stages between a tree to a table-like Inish or a prostrate spreading slirub ; while in cultivation it may hint- a crown that is columnar, pyramid;! 1, hemispherical, spherical, spreading, prostrate, or " weeping."

*Jttttipcrm comtmmis* v;ir. *nana*

This Alpine and Arctic variety is a spreading shrub, inclined to be prostrate, and **never** excelling one yard in **height,** Its needles differ from those of tlk **coramOD** form in being pressed against the stem, and in being shorter, blunter, and usually curved.

It is even more slow-growing ttian the Common Juniper; for instance, the stem of one plant, though sixty years old, had **wood** only about two-fifilis of an inch thick.

The Dwarf Juniper has a very wide and discontinuous distribution, being found high up mountains in Europe, Asia, North Africa, and **North** America (even at 10,000 feet in the Swiss Alps), and occurring far north on plains within the Arctic zone.

Its very clo.se relationship to the Common Juniper is shown by the fact that in Lapland where both forms occur all kinds of intermediate links between the two present themselves. When cultivated high up the Alps the Common Juniper assumes the shape of the dwarf variety; while conversely the Dwarf Juniper, when cultivated in the plains of Central Europe, takes the habit of the common variety.

Among other Junipers seen in gardens, *J. Oxytcdrus* differs from /. *commwnis* in having red <>r reddish-bruu-n fruits; while /. *Sabina* (wit b bluish-black fmits) ami *J. pkvnicta* (wilU ml fruits} possess cypress-like foliagt- in **addition to** painted needles.

Fig. 168.-Fruits of Juniper.

# *TAXACEJE*

## TAXUS BACCATA *(Linn.).*—COMMON YEW *(Taxacecs)*

The Yew differs from all the trees previously described in the structure of its fruit, which cannot be described as a cone. The fruit has no woody or fleshy scales, as it consists of a single seed standing fully exposed within a red fleshy cup *{aril).* The tree is further recognisable by its dark green flat leaves, which are posed on the branches in two ranks, just as in the Silver Fir, but show no white lines.

*Fig.* 169.—Bark of Yew.

Fig. 170,-Male (£] and Female (?) Flowers of Yew.

**The** Vtw is a deep-rooted tree rarely exceeding forty-five feet in height, and it is often **scarcely** more than a **bosh.** Even low down the deeply channelled trunk there are attached relatively slender bouglis, which spread horizontally or in-**eEne** upwards, and bear thin pendent branches and branchlets. The shape of the crown varies greatly.

As the trunk becomes very **peculiar** in structure we must here consider the

**Brnnciilng.**

method of branching. In the axils of many of the spirally-arranged leaves buds arise each year, and in **the** following or even in the same season those near the tip of the year's-shoot grow out into branches, which are not arranged in false whorls. On horizontal and inclined shoots the branches spring preferably but not ex-**dusively** from the: flanks. But the Yew possesses great powers **ai** throwing **out** additional branches. These can spring from the **aumerqns** buds that have remained dormant i<>r years, or from " secondary" buds *(sec* page 104), or may take origin from buds that arise **at** indefinite points nn old parts of the trunk. Thanks **largely** do these last, one often **sees groups** of shorter or longer **branches** clustering **at** or above the base of tile trunk. To its great capacity of producing new shoots the Yew owes **a power,** unusual to a conifer, of enduring and repairing **in-juries;** and to this power is due its successful **employ-**nunt to form cropped hedges or tnx'S fashioned into various shapes.

As a special example of thu throwing out of branches we may describe **the** development of the trunk. Comparatively early

**Trunk.**

in life some of the brandies on the main stem tend to grow t:rert and give to the tree se\vr.il " loaders " in place of the single leading main shoot. This **development** of several strong branches in itself is probably partly responsible for the ridges shown by the trunk; but the ridges later in life have another origin. When the tree has reached an age of between one hundred and two hundred years, and its main stem has ceased to grow in length, the latter becomes encircled by numerous erect stool-shoots that spring from its base. These grow up, thicken, and eventually coalesce with the main trunk and with one another to form a single, ridged column, which Ls therefore no true trunk, hut a collection of fused stems. According to one authority the Yew retains

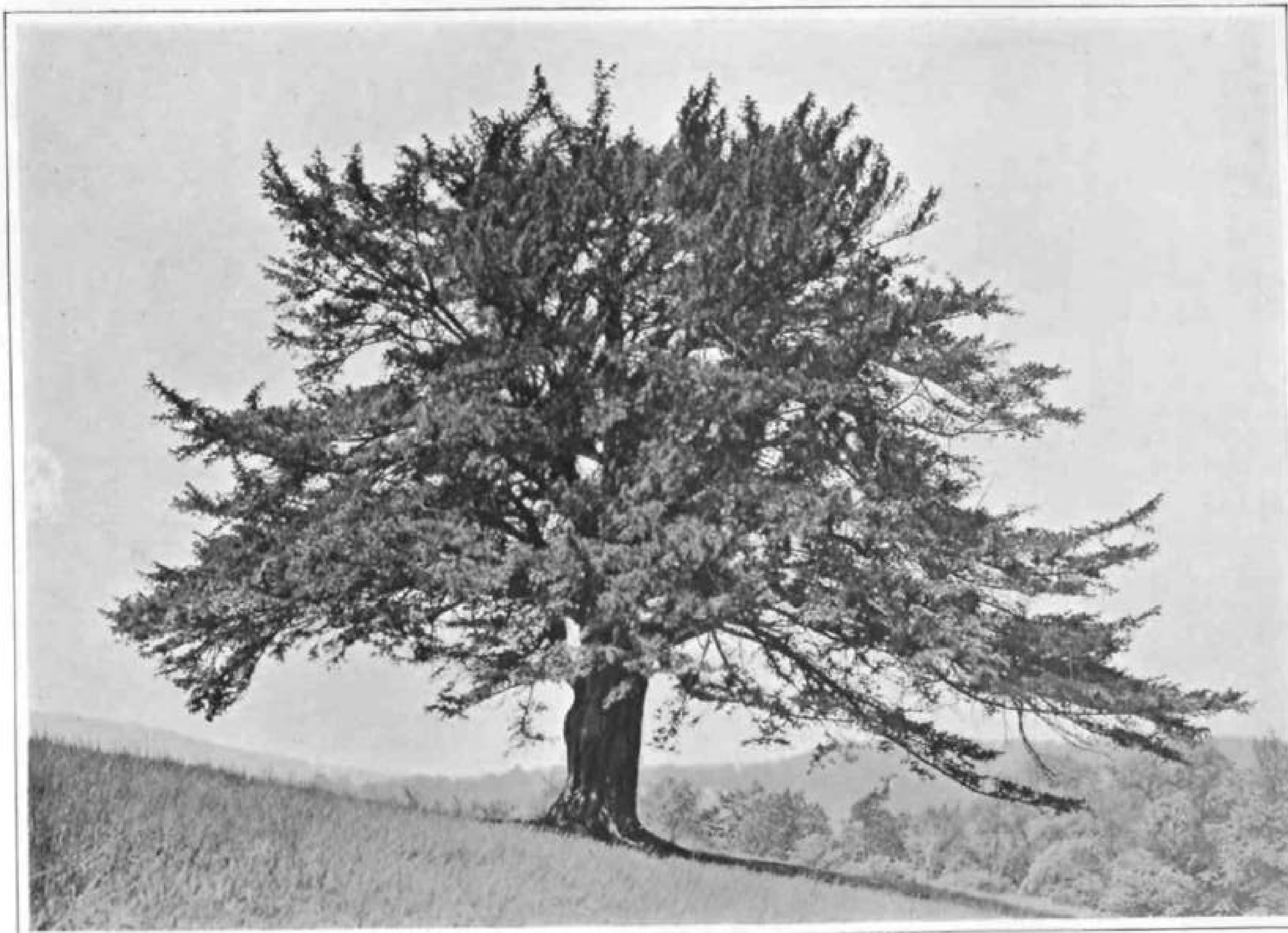


Fig. 171.—COMMON YEW—*TAXUS BACCATA.*

its true trunk for, at most, two hundred and fifty years. The false trunk may attain a great thickness and lend to the tret: a partly spurious appearance of antiquity. The thickest wliich I have seen—that at Gresford in North Wales, in 1888, measured more than thirty-two feet in circumference at the height of four feet.

The extremely slow growth in length (as well as thickness) of the Yew-shoots corresponds with the circumstance that among conifers in Europe this is the tree that endures the deepest shade.

And the red-brown bark (Fig, 169) reflects the same character, as it is thin and flakes off in delicate papwy platpies,

**Leave*.**

The foliage, too, tells the same story, as the dark green leaves remain **attached** for from four to eight j'ears, and, inasmuch as the branching is copious, the tree casts so deep a. shade that a Yew-forest is especially gloomy and sustains the scantiest of vegetation on the ground. The narrow, pointed, **flexible** leaves are flat; on the leaf the stomata. are confined to the lower face, which, nevertheless, is not marked by wMte lines, though it is paler than the upper face. The **leaves** are all solitary and spirally arranged, and **each** is continuous, with a ridge running down the twig. On erect shoots **they** radiate in various directions, but on horizontal or inclined branches they are twisted so as to form two ranks ranged in one plane like a double-comb (Fig. 170).

The little re&ting-buds are scaly, but not resinous. (Often hrge light green buds **with** radiating iiwes are to be **seen** on the branches : these are **deformities** produced by a small Hy, *Cecidomyiu taxi.)*

**Flowers.**

The Yew commences to produce its **male** and female flowers, which are on diSerent individuals, at the age of twenty years. The Bowers, which are initiated in autumn, do not open until the early spring (February to April) of the following year; they are produced regularly every year. The solitary, open flowers occur at the ends of little scale-bearing branches, which are borne on shoots produced during the previous season, the males being arranged underneath the foliage of the supporting shoot.

**Male Flower,**

The globular yellow male flower (Fig. 170, *$* ) terminates a very short stalk that is clothed with brown scales. It has from six to fifteen spirally arranged stamens, each of which is shaped like an umbrella, with from fiw to nine pollen-sacs hanging down yet fused together by their sides. In dry weatlu-r the umbrella opens, the pollen-sacs **are** split, and the bladderkss pollen escapes.

**Female Flower.**

The so-called **female** flower {Fig. 170, $ ) in appearance resembles a green bud, and lias a stalk clothed with scale-**leavCS,** This short branch is not in reality the flower itself; for on its stem, above the two first scales, there


**Pig, 172,—Ha lf-ripe Frufts of Yew.**

FIS' 17J. - Ripe Fruits of Yew.

are from eight to thirteen spirally-arranged scales, and in the axil of the uppermost **arises a** tiny branch which pushes aside the true end. The tiny branch bears three pairs of opposite scales, and ends in a solitary **ovule** ; the branch itself, or **the pvule** alone, may be regarded as being the true flower, but in the formation of the fruit the **scales** take no part (contrast a).l the conifers **previously** described). Tin; minute erect ovule projects **freely** from the bud-likt- collection of scales, and shows a drop of **liquid** oozing from its mouth. Just as in the Juniper and Cypresses the drop of liquid serves to detain pollen grains blown on to the **ovules.**

Fruit.

After pollination **a** little ring-like growth becomes clearly **visible** round the base of *the* enlarging' *ovule,* and as this grows the haU-ripe **fruit** (Fig. 172) resembles a green egg in a green egg-cup. The ktter enlarges more vigorously than the developing seed, and in October or November has become a red, **bloom-coated** cup ("aril"), within which stands the brownish-black seed (Fig. 173).

Dispersal.

The seeds are dispersed by birds, which, attracted by the red pulpy **atili peck** this or swallow **the** fruit; the seed is protected from digestion inside the bird by its hard, woody shell. Here again we note that the fruit remains green and inconspicuous until the seed **i&** **ripe,** when it becomes brightly coloured.

In germination the two green cotyledons and the succeeding leaves **are** in shape very like the ordinary foliage-leaves.

Aire.

The Yew-tree may attain a great age, but the **ages** assigned to old specimens are not reliable, for two reasons ; first, tiie stem is a false one; secondly, the annual rings of the red heart-wood are so narrow as to render their enumeration difficult.

Distribution,

Distributed widely in Europe, Asia, and North Africa, it usually occurs isolated among other trees, only rarely forming forests of its own. Yet the Yew is far from **exacting** in its **demands.** Although it endures deep shade, and as a seedling cannot withstand much direct sunlight in the open, the tree may **yd** be seen on **sun-bathed** rocks thrusting its roots into crevices. Indifferent to frost, it is able to grow on most soils save parched sand. Man lias probably been **responsible** for its relative scarcity ; and its **survival** near old castles and villages is a relic of its mediaeval **employment** in the manufacture of bows.

The Yew is the solitary conifer completely devoid of resin, and apparently tlie only one containing considerable amounts (>f a {)oisonmis alkaloid (taxin). Despite of this poison the leaves and twigs'* are gnawed by stags, goats, horses, and cattle, which gradually accustom themselves to this diet.

Poison.

One variety of the Common Yew has an orange-coloured aril to the fruit; another, the Fastigiate or Irish Yew, is characterised by numerous erect branches with radiating leaves, and by its column-like shape; still other **garden** varieties assume weeping, dwarf, rounded, or prostrate shapes, and have **leaves** that an- self-coloured or variegated in yellow, gold, white, and green.

Varieties,

## GINKGOACEiE

### GINKGO BILOBA *(Linn.)*.—MAIDEN HAIR-TREE *(Ginkgoacetr)*

The Maiden hair-tree **is** instantly recognisable by its deciduous, **partly** tufted leaves, **which** are shaped somewhat like the fronds of a Maidenhair-fern.

This beautiful tree is by no means commonly cultivated in England, but a? it is perhaps the most interesting tree in existence, a very **brief** account is **given here.**

Pig. 174. - Shoots of Maldtnlialr-tree.

The deciduous leaves are spirally arranged, and solitary on the **tang-shunts,** but tufted on the **dwarf-shoots** (Fig. 174). **In** the pattern of its vein ing the fan-shaped leaf is quite unlike that of a **dicotylous** tree, as the radiating veins are repeatedly forked. Tlie dwarf-shoots, as in **Larches** and Cedars, may give up their slow, **stunted** mode **of growth,** and develop as long-shoots.

Leaves.

The male and female flowers are on different trees und spring solely from dwarf-shoots. It is not decided as to what exactly constitute **a** single flower on **this** tree.

r lowers.

f 'П- i?S- Twig of Maidenhair-tree in Winter, The stamens are arranged along a long axis to form a catkin-like collection (Fig. 176). which arises in the axil of a scale on the dwarf-shoot. Each stamen has a long stalk, and bears at its summit usually two (two to iour) pollen-sacs.

yellow or yellow-green, plum-like seed* which has a fleshy outer coat and a s^ hard timer shell. Thus the seed is adapted for dispersal by animals.

*Ginkgo* is a solitary species of a solitary genus that represents tin? family Ginkgo-;ici',f, which in past ages included many species and some genera. Formerly the j,r('nns *Gik&go* was widely distributed over Europe, Asia, and North America, but now its solitary species may be extinct as a wild plant (excepting possibly in thf interior of China), though it is cultivated near temples in China and Japan, whence *come* the? trees now growing in European and North American gardens.

Fig. 176.—Male Flowers of Maidenhair-tree.

The ovutes are fully expn^'d, and arranged at the summit *at* ivl.iiivily long stalks, which arise in the axaJs of the leaves on a dwarf-shunt. On the stalk two ovules sre opposed ; and i-arh is suirounded at its bn*- by an aril-like collar.

Pollination by the agency pi wind is succeeded by fertilisation, which in type is intermediate between that of a Flowering Plant and of a Fern.

The ovule cttanges into a freely exposed

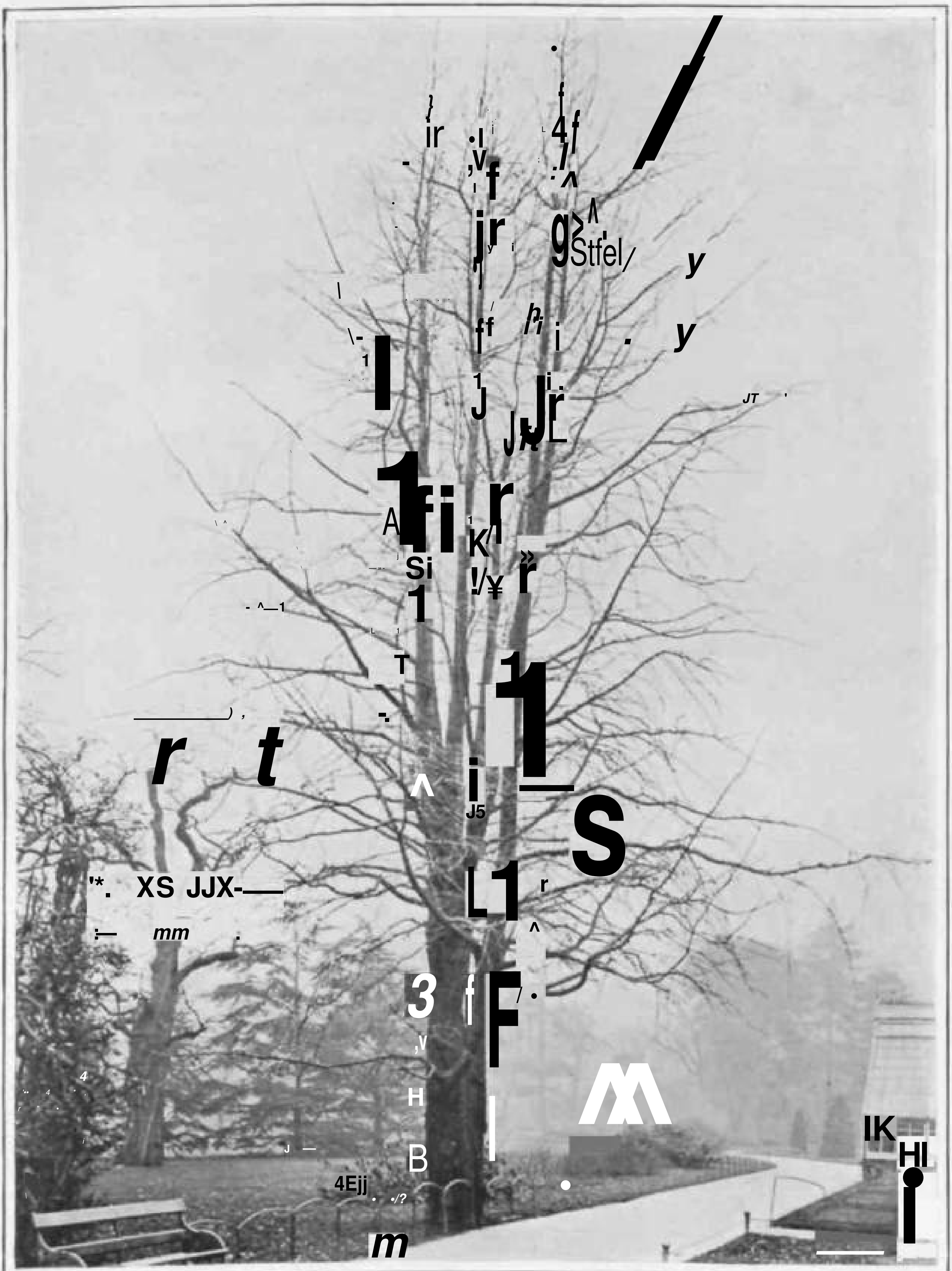


Fig. 177- MAIDENHAIR-TREE-OI/VOHrO *HILOBA:* WINTER.

Pi*. 17&-MAIDKNH AIR-TREE—*UINGKO BILOBA:* SUMMER.

K

# DICOTYLEDONES

THE subjoined table will enable the reader to take the first steps towards the identification of the various dicotylous trees described in this book, by denoting the families to which they belong. All these have their ovules and seeds enclosed in ovaries.

## GROUP I.—NO PETALS

(In this group the flowers are small and inconspicuous, as they have no showy petals.)

I. Flowers unisexual : male flowers in catkins.

(A) Leaves simple, alternate, stipulate.

1. Male and female flowers on different trees. Ovary one-chambered with many ovules. *Fruit* opening, and *containing many cottony seeds* . . . . . . Willows and Poplars (p. 147

2. Male and female flowers on the same tree. Ovary two- or three-chambcrcd. Fruit one-seeded, not opening, nut-like or winged . . . . . . . . *Fagales* (p. 178).

3. Male and female flowers on the same tree. Ovary one-chambered. Collection of fruits forming a " mulberry " (somewhat like a blackberry-fruit) . . . . Mulberry (p. 243).

(B) Leaves *pinnalely compound, alternate, without stipules. Pith chanibeved.*

4 . Fruit, a walnut . . . . . . . - • Walnut (p. *237).*

(The Ash-tree has pinnately compound leaves, but these are opposite and without stipules. Moreover, though the flowers have no petals, they arc not arranged in catkins.)

II. Flowers unisexual, but not in catkins.

5. *Inflorescences and collections of fruits spherical* and attached to long, hanging stalks, Leaves *alternate,* palmate (with tubular stipules when young), *concealing the lateral buds within the base of the leaf-stalk. Bark peeling in large plaques* . . . . . . . . Plane (p. 25S).

(The Beech-tree has its flowers arranged in somewhat spherical " heads.")

6. Inflorescence stalkless in the leaf-axil with a central female flower surrounded by many male flowers. *Leaves opposite, evergreen,* stiff. Fruit opening by three valves Box (p. 26O.

III. Flowers bisexual.

7. Flowers appearing before the leaves in tufts. *Fruits in tufts, one-seeded, fiat, with a wing on each side.* Leaves alternate, simple, stipulate, toothed . . . . Elms (p. 249).

[Flowers appearing before the leaves. *Fruit* one-seeded, *strap-like,* with one *terminal wing.* Some flowers are unisexual. *Resting buds black. Leaves pinnately compound, opposite.* Ash (p. 384).]

## GROUP II.—SEPARATE PETALS

I. Flowers hypogynous.

*(a) Stamens numerous.*

8. *Inflorescences and fruits joined to a prominent strap-like bract.* Leaves alternate, stipulate, toothed. Resting buds " hump-backed " . . . . . Lime (p. 269).

{*b*\ Stamens not more than twice as many as the petals.

*[a) Flowers irregular.*

9. Stamens seven to nine. *Leaves opposite, palmately compound.* Resting-buds large. Fruit opening by three valves. *Seed very large* - . . . . . . . . , Horse Chestnut (p. 296).

(For other irregular flowers with separate petals, *see Papilionacea.)*

($) *Flowers regular,*

10. Stamens seven or eight (usually); a disk present. Leaves *opposite,* without stipules, *simple, palmalely-lobed* (except in one case). *Fruit IWo-chanibeyed with two strap-like wings* . . . . . . . . . . . Sycamore and Maples {p. 276).
11. Stamens four or five, alternate with the petals ; no disk. *Leaves evergreen, mostly prickly.* Fruit a " holly-berry " Holly (p. 305).
12. Stamens four or five alternate with the petals ; a disk present. Leaves opposite, simple, with small stipules. *Fruit opening and showing the seeds, each encased in an orange-coloured fleshy " aril "* . . . . . . Spindle-tree (p. 309).

**II.** Flowers perigynous.

(*a*) *Flowers irregular.*

13. *Stamens ten, of which all or nine are united by their filaments. Shapes of the petals characteristic.* Fruit a one-chambered dry pod opening spontaneously . . . . . Some *PapilionacetE* (P. 321).

(*b*) *Flowers regular.*

14. *Stamens four or five, opposite to the very small petals.* Ovary two- to five-chambered . . . . . . . *Rhamnacete* {p. 314).
15. Stamens numerous. Ovary one-chambered. Fruit a one-seeded stone-fruit . . . . . . . . Some *Rosacea (Primus) {-p.* 331).

**III.** Flowers epigynous.

16. Flowers regular ; stamens numerous ; ovary one- to five-chambered. Leaves alternate and stipulate . . Some *Rosacea? (Pyrus,* etc.) (PP- S3[1]- **347).**
17. Flowers regular ; stamens four or five, Leaves opposite, without stipules. . . . . . . . *Cornus* (p. 3S0).

GROUP III.—PETALS JOINED

18. Flowers hypogynous ; stamens two ; petals sometimes absent, as in the Common Ash. Leaves opposite . . *Oleacem* (p. 384)
19. Flowers epigynous ; stamens four or five. Leaves opposite *Caprifoliaceai* (p. 391).

# SALICACE/E. WILLOW FAMILY

THE Salicace;e include only the Poplars and Willows, all of which are *woody plants with alternate, simple, stipulate leaves.* The *male and female flowers occur on different individuals,* not upon the same tree. The *inconspicuous, unisexual flowers are ranged in catkins.* Each of the numerous flowers composing the catkin- stands alone in the axil of a bract (catkin-scale), and is devoid of any petals or distinct sepals. In the Poplars a basin-like envelope surrounds the stamens or ovary, while in the Willows this envelope is represented by a number of usually isolated outgrowths, which are nectaries. The stamens of one flower vary in number. But the pistil is quite constant and characteristic in its main features. It is composed of two carpels which are joined together to form an *ovary that is one-chambered* and *has two vertical lines of many ovules on its walls.* The ovary changes into a dry fruit, whose wall splits longitudinally downwards (usually along two lines) and exposes the *numerous cottony seeds.* Each seed has at its base a tuft of hairs that acts as a sail and facilitates dispersal by wind (Fig. 180).

There are other families, including those represented by the Oak, Hazel, Mulberry, and Walnut, that have catkins. From all these the Salicacete differ in the characteristic structure of the ovary and fruit and their cottony seeds. They are also peculiar in

**Fig. i?(>.-AlaU; Catkins of Aspen,**

having the male and female flowers on different individuals.

In stature they **vary** from tall Poplar-trees down **to tiny** Willow-plants forming a **sward over** which we am **wails** »n the m< aw tain-tops in Scotland,

The important. Poplar - trees and Willow - trees show two tendencies or CSVCD characters; first, their strong demand for light; **secondly*** their fre-fjii> iit presence near water-courses. So that trees of both kinds are, or tend to be, trees of the open **country** or to occur onlv here and there in woods.

As regards pollination Willow - trees and Poplars contrast. As the former are insect - pollinated their nectar-producing flowers are arranged in more or less **erect,** often quite conspicuous inflorescences, and the pollen-grain* **have** a rough **sculptured** surface and thus ding to insects: whereas tin- **Poplars** are wind-pollinated, so that the male (and **even the** female) catkins are seen dangling and **swaying** with the breeze ; the flowers are nectarless, the pollen is smooth, and the stigmas are well developed.

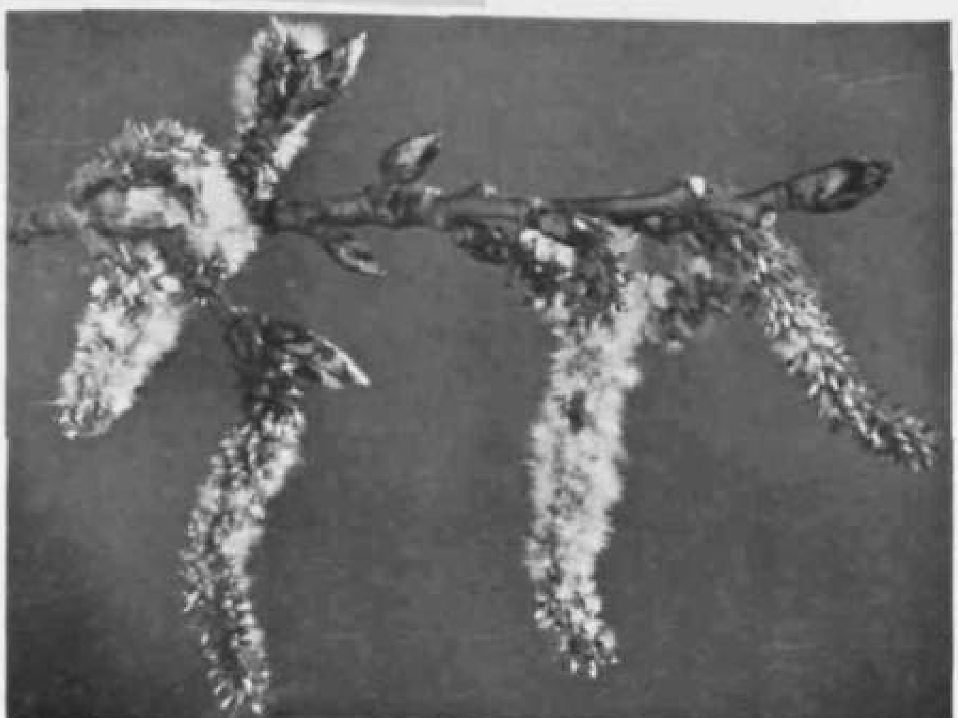


**Fig. 180,-Escaping Seeds of Aspen.**

Poplars and Willows can be distinguished by their leaves, resting-buds, catkins, and flowers, thus :—

*Populus* (Poplars): Leaves usually broad and long-stalked. Resting-bud showing several scales. Bracts (catkin-scales) more or less fringed or toothed. Flower with a basin-like envelope. Stamens in one flower, usually more than five» often numerous.

*Salix* (Willows): Leaves usually narrow and short-stalked. Resting-bud showing only one scale. Bracts (catkin-scales) nearly always devoid of any incisions. Flower with no basin-like envelope, but with one or more glandular outgrowths (nectaries). Stamens in one flower, usually from two to five.

## POPULUS. POPLARS *(Salicaceee)*

In this country there are four common kinds of Poplars : the Aspen, the White, Grey, and Black Poplars, in addition to the less common Canadian and Balsam Poplars and some rarer species.

An account of the general architecture and mode of growth of Poplars is given in this book in connection with the description of the Black Poplar ; and this account holds good for the other species, excepting as regards details which are explained in the respective descriptions of these. It may be noted that, in contrast with the Willow, the terminal bud of a shoot often continues to grow in the following season, though this is by no means always the case (as is often stated).

The different kinds of Poplars can be distinguished by seeing : (1) Whether the bark remains smooth and light-coloured for a long time or becomes furrowed early in life. (2) Whether the resting-buds are dry and hairy, or are hairless and sticky. (3) Whether the catkins are furry (because their scales have many straight hairs) or are not furry. (4) The illustrations of the leaves belonging to the different species may be consulted. The subjoined table will facilitate identification.

POPULUS

| | *Bark in Early Life* | *Resting-buds* | *Catkins* | *Special Characters* |
|---|---|---|---|---|
| *P. alba* (White Poplar) | Smooth and light-coloured | Dry, white, hairy | Moderately hairy or feebly so | Snowy buds, twigs, and under-faces of leaves, which are lobed and unlobed. |
| *P. canescens* (Grey Poplar) | Smooth and light-coloured | Dry, grey, hairy | Furry" | Some hairs on the lower face of the leaf that are grey or in patches. |
| *P. tremula* (Aspen) | Smooth and light-coloured | Sticky (more or less) ; not hairy, or slightly so | Furry | Leaves finally smooth. |
| *P. nigra* (Black Poplar) | Rough | Hairless, sticky | Not hairy | Leaves hairless, regularly toothed. Twigs not angled nor with cork ribs. |
| P. *canadensis* (Canadian Poplar) | Rough | Hairless, sticky | Not hairy | Leaves hairless. Twigs angled with cork ribs. |
| P. *balsaniifera* (Balsam Poplar) | Not so rough, but fissured and dark-coloured | Hairless, sticky | Not hairy | Leaf hairless, under-surface whitish ; leaf-stalk not laterally compressed. Twig coarse, not slender. |

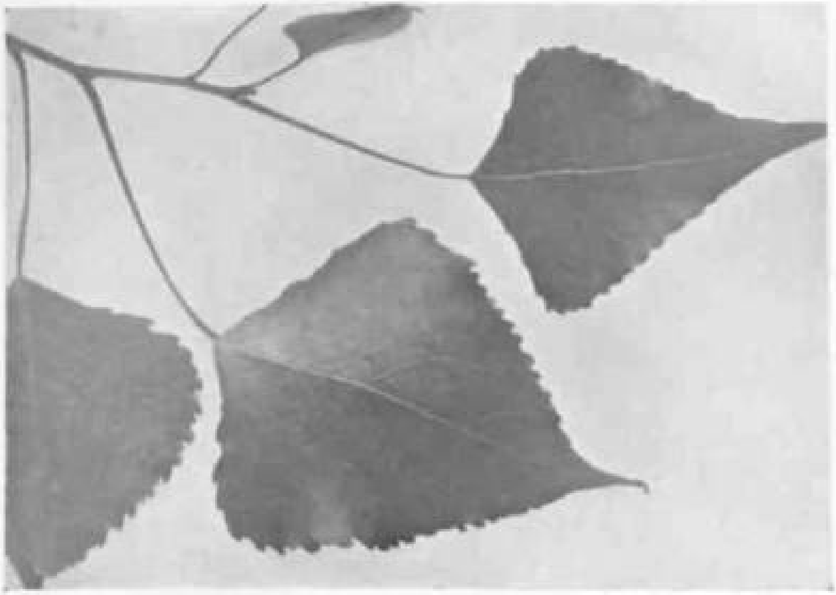
POPULUS NIGRA &*&-*** ?ovM *(Salicacca-)*

The chantctcrs by which this Poplar is d^tmguished from.others **liave** been given in the preceding table. As *Popalns nigra* shows two common forms, the Black Poplar roots which **associate** it with a deep **SOS,** ils wd, M ^^ horizont: **<**• roots wMdj — ^^ up into the air. In Edition **to possessing**

**Fig. iai.-Bark of Black Pop|ar.**

(Fig8. « **j 4** and UmtariSr **or** P»™M.I **Pophr** (Flg5_ to, **II),** we shaU at first descnbe the former vanety.

The Black Poplar has deeply descending this pow, « produci ng sw :kers, the tree CM. easily emit sh,x.ts !>,,,,, its **cat** su,n,,, or from the **Inn** , *t* . *. * ^ of ltS ***** trunk.



l-lg. 183.—Leaves of Black Poplar.

the Balsam Poplar, whose petioles are not **Battened** and whose twigs arc thick). **Secondly, the amount** of **water** evaporated from the **leaves** is **greatly** increased by their movements. Tlitr **golden,** dead leaves are described as being shed in November, but **(especially** in. fine, dry **weather) they** may commence **to** fall early in September. The tree **also** sheds **(oliaged** twigs, which often exceed a yard in length and are separated by a carefully prepared device simiLn to that employed in connection with **the** casting of leaves, so that the scar left by a fallen twig is **dean** and protected in place of being jagged and open to the attack of fungus.

**Trunk.** The trunk, quite early in life, becomes clad with a thick, rough, longitudinally fdirrowed *»*k (Fig. 181). Before the tree lias attained any great height the upper part of the trunk is already obscured by the vigorous developntent of boughs that incline upwards. The tree **rarely** exceeds 100 feet in height. The lop-sided crown, which varies in shape, is loosely branched as regards its ascending boughs, but includes numerous smaller branches, so that it casts fair shade.

**Leaves.** The- spirally arranged leaves (Fig. 182) are variable in form and in margin, but are always regularly toothed and devoid of hairs. The under surface of the **blade** is **approximately** ol the same **hoe** as the upper face, and thus contrasts with the likewise hairless foliage of the Balsam Poplar. The stipules fall very soon from I lie unfolded leaf. The long **petiole** is characteristically flattened, like **a** narrow ribbon, so that the leaves hang slackly (Figs- 182, 13) and quiver with **the** least breath of wind. The result is double. First, the leaves oppose but little resistance to the wind, so that the slender twigs carj withstand the strain of the latter (in this respect again contrast is provided by

**Twijjs.** **The** tapering rest ing-buds (Fig. 183), ;md the one - year - old twigs are glossy, \\: lluw-brown, and hairless. The twigs (Fig. 183) are cylindrical (not ribbed with cork as in the Canadian Poplar), but are raised into promineiuvs formed by the leaf-cushions of fallen leaves. The lower parts of the lateral buds are pressed against the stem. One peculiar feature in these merits notice: instead of

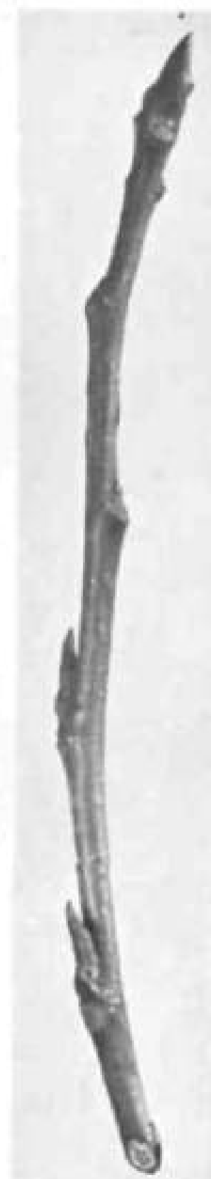


**Fig. 183.— T*iK»f Black Poplar in Winter.**

Fig. 184- BLACK POPLAR- *POPULVS MORA* , WINTER.

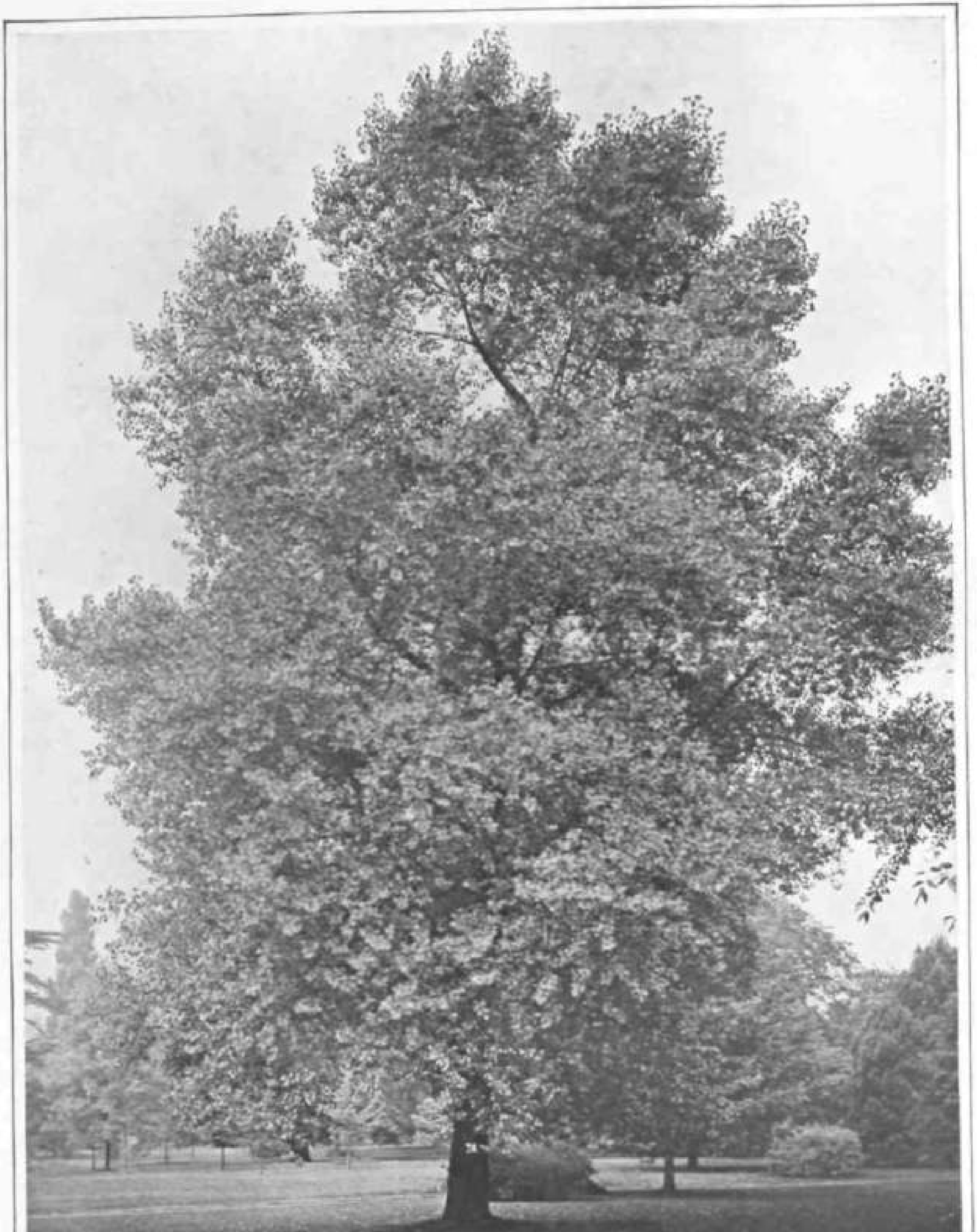
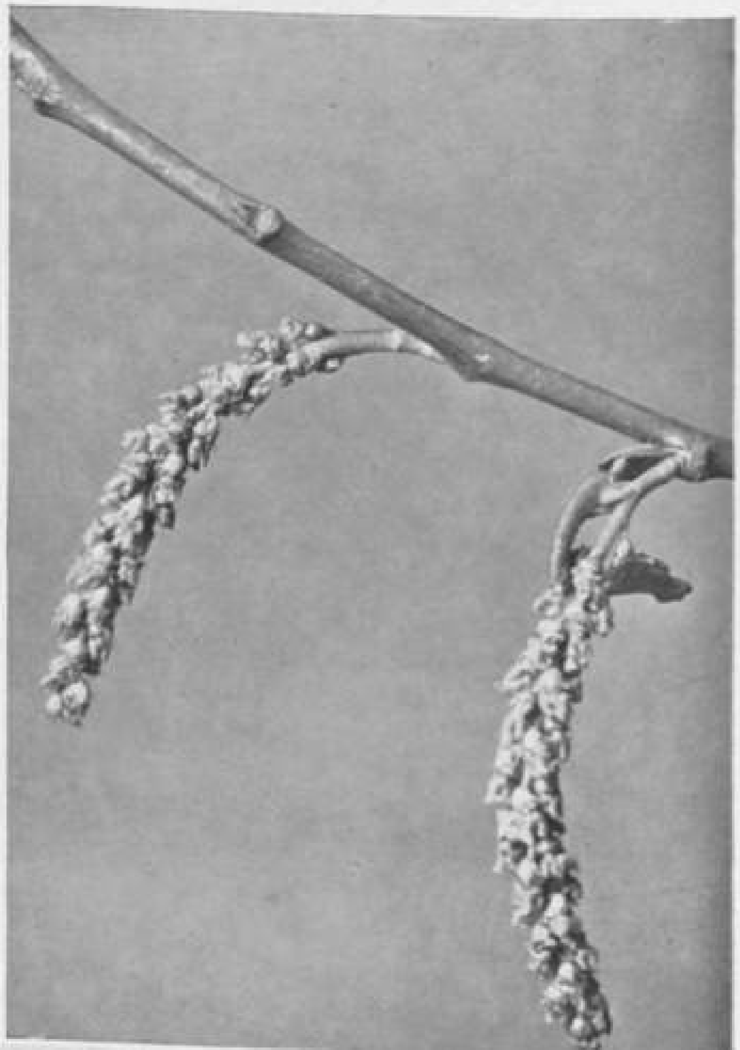


Fig. 185-BLACK POPLAR-POP*ULUS NIGRA:* SUMMER.



**Pig, 187.-Female Catkins of Block Poplar.**

producing at first two scales on its **flanks,** the stem produces on its outer **(lower)** face a single scale which is more or less clearly two-keeled (compare Fig. 189). This is succeeded by three more scales, all four being **alternate,** but ranged in two ranks ; then succeed spirally arranged leaves. When the buds awaken into activity they glisten with balsam (which is collected by bees). As they open the four scales fall, as do the stipules of the unfolding foliage-**leaves,** which force their way out and show themselves shining with sticky balsam. The lateral buds grow out into dwarf-shoots or inflorescences, but the uppermost bud develops into a long shoot which grows throughout the summer until it may be nipped off by frost. In the following year the growth is taken on by the highest lateral bud, which usurps the position of the true terminal one.

The dangling, cylindrical, catkin-like inflorescences open in March or April, the male and female flowers bring on different **individuals** and visible weeks bi'foiv tin' leaves emerge.

The inflorescences thus are borne as branches on twigs produced during the pre-

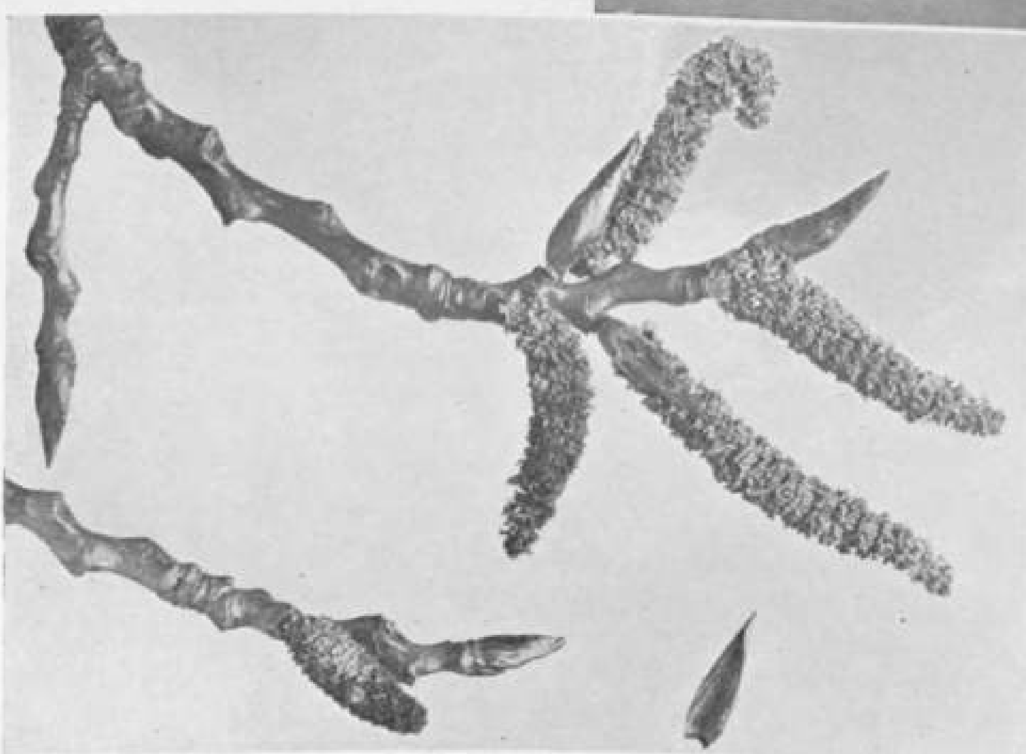


**Fig. i86.-Male Catkins of Biack Poplar.**

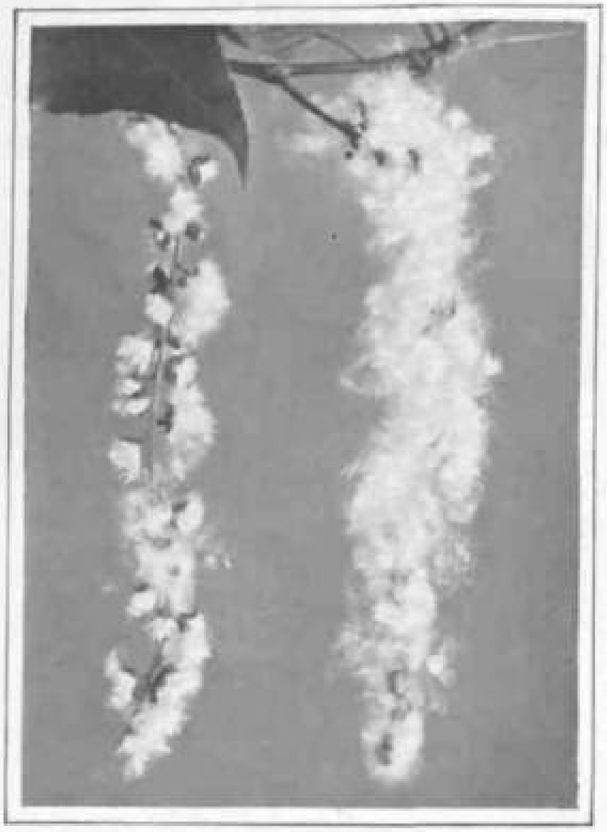


Fig. 188.—hlscaping Seeds of Black Poplar.

ceding season. The buds producing them are in design like vegetative buds, except

**Flowers.**

flint the four bud-scales are succeeded by spirally arranged bracts (catkin-scales). Each catkin-scale broadens from its narrow base and frays out at its terminal margin into a ragged fringe, which, however, is devoid of the long, straight **hairs** that characterise the catkins of the White Poplar and **Aspen.** In the axil **of each** bract is a single **flower.**

The yoitng male ait kin includes many red flowers crowded **along** its axis. Each short-stalked flower shows a shallow, oblique, basin-like "envelope," occupied by **thirty** to fifty red anthers, which are nearly sessile. The young catkin does not hang **down,** but as its axis elongates, thus separating the flowers, it eventually droops over; the catkin-scales are then shed, while the filaments of the anthers elongate rapidly and **thrust these out** of the basin (Fig. 186). Thus the wind easily sways the lax catkins and blows the pollen from ihe protruding open anthers. The **anthers shrivel and** turn brown, and the whole **catkin** falls soon—niton, in **feet, before** the pollen has been shed.

The design of the female catkin is similar (Fig. 187). But tlie basin-like **envelope** of **each flower** surrounds the base of a single ovary, which is surmounted by two **relatively** large, thick, yellow stigmas that are shaped tike arrow-heads. The ovary is one-chambered, and bears numerous **minute ovule?** in two vertical series on its wulL

After pnlkm lias been conveyed to the **stigma** by **the** wind, the axis of the female

**Fruit.**

catkin elongates, the ovary develops into **a** dry, yellow-brown **fruit,** whose **thin wall** splits along two longitudinal lines midway between the lines of **ovules,** and thus gives rise to a two-valved fruit containing many cottony seeds. Each minute seed has a tuft of cottony **bails** at its base. Thus in Slay or early June **the** ripe catkins hang with snowy white fiuff clinging to them (Fig. 188).

The **fiufiy** seeds are transported by the wind. They contain no endosperm.

One prominent character of the tree is the frequent production of "burr-wood," ;; " ,, with decora-

**" Burr-wood."**

**live bird V eye" marking.** This burr-wood arises in **connection with** the huge **tumps** visible on the outside of the trunk (Fig. 181}. The cause of (III- development **oi** these is incompletely known, but each is largely constituted of exceedingly numerous buds **that** develop extremely slowly. As the *Mrm* of each bud should have concentric wood like that of a single stem, the burr thus constituted is like a confused complex of

I" 189.—Bud "IR;, **of Lombard?** Poplar

**little** stems joined together, but radiating in different directions.

This tree, though not a native of Great Britain, is familiar especially on **the** banks of water-courses, but is not confined to wet soil. It demands a considerable amount of direct light, as is suggested by its exceedingly rapid growth during juvenility, its loose main branching, and its thick furrowed bark. Thus the Black **Poplar** is **a** tree of the open country, or forest-edge, while it is suppressed in the shady woods.

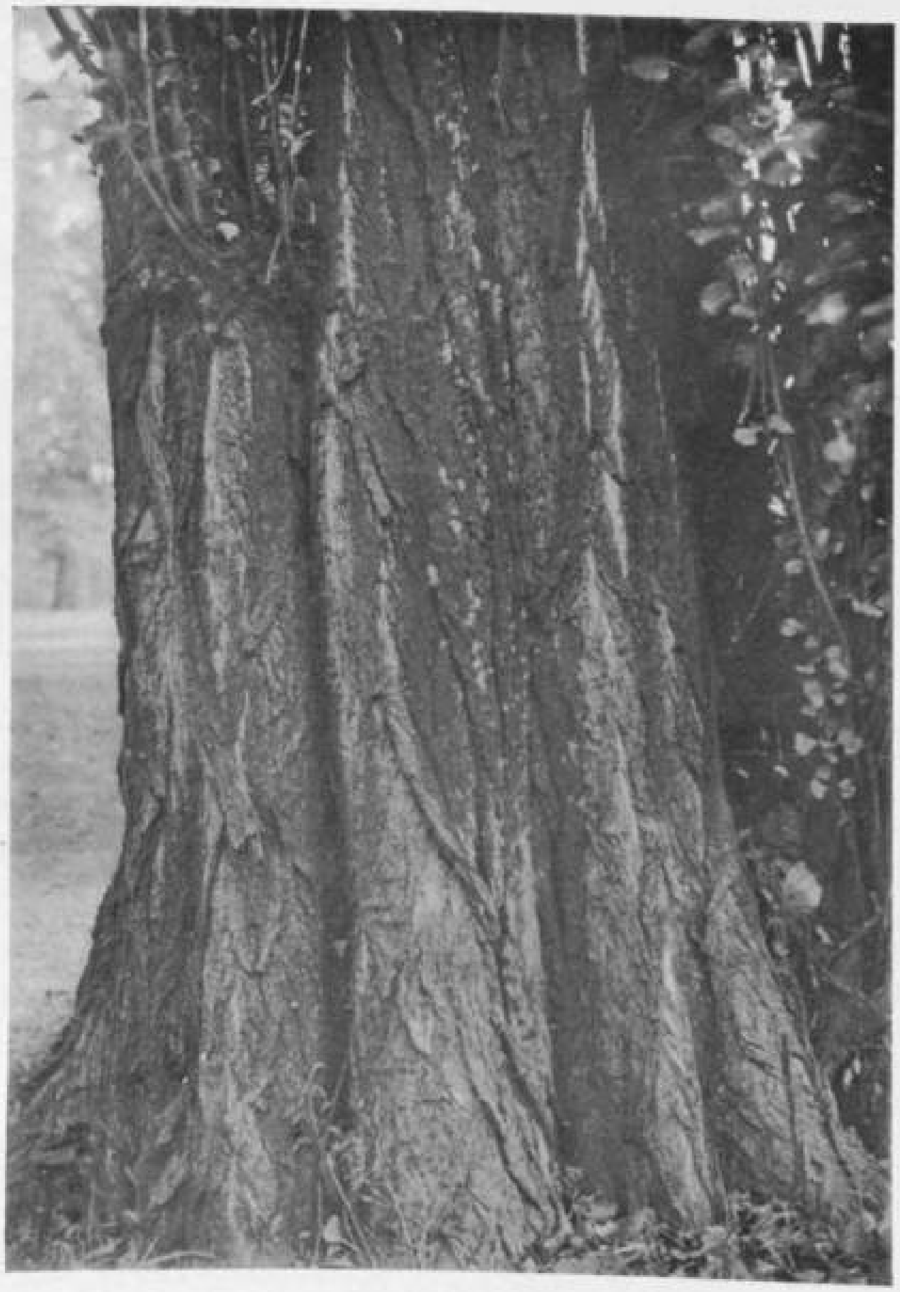


Fig. 190.—Bark of Lombardy Poplar.

The *pyramidal variety of the Black Poplar,* which is often known as the Lombardy Poplar, differs by its columnar habit, **the** tall stem being concealed by numerous erect branches, **which** in open situations clothe **the** trunk almost **to** the ground (Figs. 10, 11). Though the **lateral** buds on the erect branches are spirally arranged, only those on the outer, exposed faces shoot out.

This tree affords a good example of the influence of light in **determining the** sprouting of buds, for if we bend down a branch tlu< buds that sprout are **those** on the now illuminated inner (upper) face. Another **characteristic** feature of the tree is the deeply ribbed base of the trunk (Fig, 190). With the exception of a few specimens * -ultivated in a few gardens, **all** the European specimens are **male** plants, so that the Lombardy Poplar is propagated solely by **cuttings.** Its stringent demands for light are clearly indicated by the behaviour of trees growing among others; for these shed their lower branches up to the height at which they are free from shade. In details this tree closely resembles the Black **Poplar, with which** it can apparently produce variety-hybrids.

## POPULUS TREMULA *[LhmX*—Asr&x *{Salicacea)*

The Aspen **differs** from the Black Poplar id its bark, which remains smooth for **a** long time, in the shape of its leaves, and m having furry catkins. In general characters the Aspen agrees with the **Black** Poplar, so that in **the** following description at tent km is directed mainly to points in which the **two** are not alike.

The root-system is very shallow and spreading, and readily **throws** up **rofcrt-**suckers, **which** may even **appear years after** the tree has **been** irll.d.

Thy straight trunk retains its light-coloured (yellowish or greenish grey) **smooth** bark for many years (compare Fig. i<>8), but **later** becomes fissured (Fig. 104), and eventually thick ;ind deeply furrowed.

The tm- is <f moderate statmv, being usually from forty to **eighty** f«et in **height,**

**Dimension* and Form.**

**showing** .1 trunk only about & foQt ^ di›imt·u·r- **ft** js tht· **smallest** of the Poplars **common** in England. Its thin and usually small **crowfl is commonly perched some height** up the trunk, even in open situations, and **has few and** slender branches, is scantily foliaged, and therefore casts but little shade. The tree has a limitrd power of emitting additional new shoots from either its **branches** or bole, so that in this respect it is **largely** dependent upon the roots.

The **stipulate** leaves (Fig. 10.1) **vary in** form. The leaf-blade is most frequently rounded **in** outline, and before attaining **maturity** loses its scanty stock of hairs.

**Leaves.**

Attached by **long,** slender, **compressed leaf-stalks, the** leaves quiver and sway **with the** gentlest breeze. But **the** leaves cm the suckers have each of **then** a short st.dk and a more **pointed blade which remains** permanently tiairy. The **bright** \<'' • dead **teava fall** in **October.**

**Fift. 191 •— Shoot of Aspen.**

Pi*. *i^ASPEN-POPVLUS TREMULA* ; WINTER.

Fig. ' 93-- AS PEN—*POPVLUS TREMULA t* SUMMER.

The glossy, chestnut-brown, resting-buds (Fig. 195-G) are hairless and more or less sticky when mature. As Fig. 196 **shows,** the slender vegetative buds (the terminal one in the figure) differ from the larger, plumper buds (two lateral ones in the figure) that give rise to catkins.

The flowers open in March or April, long before the foliage reveals **itself,** Ftowers. ^ ^ g^p^d jn funy catkins. This furry appointnee is due to numerous long, straight hairs, given off from the deeply-fringed catkin-scales.

In design **the** inflorescences (Figs. 179, 197) and flowers agree: with those of the

**Fig. 194. -Older Hark of Aspen.**

Black Popkr. **The stametLS** in >m- Mmvir number only hum **four t-«** tw elve, a :i(**i have purplish-red anthoa.** The two stigmas **erf** the **femaie** ;,ir also **of this** colour, -., Ti,;lt red tints **prevail** in b'.th rr ale and **femaJe** catkins.

The cottony **seeds** are **scattered** (Fig. 180)

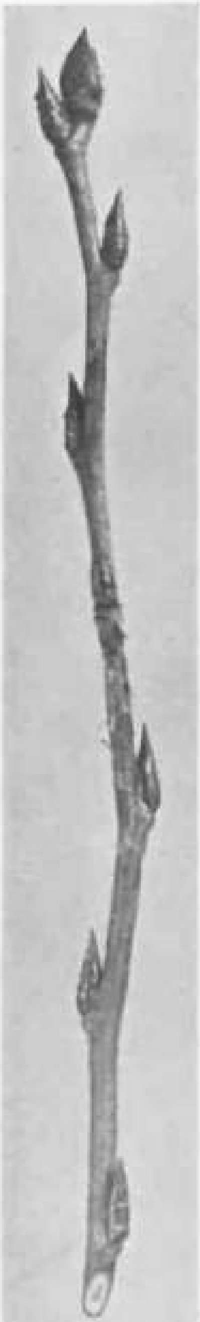


Fig. 195. Twip of Aspen In Winter.

in **May** or June, and germinate within a few **days.** As in the <jase

**Fruit.**

of other Poplars and, at least f some of our Willows that ripen their **fruit** early in the year, most of the ^*i-xh* lose their power of pit initiating a few <k\.ys **after** being shed; they must, therefore, in ordinary circumstances germinate at once or not .it all.

Although the Aspen is a **native** of England it often dies in this country before reaching **an** age of eighty years.

It is endowed with great versatility as re-

**Hahitat.**

gards its power of existing in diverse sitiuitinns, which may vary from a **wall-top** to a wet river-bunk. Yet in one respect the Aspen is exacting — it demands much, light, find with this character accord its exceedingly rapid growth in youth and tfce lightness <f its usually high-pitched crown. But the thin, smooth bark might seem to indicate rather **a** shade - loving habit; yet it must **not** be forgotten, on the one band, that in old trees the bnrk is thick and furrowed, and, on the other, that the smooth, **thin** bark is light in colour, and **therefore** throws back a considerable **proportion of** the desiccating sun's rays, just as dees the silvery bark of the Birch, which demands even more light- As the Aspen cannot endure much shade it is **suppressed when** overtopped by other trees, and in this **country** is a tree of the field rather than of the forest, though in some parts of Europe there are Aspen **forests.**

Fig. iyO.— Resting-buds of Aspen.

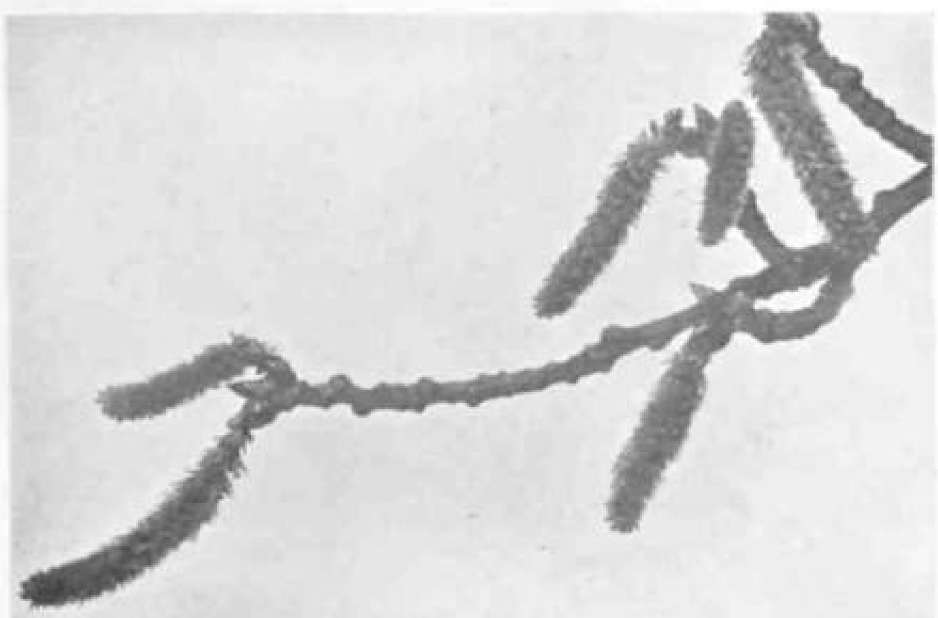
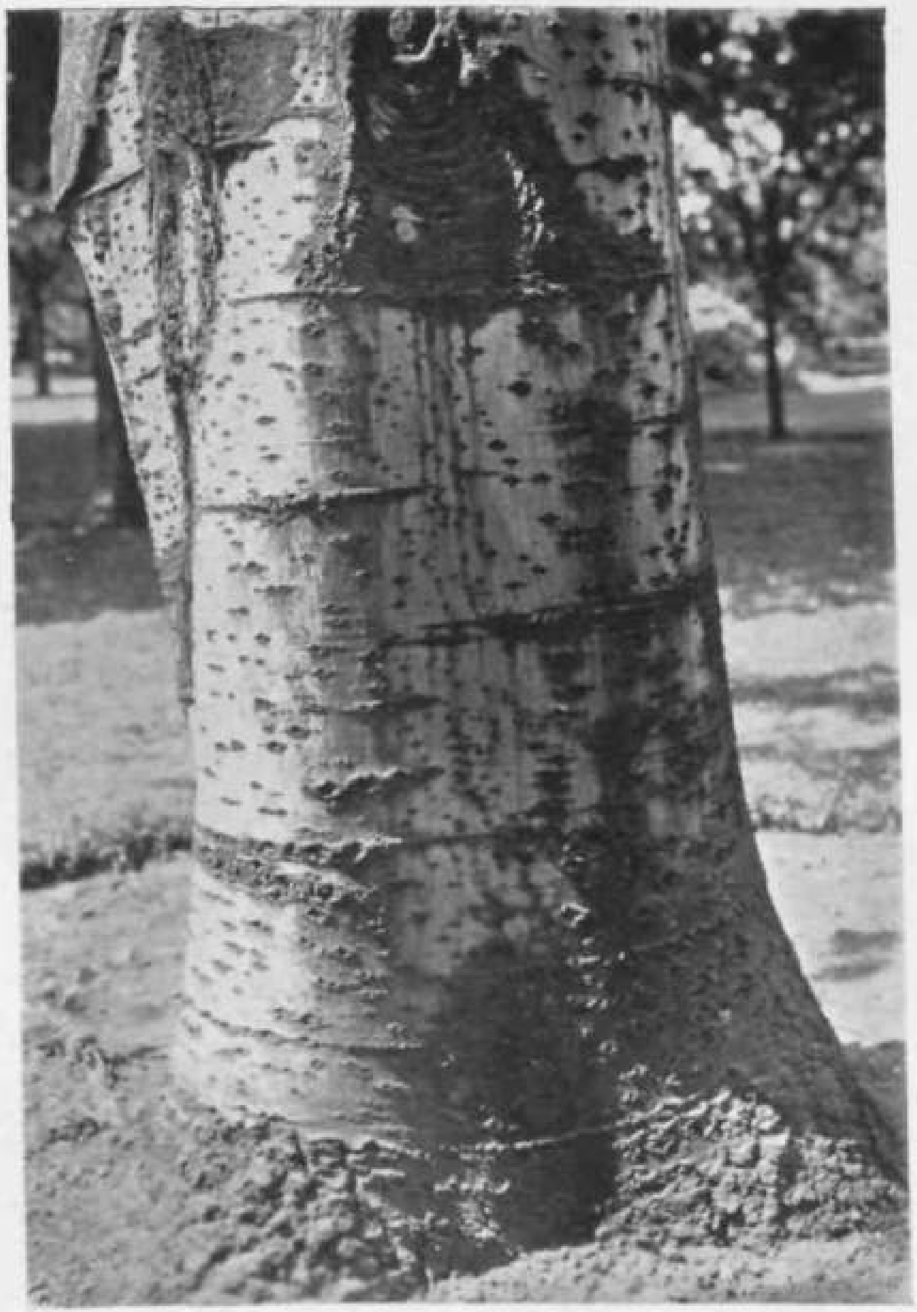


Fig. 197. -t-'emale Catkins of Aspen,

## POPULUS ALBA *(Linn.)* — WHITE POPLAR *(Salicacea)*

The White Poplar is distinguished from the Black Poplar and the Aspen by the snowy white coating on the under-snrlace pi the foliage and on the young twigs, by its dry. hairy resting-buds, and fr^l11011'^1 l)>ril s possession of lobed leuves. Thebiirk remains **smooth** and light-colon red for many years,



**Fig, 198.-Bark of White Poplar.**

The features described below largely concern differences between it and the Black Poplar.

Though the root-system includes a main root, its chief character is determined by liie extremely long, horizontal lateral roots, which are shallow and freely emit erect foliagcd shoots.

The rapidly-growing tree may attain a height of 100 feet in forty years, and ultimately the base of its trunk may become more than six feet in diameter. The trunk gives off strong boughs, which bear moderately numerous branches, so that the large crown casts fair shade.

On the vigorous branches, **especially** on the suckers, they are lobed, and coated on the ^^ ves. lower face with ti dense snowy felt of hairs (Fig. 202); but on feebler shoots and older trees the leaves arc unlobed. and may possess a snowy Coating or a more t^-anesa'nt grey :>ne on the

**Fig. iw.-Bark of Old White Poplar.**

The greyish or greenish white smooth h;nk (Fig. 198) in old age becomes deeply furrowed (Fig, 199).

The long-stfilked leaves are of two forms, **lower** face. The upper face of the leaf is gTeon ; the petiole Ss much less **compressed** than in the Aspt?n and Black Poplar; the stipules fall early.

Fig;. soo.-WHITE *POPLAR-POPULUS ALBA :* WINT15K.

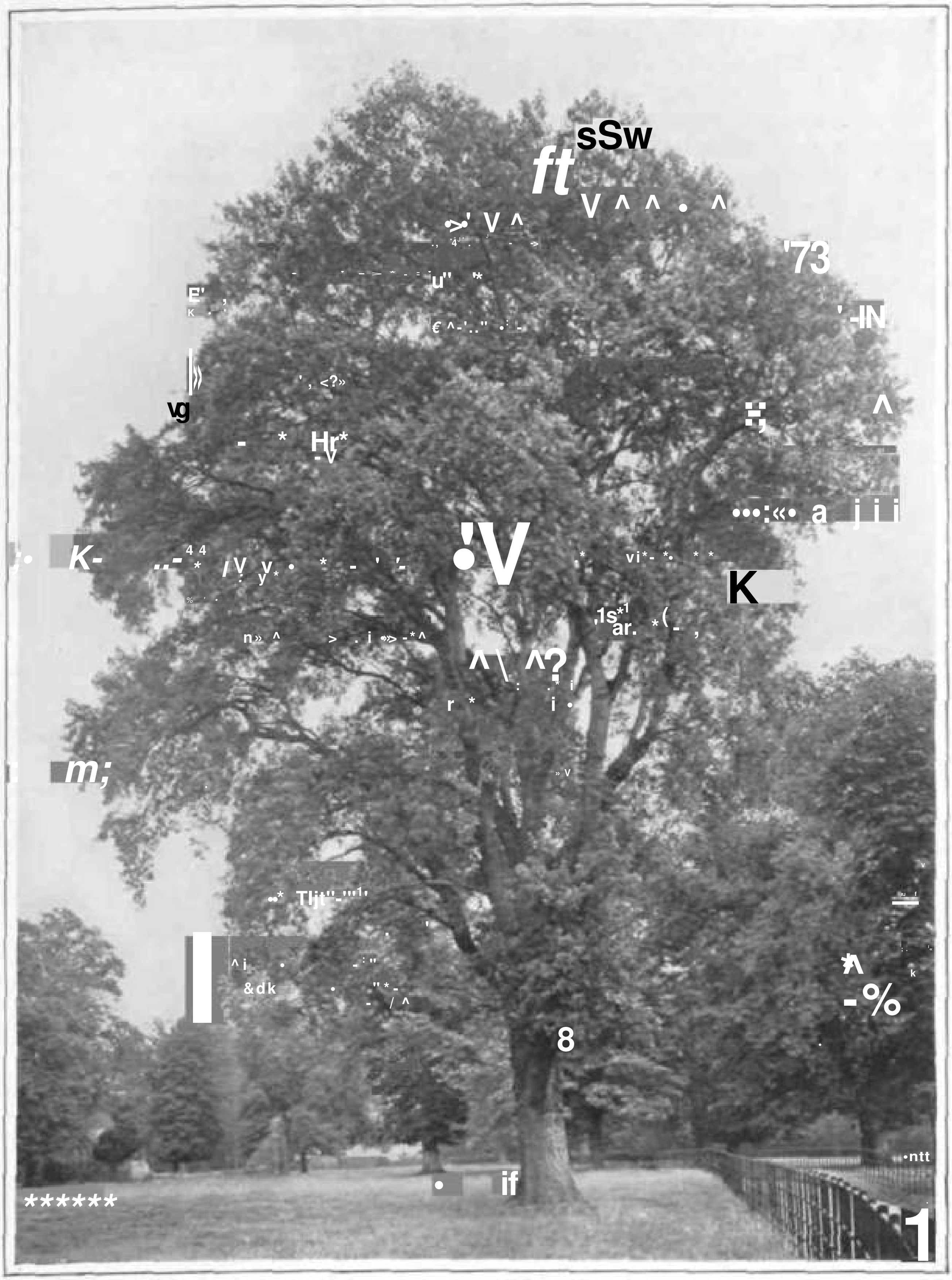


Fig. sol.-WHITE POPLAR-*POPULUS ALBA :* SUAIMER.

The resting-buds (Fig. 203) are not sticky, but are coated with hairs, which are very evident only in the young bud. **The shoot** during its first **active** season is snowy white, yet before the following spring the coating of bail's lias become **a** greyish film, which is easily rubbed off the olive-brown twig (Fig. 203).

In the male flower are from six to ten stamens, with purple anthers. The four slender stigma-**branches of** the female flower are yellow.

The short-lived cottony **seeds,** which arc shed in May or June, germinate within a

Seeds.

*6W ^11>'S- aiK* m **feVQtiiable** situations give rise to seedlings more than a foot in height in their first season.

Fig. 202.—Uaves of White Poplar.

The catkins (Figs. 39 mid 204) are in flower in March or April, before the fefcves appear. In design they are like

Catkins.

**those** of the **Aspen,** but differ in that the hairs on the feebly-fringed catkin-scales are fewer and shorter; this is especially true of the light green female catkins, which may be nearly hairless, and thus more like those of the Black Poplar.

**tts rapid growth** enables the **White Poplar to secure** tin- **considerable amount** of light which it demands. Like the Black Poplar and Aspen, it often grows on the banks of rivers, but is more **common** than **these** in woods, and stems to **enduie** heavier shade

Like the BJack Poplar, it lias a column-shaped pyramidal variety.

*Populua cancsccns {S?n>).—Crcy Poplar*

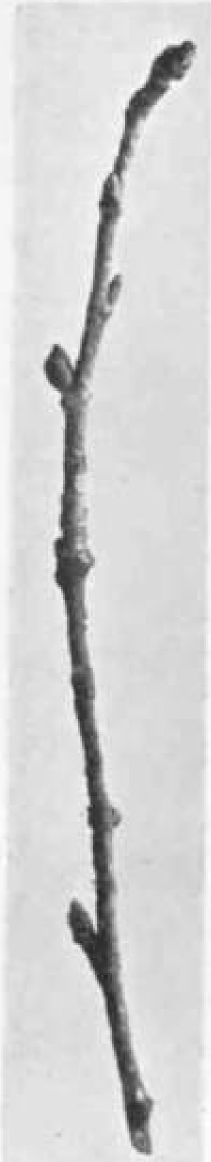


*Fig.* **303**--Twig «f White Poplar **In Winter.**

Tlje Grey Poplar is regarded as being a hybrid between tlie Aspen ami White Poplar, So that its iruo botanical name would be *Populus alba* x *P. irttnnla.* Like its parents, it remains smooth-barked for many years. R differs from the **White** Poplar in *that* **its** ]eave* are not lobod; neither fa there a lasting **SOMpy** coating on tlie lower fact oi the leaf nor on the young twigs. Its very variable leaves an* more Jik« those 01 the Aspen, but **differ** from **these** in being; more persistently (miry -ƒ lor, as *a.* rule, they sho«* on the km-tr face a thin. grey. *silky* coating, w patches of persistent hairs. The petioles an? more compressed than in the White Poplar. The buds and young twigs are more hairy than in the Aspen, and the former arc nut sticky, as is often the case in the latter troc,

**Fig. ao4. — Female Catkins of White Poplar.**

## **SALIX.**—WILLOWS *(Salicaceæ)*

**The \011towSj** wluVh *v&y* from trees of moderate height down to tiny woody **plants** only **an inch** tall, arc espedaNy familiar in w. I High ted places on the kinks of streams **and pools,** or in moist or wet soil. In this country there are more than thirty different kinds growing wild. Their identification is **a** matter of difficulty, especially as there exist a number of varieties and hybrids. The main points to notice are : liabit (tree, shrub, sub-shrub, or tiny plant); the **nature** of the twigs, whether osier-like or not; breadth of the leaves ; **whether** the catkins are borne on fotiaged or not foliaged dwarf - branches 5 number of the sfamens in **cadi** flower. Many subsidiary features require notice.

Their general scheme of growth is illustrated by the Crack WiHow, of which a description follows.

## SALIX FRAGILIS *{Linn,).*—CRACK WILLOW *(Salicacea.)*

Tlie Crack Willow is a narrow-leaved species with a rough bark, and lanky osier twigs that easily break off at the base.

It is a large shrub, or a ^tree which usually does not exceed forty feet in height but may reach ninety feet, and is often seen in the pollard form because *at* repeated lopping of its osier branches,

Fig. aos.-Bark of Crack Willow.

It acquires a thick, furrowed bark (Fig. 205).

The spirally arranged leaves (Fig. 207) on the long-shoots are toothed, but are even-margined on the dwarf-shoots. The *IMWS* **blade** tapers to a long oblique point, is hairless when mutnrr. and is pale green or whitisU-bluish-green on the lower face. The stipules are half-heart shaped, and fall soon. Near the top of the petiole are usually some distinct glandular lumps (whose presence distinguishes this tree from the White Willow).

The long slender, straight, and supple shoots attain a length of nine feet in one season, and are of the form used for making baskets, but their brittle nature decrease their value in this connection. In spring time only gentle force is needed to break a shoot off at its base, and it parts with a fairly cracking sound, leaving behind it a clean scar (though if broken across elsewhere the wound is ragged).

Long shoots.

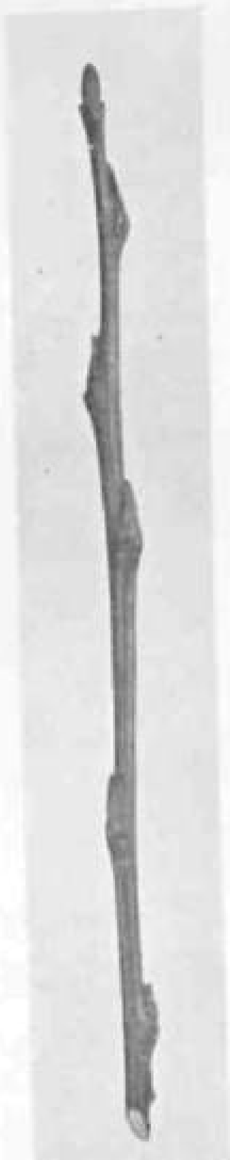


Fig. 206.—Buds of Crack Willow in Winter.

If we consider the yellow one-year-old leafless shoot (Fig. 206) we see it ending in a resting-bud, and bearing on its sides a number of lateral buds pressed against the stem and standing above the prominent leaf-cushions. The terminal bud, which externally shows only one scale, develops into a long-shoot. Each lateral bud likewise shows only one scale, which is attached on the face away from the mother-shoot. The lateral buds may grow out into long-shoots or into flowering dwarf-shoots. In the latter case the shoot first produces one or two little green leaves which usually fall soon; these are succeeded by from three to five true foliage-leaves; and above these the stem ends in a male or female catkin. The catkins place them-

Fig. 307.—Shoot of Crack Willow.

selves in an erect position (Fig. 210). The female and male catkins are on different individuals, and open their flowers in April or May, when the tree is in full foliage. They are constructed on the same plan as those of Poplars, as there are a number of spirally arranged bracts (catkin-scales) coated with hairs, and in the axil of each stands one flower. It should be noted that the catkin-scales of the female inflorescence fall very early.

Catkins.

The male flower shows two stamens standing right and left, and capped by yellow anthers; between and outside their bases are two little fleshy lumps—the nectaries—which are placed fore and aft.

The female flower has two nectaries occupying the same positions, and a single tapering ovary mounted on a relatively long stalk. The one-chambered ovary contains two vertical lines of (about six) ovules on the lower part of its wall. The short style

Fig. aoS.-CRACK WILLOW—S^L/Jf *FRAQIUS;* WINTER,

Fig. jop.-CRACK WILLOW- *SALIX FRAOIUS:* SUMMER.

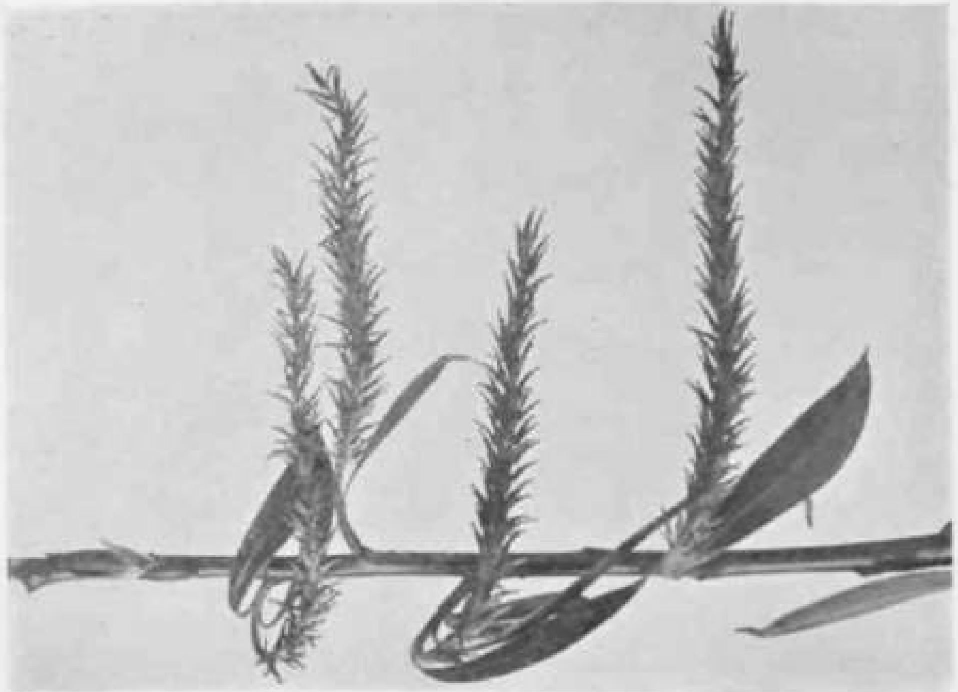


Fig. 21o.—Young Frailing Catkins of Crack Willow.

terminates in two stigmas, which are slightly larked **at the** tip.

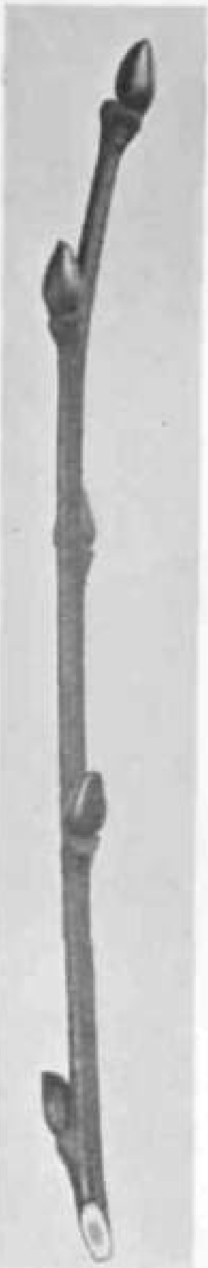
Insects, especially bees, attracted by **the** scent and nectar, transfer the rough-surfaced pollen-grains to **the** female flower. The fruit is ripe in June ; it splits down two linos midway between the vertical rows of ovules, and the two **valves** curl backwards, thus exposing the fluffy seeds, which agree in structure with those of **Poplars,**

The Crack Willow is most frequently found in damp soil, in osier beds, and along water-courses,

*Saiix alba* {Litin.), the White Willow, is very like the Crack Willow, from which it differs in the following respects : The leai-bJade, excepting whim tiki, has a silvery coating of hairs, particularly on the lower face ; the leaf-stalk has no glands : ihu stipules fire narrow, **lance-fihape&** The ovary **has** H **very** short stalk, at the base of which only one nectary occurs. Two oth«r **Q&tPOW-leaved** osier WilJim-s an- **distinguished** from the Crack Willow by **the number <>f the stoutens** in the **mala** I'uwor. ***Stthx triandra*** *{Li»»-* has **thtte, while *S. ptttputta [Litm.)*** has only one. which ***'at* ptirpta** and represents two joined stamens, as the **anther** shows **four** lobes instead of the usual two. Another **namKMr-**Ieaved osier Willow, *S.* ***vUmnalis {Liim.},*** as well as *S.* ***purpwta,*** differs from the **White** and Crack Willows in bearing no true foliage-leaves on the flowering dwarf-shoots.

## SALIX CAPREA *(Linn.)*.—GOAT WILLOW *(Salicacea.)*

This species contrasts with the ("rack Willow in ]laving broad **leaves, also in** that iis suilkltss **catkins** shoot forth and flower before the leaves emerge (Fig. 213), and in that **the** flowering dwarf-branches bear no **foliage-leaves.**



3. H I . - Twig of"Goat Willow in Winter.

The **Goal** Willow or Common Sallow is a large shrub or small tree, which may **be** thirty or thirty-live feet in height. Its bark, at first smooth, later on **gihows** a network of shallow fissures. **The** spreading boughs bear hninrh-Iets which are not long, slender osiers, but, being twiggy and knotted, are **Unseated** for b:isket-niaking.

**Leaves.** The spirally arranged **leaves vary** in form, margin, tip, and **even** in **the** distinctness of the stipules, **which,** when seen, arc **half-kidney shaped*** *Tin* blade often **continues** out **into** a long **tip** whti **h** may be **twisted** and bent (Fig. 212}. The **upper** surface, whui **mature,** is pure though dark green, and more or less glossy I. .mil;i>t 5. ***catrUa)*** **;** tin[1] **lower** face may hi' smooth, or may **show a thin** cottony (n«t silky) coating of hairs; and is marked by a network of projecting veins.

**f'i}f. 212.—Shoot of <ioat Willow.**

**Calkins.** The **catJdns sbool** nut 111 **March or** April from **hairlcaa resting^bads banti laterally** oo twigS Foduredd during the **preceding year.** Thi- **dwarf-shpots** they **represent are devoid** of foliage-**leaves, though** they bvar **ft few bracts at the base (Figs,** 215-6). The long silky hairs un **the** Qitkin-srales give a **pretty,** silvery appearance to the opening catkins, and especially to tht- male catkins. The catkins ;nv large; **the** male ones are **egg-shaped,** and **their** silver is mingled with the guM of the **yellow anthers**; **while the green** fc-male catkins are more slender and less conspicuous.

In **general** structure the catkins, flower, fruit, and seeds agree with those of the

*Fit:.* ai$_3$.-UOAT W1LL0W-S.4L/* *CAPRBA :* EARLY SPRING.

Fljt. 2l^.—OOAT WILLOW—*SALIX* Cy4Pfl£\4 : SUMMER.

Fig. 215.-Female Catkins of Ooat Willow.

woods (with **Birch** and **Aspen),** and in clearings of the ion-st.

Am0Hs relatively broad -leaved Willows resembling S, *cafrea* in habit and many details arc thrcs; *S. aurita* (Eared Willow). *S. einerea* (Grey Willow), and :*>. *nigricans.* The first two of these agree with the Goat Willow not only in that their catkins terminate un-fnltagei] **dwarf** - shoots, and in the frequently large size of then stipules, but also in Crack Willow, except that these is only one nectary to each flower. [Thus **the** Goat Willow is **easily** -l^tinguishcd from the broad-leaved *S. pentavdra* (Linn.), **widish** has tivi- (or four) stamens in each **flower.]**

M ny bees are attracted to the catki 11-. mul are largely responsible *U>r* fmllinatiiin. As **early** us **May** the **long-stalked** fruits opi'ii and >ln-il thiir fluffy seeds (Fig. 2x7).

The Goat Willow, though it is a short-livt'd *tied,* displays a great pow-1 **ol accommodating** itsrlf to ^riiius soils; **for** it grows not **only** on moist or **even** wet marshy and peaty soils, but also in dry places, on stony soil, and even lodges its roots in the crevices of rocks or ruins. These last situations conform with its shallow root-system. Yet the tree has its limitations, and ivtltxts its imperative demands (or light in the rapid growth **of** its shoots, as well as in the situations that it selects. These aTe always in open country, or in well-lighted thin

Fig. Si6.— Male Catkins of (iont Willow.

the tielsiJ that the lower face of each leaf-blade shows a complete network of projecting **veins** • but they **differ** from the last-named species in that their leaf-blades are dull on the upper faco because of a permanent film *ni* short hairs. The one-year-old twigs of 5. *caprea* anil S. *aim in* are coated at most witb minute down, and arc never clad with the grey felt of hairs characterising those of the grey-leaved *S. cinerea.* From all these three species *S. mgricans* difFcis in that its leaves blacken as they dry, anil at no time show any complete network of prominent veins oti the lower face.

Very interesting but **very different to** /orm are the two tiny Willows found 011 the tups Of high mountains—*S. reticulaUt* ami *S. herbacea*—both of which have broad leaves but tire reduced to pygmies sometimes only an inch or so in height, and with more or less completely subterranean stems.

**Fig. a 17. Fruits Of lioat Willow shedding Seed.**

These product an incomplete sward, or extend among stores along the ground, so that one tan walk over them and pass tht'm unnoted.

By French and German botanists they are described as " Glacial Willows."

## FAQALES. OAK AND HAZEL FAMILIES

The natural order comprising the *Fagales* includes the Oak, Sweet Chestnut, Beech, Hazel, Hornbeam, Birch, and Alder.

All these are *woody* plants with alternate, simple, stipulate leaves, and *inconspicuous unisexual flowers,* which are devoid of petals, and are often (almost without exception in the case of the male flowers) arranged in *catkins.* The most obvious difference between this natural order and the *Salicacece* lies in the structure of the ovary and fruit, Here the *ovary* is *inferior,* and has *two to three chambers* (usually more in the Chestnut), each of which contains only *either one or two ovules.* The *fruit is dry, one-seeded,* usually a nut, *and does not open spontaneously,* The seed is wholly occupied by the embryo,

The green perianth, which is small or entirely suppressed, is epigynous when escnt.

The simplest method of regarding the group is to view the constituent plants as having degenerate flowers and inflorescences, whose original types are best preserved in the Sweet Chestnut. The Chestnuts, unlike the majority of other representatives, are best represented in warm countries, even within the Tropics, where they are connected bv numerous transitional forms with the Oaks The remaining members of the *Fagales* are, almost without exception, north-temperate, or if tropical are on mountains, Nearly all the representatives are confined to the Northern Hemisphere, but Beeches provide a striking exception by forming forests in extremely southern lands (New Zealand, the southern extremity of South America and the adjoining islands).

Many points of interest are encountered in the natural order. (1) There are all stages between complete bisexual flowers, ranged in elaborate inflorescences *(e.g.* Chestnut), and simple spikes of naked unisexual flowers ; various stages of reduction or modification of the bracts. (2) The flowers of the Chestnut may be insect-pollinated; the others are wind-pollinated. (3) The stamens show all links between perfect ones, and such as are divided completely down the middle into two halves, each with a filament and a half-anther. (4) In the Chestnut at the time of pollination the ovary-chambers and ovules are present, but in a number of other forms at this time there are neither ovary-chambers nor ovules, which first develop as a consequence of pollination. (5) Some of the species open their flowers earlier in the season than the leaves unfold ; others send out leaves and flowers simultaneously ; in still others the leaves emerge first.

The constituent trees often take a more leading part in forming forests than do the *Salicacece,* which are generally marked by their demand for light, and often by their preference for wet soil. More diversity is shown by the *Fagales.* The Beech and Birch represent the limits attained by British broad-leaved (dicotylous) trees respectively in their endurance of deep shade, and demand for direct light ; these and the other intermediate types beautifully illustrate the characters of shape, behaviour, and distribution of trees according as they demand much or little light. As regards soil some are versatile : the Birch, for instance, can grow on dry shallow soil, or on soaking peat soil close to the moisture-loving Alder which fringes rivers or pools ; the Beech, on the contrary, is killed by a soaking soil, and the Oak is stunted save on a deep one.

The *Fagales* naturally fall into two families :—

(1) *Fagacece* (Sweet Chestnut, Oak, and Beech). Here, in each female flower the stigmas and chambers of the ovary number three (or multiples of three), and there are also all stages of reduction of the perianth, and two ovules in each chamber.

(2) *Betulacece* (Hazel, Hornbeam, Birch, and Alder). Here, the female flower shows two stigmas and ovary-chambers, each of which encloses only one ovule.

(I.) FAGACE.E

In addition to the points already mentioned it may be noted that the inflorescences arise as branches on the twig produced during the current season. *Each fruit or group of fruits is enclosed in a cupule,* which is familiar as the acorn-cup of the Oak, or the four-valved spiny cupules of the Chestnut and Beech. The three genera are easily distinguished :—

(1) *Castanea* (Sweet Chestnut) has erect male catkins, a spiny four-valved cupule enclosing (usually) three fruits, which are rounded in cross-section.

(2) *Quercus* (Oak) has hanging male catkins ; the cupule with scale-like or pointed outgrowths encloses only one fruit (acorn) which is circular in cross-section.

(3) *Fagus* (Beech) has pendent long-stalked male inflorescences, of which the flowers form a rounded tuft; the four-valved spiny cupule encloses (usually) two fruits which are triangular in cross section.

(II.) BETULACE/E

To the characters already given may be added the following details. The open inflorescences are typically attached directly to a stem produced during the previous year. The male inflorescences are always pendent cylindrical catkins. The perianth is often lacking. The stamens are often more or less completely divided into two halves. The fruit is surrounded by a cupule only in the Hazel. The four genera are distinguished most easily by their fruits :—

(1) *Corylus* (Hazel) has the familiar filbert with a cupule round it. (Note also the female inflorescence concealed, except for its red styles, inside a bud.)

(2) *Carpinus* (Hornbeam) has a hanging collection of fruits concealed by large three-lobed scales. Each fruit is a ribbed nut with a large three-lobed scale clinging to it. (Note also the hanging green female catkins and the smooth-barked fluted stem.)

(3) *Betula* (Birch) has a catkin-like cylindrical collection of fruits with flat scales and flat winged fruits : the scales fall off separately and release the fruits. (Note also the erect cylindrical female catkins, and the silvery bark.)

(4) *Alnus* (Alder) has a woody cone-like collection of fruits, whose thick woody scales merely gape asunder, without falling, to release the flat seeds. (Note also the little cone-like female inflorescences, and the stalked resting-buds.)

## CASTANEA SATIVA (.VJV/.).-CHESTNUT *(Fagacedf)*

*Caslanea saliva (C. vesca, C. vitlgaris),* the Sweet Chestnut, is recognisable by its spiny, four-valved cupule, which encloses from one to three chestnuts; by its long, erect, conspicuous male calkins ; and by its long leaves, **the** tooth and tip of which are sharp-pointed.

The **Chestnut** thrives only on a deep soil, as the massive main root as well as the strong lateral roots descend deeply.

Fig. 218.—Bark of Sweet Chestnut.

The large tree in dose forest may show a **tall** straight trunk unbranrhed up to a considerable height ; but in the open, or in well-lighted woodlands, the Chestnut

**Form rmJ Dimensions,**

**produces heavy branches** and an :imPlc brOild crown, below which there may be only a relatively short bole. Though the tree may attain a height of ninety feet, it is thickness-rather than length tliat is the marked feature of the trunk, which is known to attain a diameter of twelve feet. In fact the trunk of the extraordinary *Cas/agno di cettfo cavalli* on Etna measured more than 150 feet in girth; but this monstrous stem may have resulted from the fusion of several. The stool and stump of the Chestnut have remarkable powers of sending forth vigorous erect shoots; and boughs dipping on to the ground readily send roots into the soil, The roots, on the contrary, have little or no power of producing suckers.

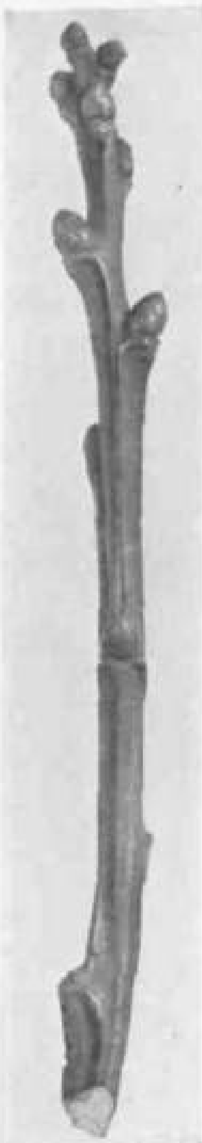


Fig. 219.—Twig of Sweet Chestnut in winter.

The bark (Fig. 218) becomes thick and *hMigi* 111 d i na lly Ji 1 rrowed, und acquires a grey to brown **colour.**

The stalked **stipulate** leaves **a** re arra nged spi ca lly *on erect* **shoots,**

**Icivcs**

and, to somi; extent, on vigorous branches, but for the most part they spread out horizontally in two ranks. In the bud the blade is plaited along **its** parallel **lateral** nerves, and is **eosheathed** by the stipules belonging to the same leaf; but the stipules soon fall oi'l when *once* they have ceased *to* be of use as bud-protectors. The large, glossy, somewhat leathery blade (Fig. 220) is not unlike **a** nugiiitVii Hornbeam *leaf* in **shape,** and is more or less completely hairless when mature.

The short, blunt resting-bud (Fig. 219) shows only two external scales. *On* the leafless rather ^ twigs the lateral buds may be seen to

Fig. 220. **Leaves of Sweet Chestnut.**

stand in tlie axils of **prominent leai-**cushions.

The Sweet Chestnut commences to **bear** fruit at an age of from **twenty to thirty** years in the i>j»-n, but not

***Pkmtifat* Age.**

*uatUitls* fifty *or sixty yea* rs old in close forest. In **well-lighted** situations it fruits every year, though good crops succeed only at intervals of two or three years, or even at longer intervals inside the forest.

The in florescences and flowers deserve close attention, as they **provide** a clue to tho **structure of** the simple

**Inflorescences.**

and, at least partially, degenerate ones of the Oak, **Hazel,** Birch, Alder, and Hornbeam.

**The** *long* erect rat kins arise as branches in the axils of **foliage-leaves** on the current year's-shoot. Their own stems bear no

RK. 321.-SWEET CHESTNUT-*CASTANEA SATIVA :* WINTER.

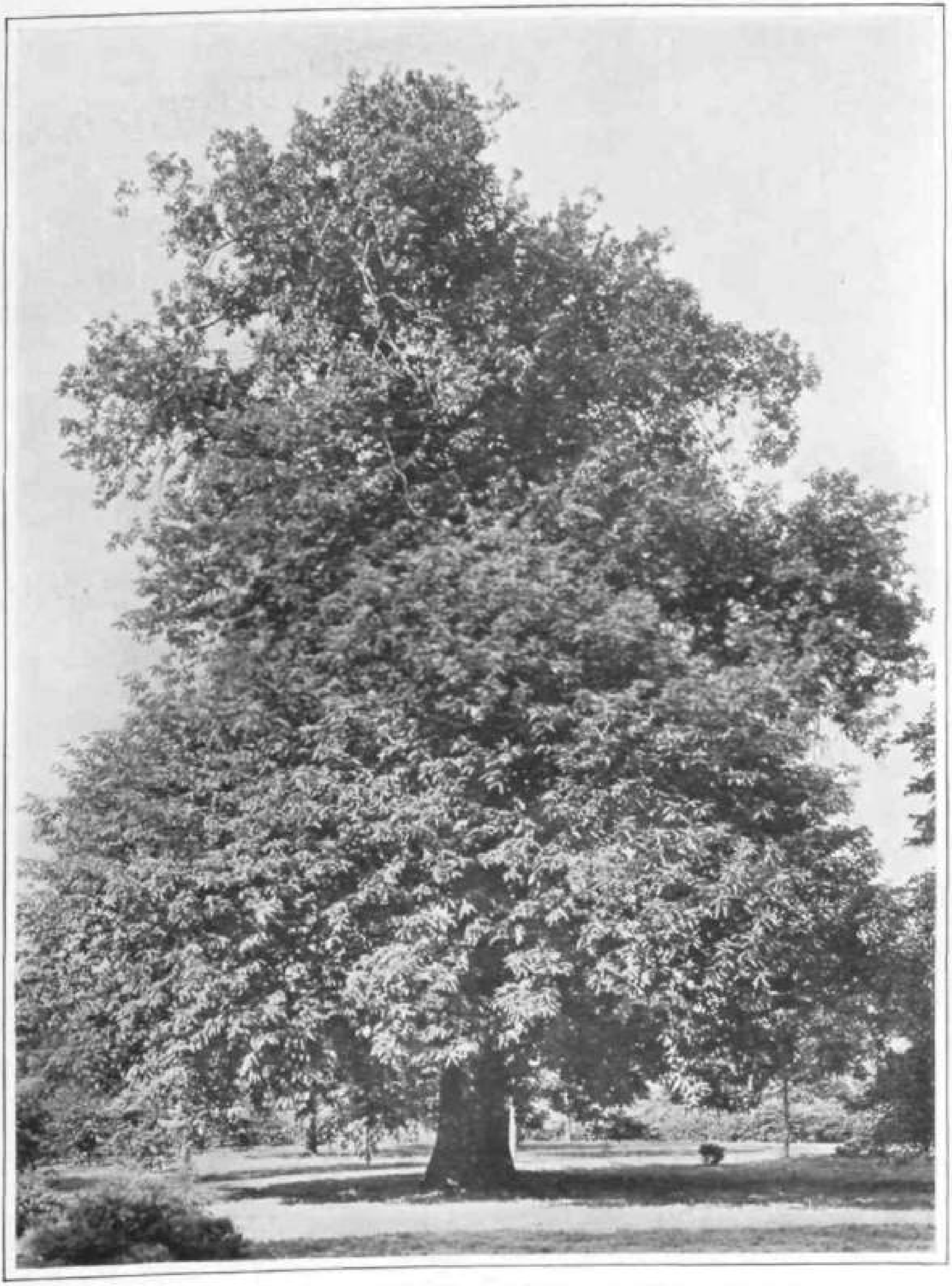


Fig. JM.-SWEET *CflB&TNVT-CASTA\EA SATIVA* : SUMMER.


**Fi-. 223. Male and Mixed Catkins of Sweet Chestnut.**

foliage* On weak dwarf-shoots **whose** leaves are all two-ranked, male catkins arise in the axils of **two** or three of the lowest foliage* leaves; **higher** up these dwarf-shoots no other catkins occur- But stronger shoots, whose lower leaves are two-ranked, but whose upper ones are spirally arranged, show in the axils of the successive leaves, commenring from **below,** the following: (i) Resting-buds. (2) M.ilr catkins (Fig. 223, J). (3) Mixed **catkins** with clusters of I, in.ile flowers below, and of male flowers above (Fig. 223, ¥ *S).* **(4) Rest*** ing-buds.

**Explanation of Catkin,**

Both kinds of catkin^ bear **spiralijr-arranged cat-kin*-** scales, with dusters of flowers **Standing** in the axils of these. In order to under-stand the nature of a single cluster in **the axU** of a catkin-scale we will, for **a** moment, imagine thr inflorescence that it 1'presents to **possess aU fcts** stems (which **in ideality** havt: ht't-n suppressed).Tin-**dnster** would then take **the** form of an infloresc-ence *{see* Fig. 224) with •1 Miigle stem which ends in **a** flower (Number *1)* and **bears** on its sides two **leaves (bractlets I.** and **II.). In** the axils **of these** last two are **two branches,** each of **which tikewi** ends u flower (Numbers 2 and 3), and **bears two leaves** (bractlets **III.** and IV.. V, nml VI.). In i axils of these last-named **are** single **flowers** (Num-bers 4 and & 0 and 7). If we **uow** tele-scope all the stems together **we have** on the main stem (A) of the catkin, in the axil of **a** catkin-scale **(c),** an **Inflorescence** showing not only **a central** Mawer, and on **each** side of it ii **group** of three flowers, but. also six **scaMfce** bractlets between them. And this is precisely the constitution of the mate cluster of the Chestnut showing seven flowers and six bractlets. From such a type we can derive all the simpler other types met with in the great group *(Fagales)* including the Oak, Hazel, and others.

For instance, consider the Chestnut's cluster of female flowers, of which there are three in the axil of a catkin-scale: here the four ultimate flowers (4-7) are missing, only the main flower (1) and the first two lateral ones (2 and 3) being present; bractlets I. and II. are visible as scales, one being on each side of the cluster, but in place of the four other bractlets (III. to VI.) there is a cupule which surrounds the three female flowers, and shows many narrow scale-like outgrowths and little bristles. When the fruits are ripe, the cupule is a spiny investment which opens out four valves; these four valves are often regarded as representing the four missing bractlets. But even in the Chestnut there are cluster-inflorescences that include from four to six flowers, and thus represent stages intermediate between the three-flowered and seven-flowered clusters. On the other hand, the female inflorescence in the axil of a catkin-scale may also be reduced to the single central flower (r). Thus on one tree we find stages from an elaborate cluster in the axil of the catkin-scale down to a solitary flower, which may possess all the attendant bractlets of the complete cluster, and thus demonstrate its degeneracy.

Each male flower has a perianth of from six to eight (most frequently six, representing two whorls of three each) sepals, which are joined below. Within these stand from eight to twelve complete stamens, which surround a tiny three-lobed lump that represents the rudimentary remnant of a pistil.

**Male Flower.**

The female flower possesses a perianth consisting of five to eight (most frequently six) joined sepals. Within this (there may or may not be some stamens, which are rudimentary as they lack anthers. In the centre rises a tuft of rod-like styles which give the flower a spiky appearance. The inferior ovary, even when the flower first opens* already possesses distinct chambers with two ovules

**Female Flower.**

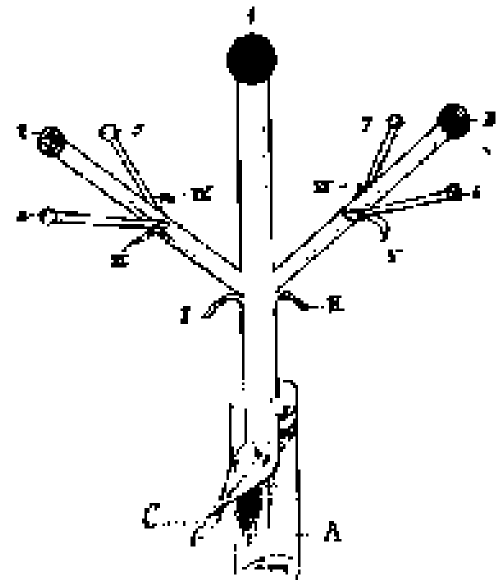



Fig. 224.

in each. Styles and ovary-chambers frequently number six, but vary from three to twelve; and it is of interest to note that intermediate stages occur; for instance, three larger alternating with three smaller ovary-chambers and styles.

Yet another point of interest is encountered in the mixed inflorescences, in the middle part of which there are clusters and flowers intermediate between the male and female types. Above the female clusters on the main stem of the catkin may be found other clusters, each showing a central female flower and two bisexual flowers. Above these again may appear a cluster of three bisexual flowers with a reduced cupule. Still higher, as the number of flowers in a cluster increases and the cupule dwindles (till only scaly outgrowths on separate bractlets recall it), the stamens become more marked, and the pistil less significant, until the typical male clusters are reached.

**Mixed Inflorescences,**

All these facts suggest that possibly the

**Fig. 225,-Catkins of Sweet Chestnut showing Male (<jj and Female (?) Clusters.**

ancestor of the Chestnut, and of the whole group to which it belongs, originally possessed **bisexual** flowers arranged in elaborate branched and stalked inflorescences. If so, that the complete flowers have been reduced to male and female flowers by the more or less perfect suppression of carpels and stamens, which are now functionless relics; while the lateral inflorescences on the stem of the catkin have been condensed into stalkless clusters. And these suggestions receive fresh light from observations on the pollination.

**Pollination.** - The male catkins are rendered conspicuous by the ,, ... .. **yellow** colour of then" envelopes and projecting anthers, also by their length and grouping. They are sometimes scented (**perhaps** always so in their sunny **southern** home). The male catkins, too, **are erect**—not pendent, like those of the wind-pollinated British Oak, Hazel, Birch, Alder, and Hornbeam. Finally, the pollen-grains are stated to cling in groups, and not to separate like powder. All these facts suggest that the flowers are pollinated by insects. Crowds of bees, also some other insects, may be seen collecting pollen; and in creeping about these visitors cannot fail to transfer pollen on to the stigmas of adjacent female flowers. But insects visit admittedly wind-pollinated flowers, and the pollen of the Chestnut is smooth like that of such flowers. What then does the female flower suggest ? It is inconspicuous, has neither **yellow** pollen nor. nectar to invite insect **visitors,** and at least to human beings it is devoid of odour. Its numerous **projecting rod-like** stigma - bearing styles agree in size and position with the large stigmas of **wind-pollinated** flowers at least as much as **with** the relatively smaller ones of insect-pollinated flowers. Thus we find different observers describing the Sweet Chestnut as insect-pollinated and as wind-pollinated.

Apparently the flowers are intermediate between wind-pollinated and insect-pollinated flowers. So that the Sweet Chestnut's

Fig, 2*6. **Fruits of Sweet Chestnut.**

ancestors may **have** possessed conspicuous or strongly scented flowers (or inilorescences) that were regularly **haunted** and pollinated by insects. Neglect by insects may to hive brought into existence the whole-*™» of degenerate wind-pollinated Oak Beech, Hazel, and others forming the *logaks.*

After pollination the ovary enlarges but aB its ovules save one remain small so ^ it becomes the **gloss?** edible Chestnut containing one seed. The **capote** gradually grows over and ensheaths the three young fruits of one cluster in spiny armour (Fig-226), but to October it **unfurls** its four **valves** and exposes **the** ripe nuts which are now protected by firm chestnut-coloured walls (Fig-227).

Fruit*

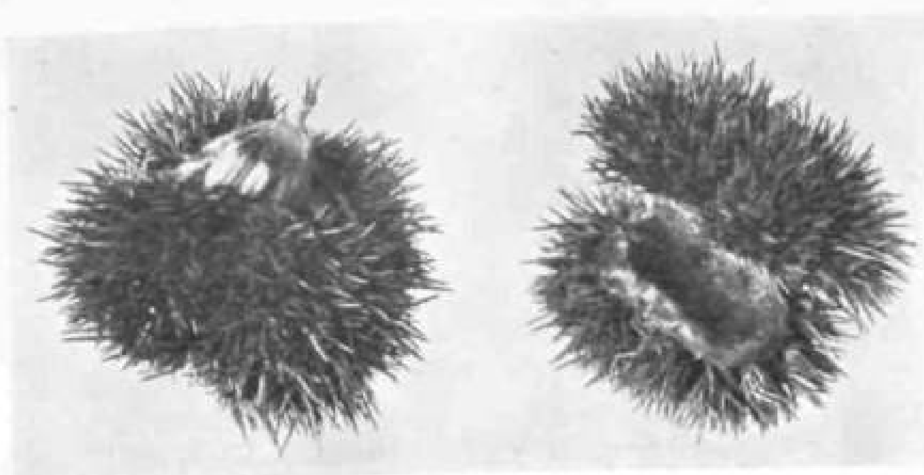
The seed contains only the embryo, which is mainly constituted of two thick massive cotyledons that are filled with food. When the seed **germinates** the cotyledons **remain** below ground as **subterranean** food - reservoirs, and the stem **at** once produces small foliage-leaves. From the fust and for **many years** the young plant grows rapidly.

**Seed**

The tree may attain a great ago, possibly **a thousand** years.

The Chestnut comes to us from the **warmer** south of **Eu-fope,** and **reflects** the imsuitabihty of our climate in the small size **and** incomplete ripening of its fruits in Great Britain. Apparently as regards demands for light it stands between **the** Oak and shade-bearing Beech. Its general **habit** of growth suggests alternately demand for light and endurance of shade: for the tree has a rapid upward growth during youth, and acquires a thick bark; yet, like a **shade-bearer,** it casts deep **shade,** thanks to the large size and **horizontal extension** of its leaves. As regards **soil,** it shows a marked shyness of lime, und at best grows feebly on soils **rieh** in lime.

**Hnbitat.**



fl& «7 Fallen **Cupules of Sweet Chestnut, one with 0 Fruit.**

## QUERCUS ROBUR (Żm,,.) .-COMMO* OAK {Fagaaa)

A Common Oak is recognised by: (1) the acorn which ... year, and is seated in a cu... overlapping

Fig. 338.—Bark of Common Oak-

little scales pressed close against the surface; (2) the pendent male catkins with flowers grouped at intervals; (3) the characteristic lobed lea\-es which are deciduous and have stipules that fall very early.

Under the name *Quercus Robur* are included two sub-species or species—*Q. pedunculata* (Ehr.), the Pedunculate Oak, and *Q. Mssiliftora* (Salisb.), the Sessile Oak are connected by intermediat f wJllch the following description the \ """^ *" described coUectivelv under the name of the Oak, and the more important distinc-

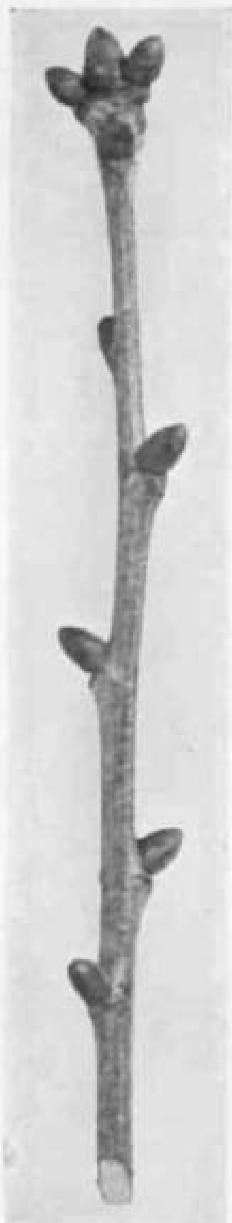


Fig. 229.—Twig of Common Oak in Winter.

tions between the typical forms will be indicated.

The deep and massive nature of the root-system with its large spreading and descending lateral roots accounts for the Oak's **sturdy resistance** of storms, and for the fact that it flourishes only on deep **soil,**

**Dimensions** and I' turn.

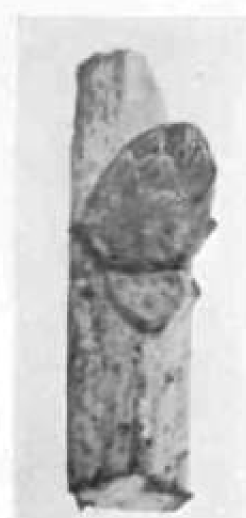
Though this largest of British, trees may tower to a height of no feet, or even 150, the more striking feature in **regard to** the **trunk** is **the** thickness to which it van **grow** : **one** mighty English **specimen** possessed a trunk measuring seventy feet in circumference. From the trunk are **emitted greatignarled and tortuoos** boughs, \\h'>s<- iinrr brandies are **relatively** insignificant a *n*d s I) 11 r t. In the **Pedunculate** Oak, |he trunk, at no **great** height from the ground, **seems** to divide into **a** number *1 >i* big **boughs,** producing ;i **relatively** low-**pitched spreading crown,** which is **especially** low in the **open.** The Sessile Oak is described as having *.1* trunk distinrt up to a **greater** height, a more regular **crown,** and more steeply ascending boughs. The bark becomes thick and deeply furrowed (Fig. 22S).

Leaves.

The lobed leaves are spirally arranged and, towards **the** ends of the twigs, **characteristically** tufted because ili<- internodes are short. This *tea* 11 J re of thrusting its rosettes of leaves into the light is of special interest when it is noted that the Oak demands a considerable amount of direct light. The kibed leaves are stalked and stipulate, but the stipules fall **soon.** The leaf of the Pedunculate Oak (Figs. 233, -3.15) has a short stalk; the blade is practically hairless, and as a rule does **not** taper at the base. But the leaf of **the** Sessile Oak (Figs. 234, 236) has a much longer stalk ; the blade more frequently tapirs towards its base, shows some hairs on the lower face, and is more Jinn and **leathery.** The brown or yellow autumnal leaves of the Pedunculate Oak fall before winter, **except** perhaps from sunn- of the erect younger shoots springing from tiie base of. the old trunk ; but the thicker 1« ai • H DI the Sessile Oak hang longer, and in **sheltered** places green leaves may be found in winter still **attached** to **shoots** emitted from the **bole,** Thus there is a feeble indication of the **evergreen** habit that **characterises the** Holm Oak and many **other 3pe££es** of *Quercus.*

**Resting-hud s.**

The resting-buds (Figs. 229, 230) show many pairs of scnles **which represent** stipule of leaves **whose blades are** not **developed.** But **one peculiar** feature **showa by&itisti and** other Kiiropeini ();ik> *a* thai the **lateral** buds are clustered towards **the** tip of the twigs • I'. ' iiitse the **leaves** are **likewise** so). As tin- **Common Oat demands considerable** illumination, *only these* irdJ-lighted and clustered buds **develop** as **a** rule, while those **lower** down the year's-shoot **remain** living, but in-; 1 < • t i ve, for m any *ye$* rs. The result of this behaviour is double. First, the design of the branching is char-**acteristKsIIy** tufted; moreover, this tufted



FiK· „„·— RestinK— hud of Common Oak.

Fig. 231.—COMMON OAK—*QUERCUS ROBUR*: WINTER.

[illegible]—COMMON OAK—QUERCUS ROBUR: SUMMER.


**Fig- 333—Male and Female Inflorescences of Pedunculate Oak.**

branching coupled with the occasional **death** of the terminal bud or end of the shool is, at least **partially,** resjxmsible **for the curious** *z\g-z<\g* shape of the main branches. Si ••-nelly, there remain many resting-buds pn **the** O;ik,so that the tree has great power of tlin w in_ out shoots from stumps, or from **old** parts of the trunk after this has been • v - il to increased litjlii or ;iftej **tbe** i rtnwn has *U* :i lopped. OfteiJj tln.n, Oaks show on thei• trunks bosses studded with twigs and bud>, Tiu-se little branches arising on the veteran stem, as weil as the great boughs springing fmm it, **cause Oak-trees** grown in the opim to produce timber showing much burr-wood and gigantic knots. But **another** important peculiarity of the Oak influences its shape. Tlie tree has the habit of emitting a second crop of shoots—the so-called ** lammas-shoots "—in one season. In summer the resting terminal and higher **lateral** buds suddenly awaken into activity, their scales are forced asunder, and there emerge fresli green leaves, which in details differ from those exposed at springtime. Consequently **the Oak produces** two degree? or generations of branching, **instead** of one, in a single season.

The **tree** does not commence to bear good seed until the ripe age of sixty or eighty

Flowers .V[li;irs]- The male rind female iiowers come out on the same individual, and **at** the same time as the leaves are emerging, namely in April or May.

Both malt; and female inflorescences arise as **branches** on shoots produced during thu current season. On feebler dwarf-shoots only pendent male catkins arise ; but on more vigorous shoots springing from the terminal portions of the previous year's twig both kinds of inflorescences occur.

A resting-bud abrmt **to** produce a flowering branch is encased in pairs of **scales ; Wtien** it shoots out, the mule inflorescences nii,-< in the axils of **a** few of the uppermost of paired scales. And on male branches **the** catkins can be seen before the foliage-leaves are revealed (see Fig. 233). When **Lu-branch** has grown out from the resting-bud, its lower foliage-leaves will be seen to **have** rest ing-buds in their axils; furthermore, if t**he** branch be a " mixed one," in **the** 'axils of leaves still higher up are the little, erect female inflorescences : and **above** these again may succeed leaves **with** resting-buds in their axils.

Both kinds of inflorescence are very simple, and produce only one stalkless flower in the **axil** of each **bract-Scale** (catkin-scale).

The hanging male catkin bears many spirally, but unevenly, distributed catkin-sr.ilts. E;i.<:li mule flower consists of Ir<»m five to seven sepals joined below, and from live to twelve complete stamens ; ttiere b **no** trace of a pistil.

Tin.* female inflorescence shows fewer **flowers** on its axis, only from one to five. In the Pedunculate Oak the erect inflorescence has a distinct stalk witli **fiowere** at its sides (Fig. j.jj. 4 }. So tliat eventually **the acorns** JIV **raised apona stalk,** a *peduncle,* longer than tin- **leaf-Stalk** (Fig. J.57). But in the Sessile **<)alt** the female flowers are crowded together apparently in **the** uxiJ **of** the foliage-leaf, be-cause the **inflorescence-stem** is contracted (Fig. 234, *% )*; consequently the <teams are not stalked **but** *sessile-* (Fig. *23b),* Each flower is surrounded by a basin-like scaly cupule, **which** becomes the woody acorn-cup. **The distinctly** toothed perianth consists usually of six **joined** sepals inserted above the minute lump representing the inferior ovary. In the **centre** rises the three-branched style **terminating** in three stigmas. At the time of **pollination the** ovary shows **no**

***Fig. 234,-* l'emok* Inflorescence (?) of ><.••>-ik- Oak.**

Fig. 235- **Shoot ol Pedunculate Oak.**

Fig. 336.—Fruit of Sessile Oak.

distinct cavity, a till less any ovules, but later it acquires three chambers, each of which encloses **two** (males.

After pollination by the agency of wind, the fruit ripens in the same year.

**Fruit.**

so that in October the full-sizt.'d mature acorns may be se**en** in connection with twigs produced during the current year. Nearly always the ovary changes into **a** one-seeded acorn, though it previously possessed six **Ovules** ; yet cases are known in whir 11 •**Al** six ovules change into seeds, *w* which case the acorn produces six seedlings. The scales on the cupule overlap and lie flat against the surface.

The seed is wholly occupied by the embryo, which i« mainly constituted of two large cotyledons; these arc **Sat** on their inner **(applied)** f;RVSi b1U **rounded** on *n^ outer.

**Seed nnd Ciermttiation.**

In germination the root emerges, the acorn-wall splits, but the food-containing **cotyledons** remain **below** or on the ground. The main stem, grows up **and** produces at first little scale-leaves ; Urns the y<.nnK **seedling** spends its substance **Beady** entirely in **producing a deep,** unbranciu-d tap-root, and a long, unfr.l ia, e1 .... ,n, which shall misi-tlie **orsl green leaves** above the **adjoining** humble vegetation. Thereafter *UH* **growth** of the yon, ig tre,; is moderate-n,.JtiK:r so ra]]|,| ,, ^ *ot* tlie Birch, nor so slow **as** that of the Beech.

Fig. 2371-Fruit of Pedunculate Oak,

The tree may attain **a** great age, probably **a** thousand years.

The Oak can grow on various kinds oi soil, and even **endures** the vicinity of the sea, though in windy exposed situations **it** dwindles to a wind-clipped dwarf {Fig. 31), The Pedunculate Oak is said 10 demand more moisture than the Sessile Oak; at least it is found more .ibunduntly in moistcr lowland soil

Fig. 239.—Oak Spangle-galls.

**Fiji. 338.-Oak Apple-calls.**

**than** the latter, **which** often occurs ;it higher levels on hiUsides. The difference in the situation of tin- two species partly accounts fur **their** difference in form (thickness of leaf) and behaviour (time of sending out foliage). *Q. pedunculate* is generally more common in England, but *Q. sessilifhra* is the more **abundant** in certain parts of Wales.

Tn addition to interm^li.it.- forms there are various peculiar cultivated or wild varieties of one or other **of** the **two** species; such as columnar and weeping forms, as well as forms with split or narrowed leaves and lobes.

Tin- Oak **suffers** from a horde of foes—both fungal **and animal. The** 0.iii-. most familiar **effects** <r these are galls, caused by minute midge - like gti 11 - **wasps** *(Cynipida),* which pierce and deposit eggs in young **developing parts** of rootSt stems, or leaves, and thus cause these to produce distorted members known as galls (Figs, ig,

20, 238-9). The study of these galls is complicated, because ; (1) One and the same species of insect at different stages of its life may cause two entirely different, though perfectly characteristic kinds of gall. (2) If we open a gall it may contain—first, the small insect causing it; secondly, other insects that have invaded tht- gall; thirdly, minute insects whose larvt« an> parasitic upon the two preceding types of vegetarians; and, fourthly, still more minute ones whose young are parasitic on the par. *u-hv* fpsi ni.-ntioned.

## QUERCUS CERRrS (I»IK.).-.TURKEY OAK (*Fagaceæ*)

*mw cerris* is an oak which sheds its leaves every autumn and, in habit, is very like the Common Oak, but is easily dis-

Fig. 240.—Fruit of Turkey Oak—*Quercus cerris* half-grown—and ripe fatten.

tinguished by the persistent stipules, the outer scales of its rcstirrg-buds, and scales on its cupule, all of which are narrow, elongated structures which taper to a thread-like end.

In the following brief account comparison is made throughout with the Common Oak.

The rough bark is darker, being nearly

**black.** The leaves vary greatly in form, but usually have more; pointod and relatively narrower lobes (Fig. 241);

Comparison with the common Oak.

the s**tjpules** of the upper leaves may remain attached **to** tht! twigs for more than a year as bhrk threads.

The resting-buds, for the most part, show the narrow thread-like ends of tin- outer scales *(see* the topmost bud shown in Fig. 242).

The flowers and inflorescences (Fig. 46) 1iv drsifOivd .mil arranged ,i» in tin- **CoitixnOD** Oak. but the male catkins, by reason of their length and number, are more **conspicuous.** The litt**If female** inflorescences with short stalks show one to four flowers.

**The greatest** difference **concerns** the fruit. After pollination, iji April or May, the ovary

Fig. 241.—Shoot of Turkey Oak.

and cupule grow comparatively slightly in their first season, so that the following spring finds the young fruit represented by a very small juvenile acorn **concealed** within

Ripening of Acorn.

a little " mossy " 01.1 pule (Fig. 46, 1a). In its second season the fruit grows greatly, and ripens, so that the **fall-sized acorns** are **connected** with the previous year's **twig** (so-called two-**year-old** twig).

The acorn projects from **a** cupule from which stand out many narrow, elongated, and curled or **curved** scales that cause this tree to be known as the " Mossy-cupped Oak " d — - 240).

The tree is a native of the more southerly parts of Europe, whence it has been introduced into England, where it is by no means uncommon.

Three American species of *Quercus, Q. coccinea, Q. tubra,* and *Q. Pht/tos,* occasionally soca in Eng- Jisliparcicnsor parks, agree **with** the Turkey Oak in having leaves th&t fall each .minttin and acorns **thai** require Uvf.i **seasons** for ri**pening**, They differ. however, in that 1li t- scales on I heir acorns **resemble** those of **the** British **Oaks,** ami arc not "mossy." Q. *Phelios.* a Willow-Oak. is unlike all three others in its leaves, which are narrow, willow-like, and **devoid** of bntli teeth and lobes. The leaves of the other three am lobed and not ***v&y* tmlike.** In *Q. coccinca,* the Scarlet Oak, the young emerging leaves are vivid red in colour, wliitc in autumn the foliage is blazing scarlet. In *Q. rubra* the **young** leaves arc pink, and tlte autinnn-kaves are orange, brown, or red.

Rft- ***342.***— Twig of **Turkey** Oak in Winter,

## QUERCUS ILEX (/./,,,,).-Hc,« OAK (*Fagaceæ*)

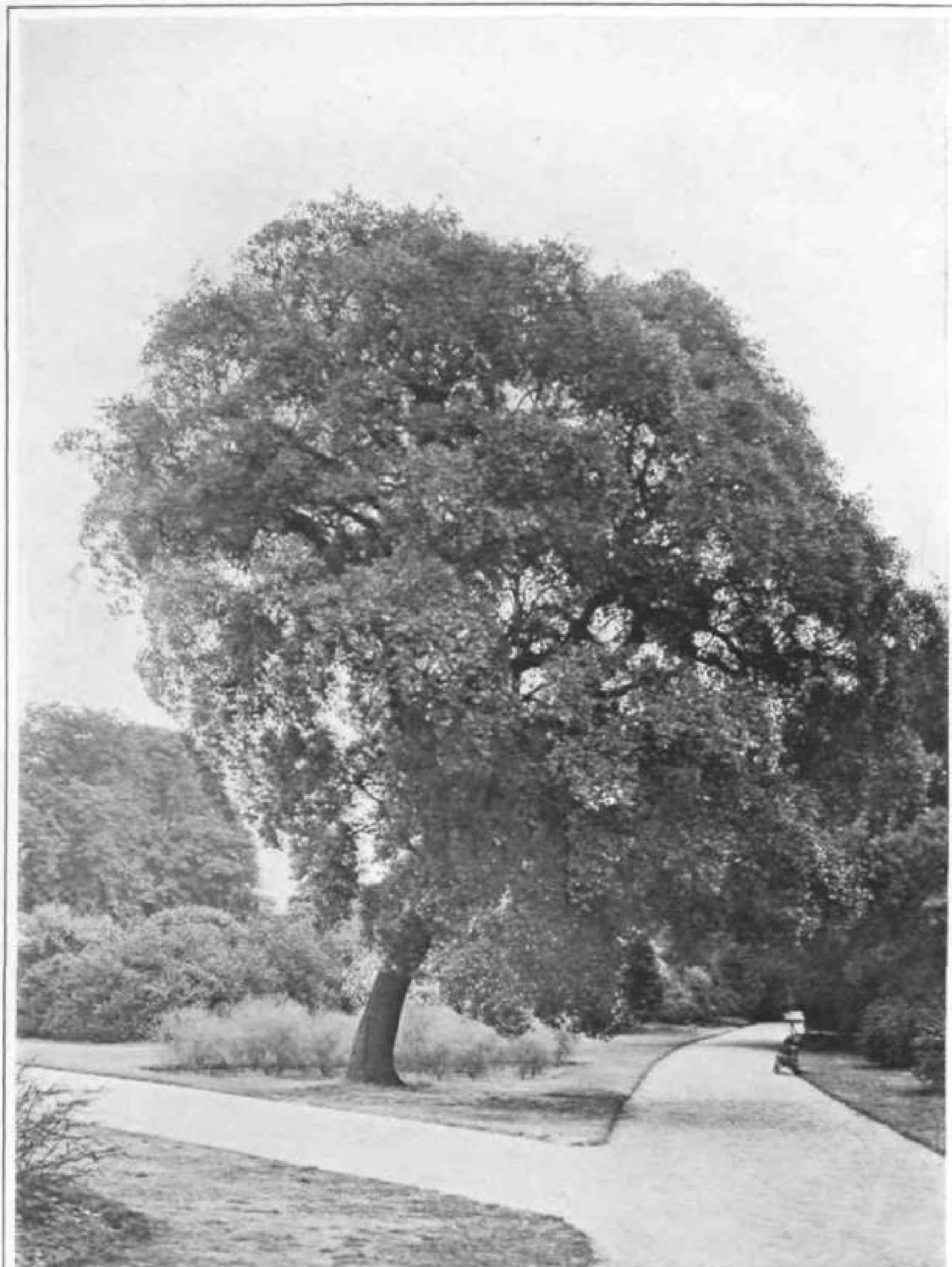
The Holm and Cork Oaks differ from the preceding species of *Quercus* to having m.r. green leaves, which are leathery and **n«rfy**

Fig. 243.—Hark of Holm Oak.

always show on their pallid lower faces a white or grey coating of close-set hairs, as do the young twigs,

The Holm Oak, in this country, *h* **a** tree of medium size, with **a** relatively short

tn.nl cr *I* SU TM OUntcd b>'fl rounded, often wide, d i v ^ 2 "***' b r o ^ or ^ey, bark is •m«i into snvjll **scales** by numerous fine longitudinal and tliinsv era*s fissures (Fig. 243)- jn **this** i* siniii;r Cnrk'oVllTT wiMl the nitiler invested in a V'-rv *I* ^^ tn,,k h covering of eadTlTEr ^eep!y furrowed



**Flj:. *344*— HOLM *QAK-QUERCUS ILEX.***

**Leaves.**

The spirally arranged leaves (Fig. 21) are extremely variable in form, showing an even or a toothed margin; they last for two complete seasons, but their stipules are short-lived. It is interesting to absorb water rapid from the cold soil, yet the evaporation of water from : shoot may be favoured by ary air anc winds; consequently, leaves retained during winter require speciai proterr • ion.

Fig. *45.-Bark of Cork Oak.

compare the nature of the leaves of the evergreen species of Oak with those of deciduous species. The former tire thicker and more leathery—and tho same is true -I p ( p 3 4 % o One reason for this Is that during winter the roots cannot

**Flowers and Fruit.**

The tree bears at an age of eight yettrs* Thc ^«'^rs J*'" in ^Pnl or May, and the J^™* ?? na riPen in Se- florescences, flowed Zdi T* ^ f ''uw*»s» and fruits are arranged

Fig. 246.— Withered Mnfe Catkins and Voting Acorns of Holm Oak.

and designed much as in the Common O;ik. the. fruits being **inserted** on shorter or longer suilks. (Figs. 6. 246-7.)

The Holm Oak belongs to **the south of Europe,** where it **can grow** on dry **Open** places. **Thus** 11 it* tliirkmss and hairiness of **the** leaves must also be associated with the dryness of soil, and ciryness of summer, which often **prevail where** tiie Holm Oak naturally **lives.** The Cork Oak, too, belongs to **fchfi** south of Europe, **where** it often forms woods near the roast.

The evergreen Cork Oak likewise has variable leaves, which may or **may not possess** well-marked teeth. Apart from its bark, it differs from the Holm Oak in that the. **scales** of the acorn-cup **project** outwards at **their tips,** whereas those of the latter tree are closely pressed against **the** surface. When these two species have **toothed** leaves they somewhat resemble **the** evergreen *Qucrcus coccifera,* but the **acoms** of this tree do not ripen before lluir season, and the **acorn-cupls** beset with projecting, hard-pointed scales.

Fig. 247.—Fruits of Holm Oak.

## FAGUS SYLVATICA (L,«,,.)._BEECH (F,,,,,,,..)

The Common Beech is recognisable by its smooth bark, its stalked, rounded, male and female inflorescences, its three-angled fruits cylindrical in type, not being fluted as is that of the likewise smooth-barked Hornbeam. In dense forest it remains distinct

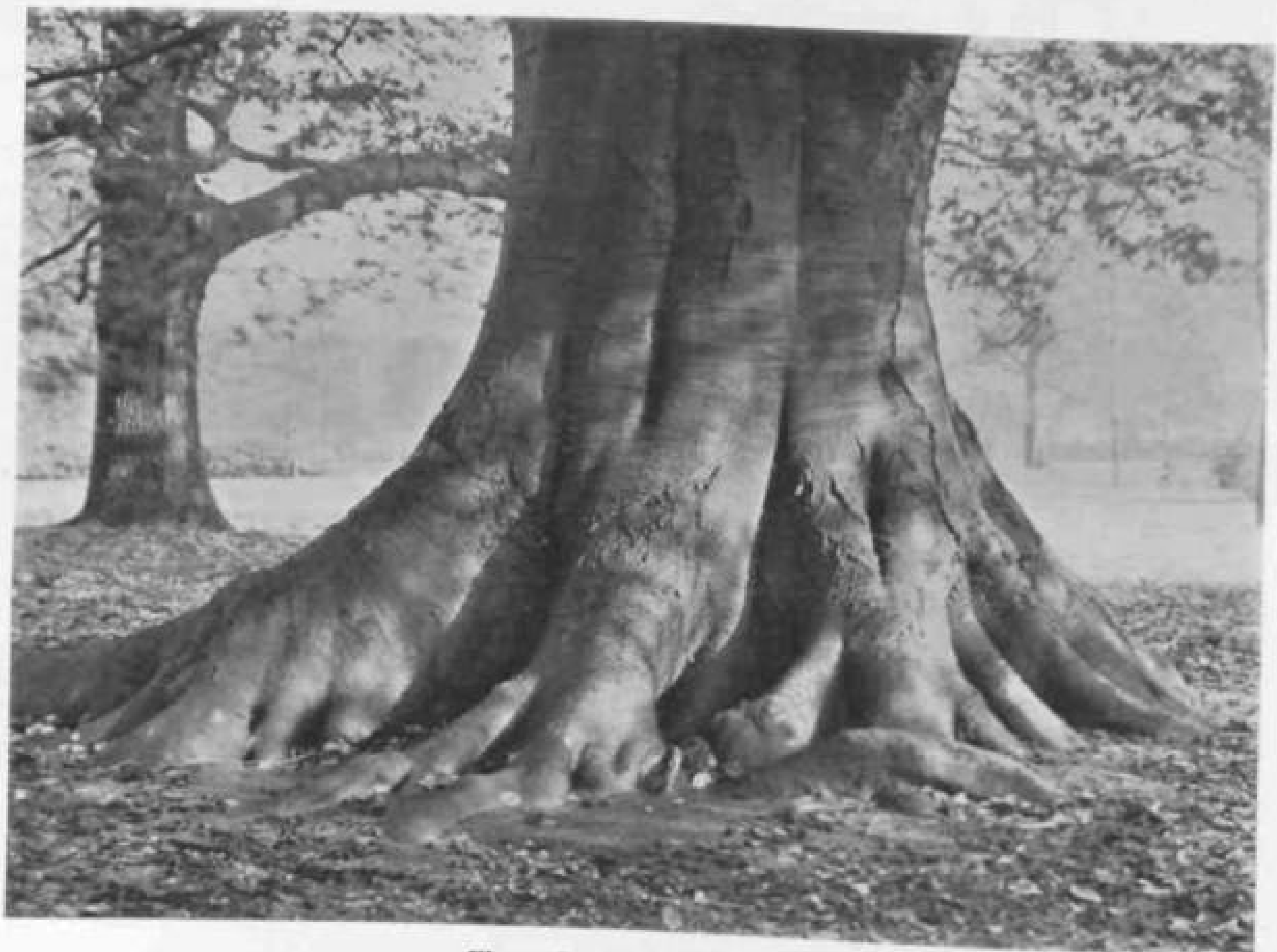


Fig. 248.—Bark of Beech.

arranged in pairs within a four-valved spiny cupule, the silvery fringe of hairs on its younger leaves, and finally by its spreading, long, narrow, chestnut-coloured resting-buds which show many scales.

The root-system, as a whole, is not deep-seated, but rather possesses very extensive shallow lateral roots which are continuous with ridge-like buttresses up the base of the trunk (Fig. 248).

The tree is a large one, sometimes 110 feet or even more in height, and may have a trunk six feet in thickness. The trunk is and straight up to the top of the crown, which is egg-shaped and may not com-[illegible] until sixty feet above the soil; but in the open the trunk soon becomes lost among a number of spreading and ascending large boughs, [illegible] crown that [illegible] nearly to the ground. The dense branching and close arrangement of the leaves cause the Beech to cast a deep shade (Fig. 1). The deep shade terminates [illegible]dlings of all light-demanding trees, as well as all herbs, save those which are shade-lovers; so that in a Beech-wood the relatively poor but characteristic vegetation on the ground contrasts with the wealth of herbs found in well-lighted woods, where Aspen, Birch, and perhaps Scots Pine may be found growing together. Even in the shade of chimps of Beeches or of a solitary tree the obvious vegetation is meagre (Figs. 1, 248).

The bark (Fig. 248) remains thin and smooth till the tree is very old ; it usually seems to be of a light grey colour, owing to the presence of various lichens, but sometimes is greyish black. Occasionally trees may be found showing the bark raised into rough stony lumps. But, quite apart from such rough-barked "She-Beeches," very old trees may show at the base furrowed rough bark.

Leaves.

The stipulate, stalked leaf (Figs. 253-7) varies in size and shape of blade, which, however, always has a marginal fringe of silvery hairs when young. The upper part of the pointed blade is toothed, but the lower parts are usually not so. In autumn the leaves show colours varying from light yellow to deep rusty-brown, and the autumnal beauty is often prolonged because of the tardy shedding of the dead foliage, which may remain attached to young Beech-trees all through winter and early spring.

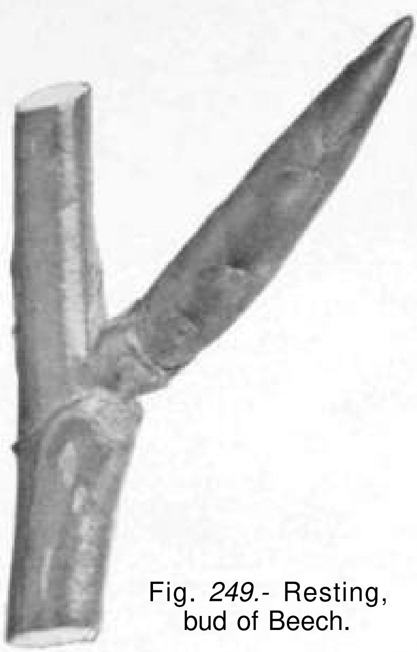


Fig. *249*.- Resting, bud of Beech.

The leaves are arranged in **two ranks,** along the sides of the horizontal or inclined stems; by twisting their stalks they place **their** upper faces perpendicular to the light. There are two different kinds

Branches.

of shoots — long-shoots and dwarf-shoots. The latter kind *{see* Fig. 255) **have** very short internodes, are unbranched, and bear very few leaves, so that old dwarf-shoots (say fifteen years of age), showing many close-set rings marking the places of fallen leaves, may be much shorter than a long-shoot only a month old. By the mingling of dwarf - shoots and long - shoots, the foliage is arranged in a dense pattern (Fig. 255). It is the long - shoots with longer internodes that provide branches and carry the leaves farther out into the light. When accident brings a dwarf-shoot into a well-lighted place, or kills the long-shoots above, the dwarf-shoot may develop into a Inng-shoot. On an inclined long-shoot the leaves are inserted nearer to the lower face than to the upper face of the stem, but the lateral buds do not share this peculiarity. Consequently the buds are not exactly in the axils of the leaves or leaf-scars, but only obliquely so (Figs. 249. 250). As the leaves and lateral buds spring from the two sides of a branch, the branching is in one plane, which, of course, is

Fig. 250,— Twijr of Beech in Winter.

Fig. 251.—BEECH—*FAGUS SYLVATICA*: WINTER.

Fig. 352. -BEECH—F.4GI/S ***SYLVAHGAt*** SL.MMER.

Fig. 253,—Opening Buds of Beech, early stages.

horizontal in the case of a horizontaJ branch. At the conclusion of the active season the terminal bud often persists, but it may die; mid be replaced by the topmost lateral bud.

The glossy, chestnut-coloured resting-buds (Figs. 240, and 250) are of a narrow spindle shape. Standing out from the stem, they show numerous scales which are arranged in four ranks because they are the paired stipules of bladeless leaves that are two-ranked. The highest buds on the year's-shoot **grow** out into long-shoots, those **lower** down into dwarf-shoots, while the lowest remain dormant. As the **dormant** buds do not retain their proper connection with the wood of the stem for more than about twenty years, the Beech **has** but few old dormant buds. <*'>n-**sequently** we do not see any young branches sprouting out from the old trunk; even when felled the Beech has **specially** to manufacture **new bud3** that sprout from its stump.

Ruds.

The various stages of sprouting shown by **a** resting - bud when **aroused** into activity are illustrated in Figfs, 25,5 **and** 2*,j. These show the pleated foliage-**leases** (.'merging from its tip. Silvery ***hates*** **fringe** the **yonng** blade ;ind coat the nerves on its lower face, especially at the angles of these, also clothe the long shining white stipules which invest the infantile blade, and adorn the leaf-stalk which **eventually** emerges. And Figs, 255 and 256 continue the story by showing **the slightly** older twig that has shot forth; tlu-

Fig, 354. -Opening |jUds of **Bcedi**, later stage.

stipules have been shed or hang down, because they have performed their duty of protecting the young leaves, **while** the hairs **on** the older **leaves** liavt: shrivelled or fallen.

**Flowering Age.**

The Beech does not bear seed until it **has** reached the ripe age of sixty or eighty years in **forest,** or from forty to fifty in open country. **Though** it can produce flowers i-very year, rich crops of seed occur only at **intervals** of live, six, or even more years. The flowers open ut the same time as the **leaves** eume out, in April or May • the imit ripens in September **of** (he same V'-.ir. ;md is released in October.

„ **Flowers.**

*T\w* male and female flowers are **arranged** on long-stalked, almost globular inflorescences, which arise in the axils of leaves on short branches of the current year. The feebler flowering branches, distant from **the** tip of a shoot, may bear only

**FJJJ. 255. — Brunch of l!i-iv!i OIKvi in:; completed Vear's-shouts, and Inflorescences.**

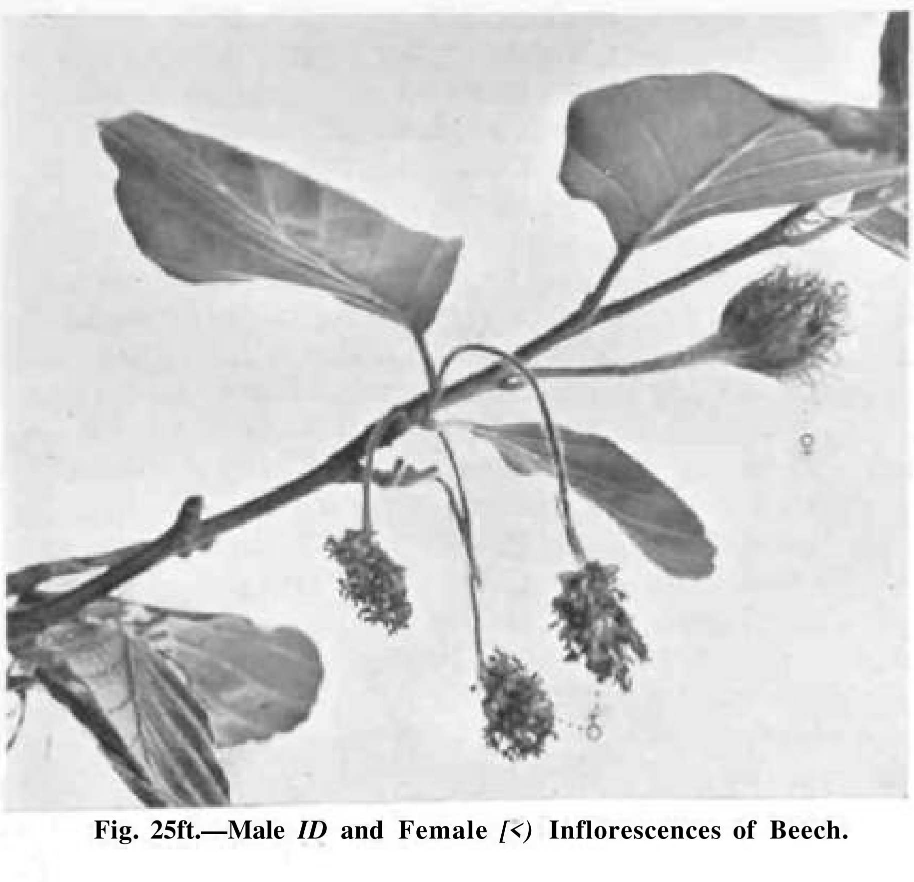


**Fig. 25ft.—Male *ID* and Female *[<)* Inflorescences of Beech.**

**male** inflorescences (Fig. 255, ? ) ; but the mure vigorous and **exposed** ones have in the axils of their lower foliage - leaves male inflorescences which are pendent on ioug, slender stalks, and in the axils of their higher leaves female: inflorescences which have shorter, stouter stalks that enable **them** to stand erect *(see* Fig. 256). Both types of in-ilorescenccs may bear

Fig. 257. Fruits of Beech in Cupules.

on their stalks one or two narrow scales, and a few more immediately below the head-like groups of flowers.

The male "head" consists of a number of short-stalked flowers arranged in a tuft. Each small flower has an unequal-sided, bell-like, hairy perianth showing from four to seven teeth, which denote as many joined sepals. Within the perianth stand from eight to twelve complete stamens, whose long filaments thrust the anthers well out of the flower. In the centre may be a tiny rod-like vestige of a useless pistil,

the female "head" consists solely of two female flowers situated within a four-lobed cupule, which is externally coated with many soft narrow outgrowths that have long thread-like ends. Each hairy flower has a perianth with from four to nine {often six) teeth; it includes no stamen s. I nl he centre rises the deeply three-branched style which surmounts the three-chambered inferior ovary; in each ovary-chamber are two ovules,

Frult<

After wind has conveyed pollen to the stigma the ovary changes into a three-angled, three-sided nut which contains only one seed. Two Beech-nuts are thus encased in one cupule, which becomes hard and woody at the same time as its out-growths change into stiff bristlea or spines. In October the four valves of the cupule open out and permit the nuts to escape.

Tin- sci'1.1 is wholly occupied by the embryo, which has two broad, folded cotyledons. At the commencement of germination the root emerges from the nut and pierces the soil; and soon afterwards the nut, still concealing the cotyledons, is raised above the soil by tin- stem (hypocotyl). The opening cotyledons throw off the cracked nut-shell, and, being still folded, show their white, hairy, lower faces; subsequently the cotyledons open out, bend down, and thus acquire a horizontally extended pose (Fig. 27). The stem grows and at once produces foliage-leaves. During the first five years of its life the young plant grows in height very slowly; and even up to twenty or thirty years the growth in height of "this ^hade-bearing tree is slow. The little shaded plant has a problem to face. Its leaves are arranged in two ranks, so that if the main stem were to grow erect, and the leaves were to preserve their natural positions, the latter would shade each other seriously, HeOCe in its early life the little plant adopts an admirable plan for collecting light. The end of the leading shoot inclines and arches over, and the leaves on its sides twist so as to place their faces horizontal. In the following year it is not the bud at the end of the drooping shoot that grows up, but

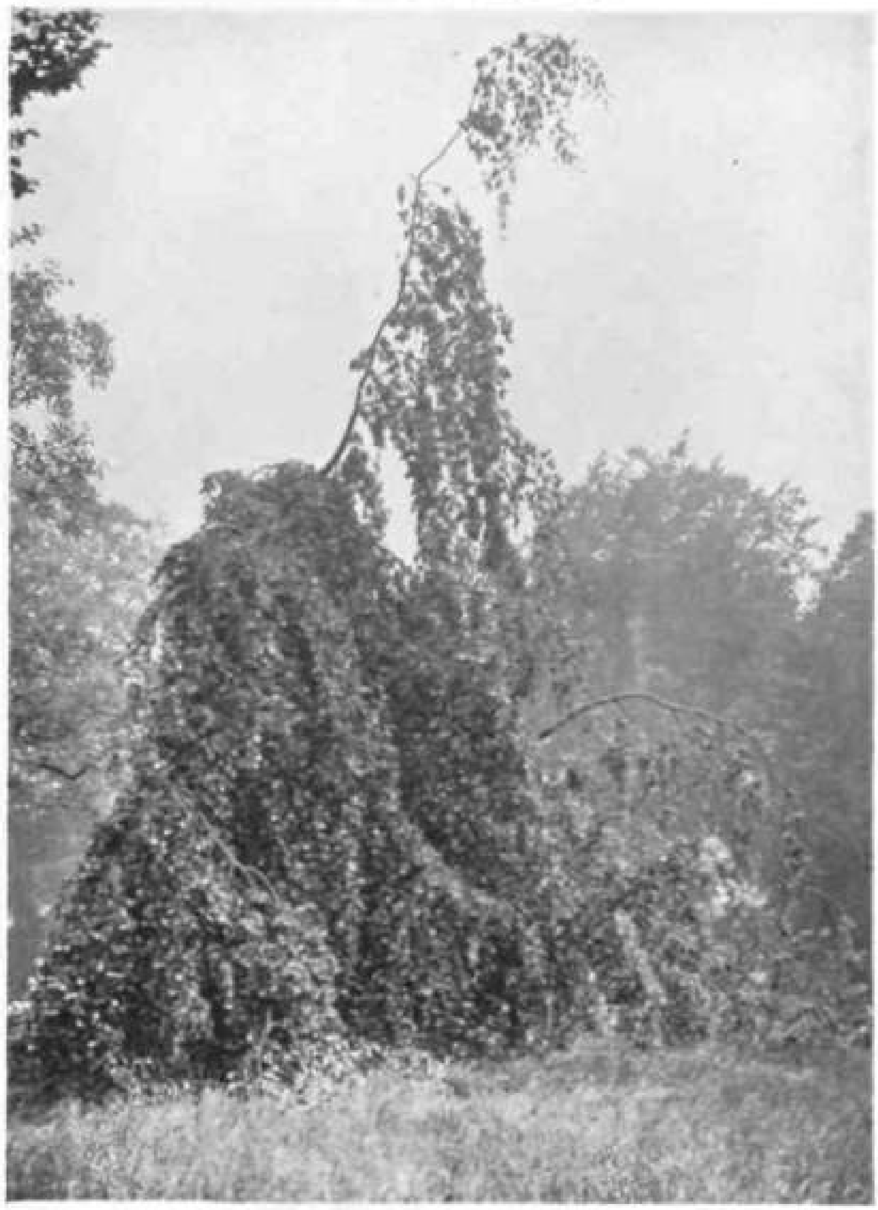
Cierm! nation.

a bud produced nearer the top of the " arch," and the resultant new leading shoot behaves in the same manner as its predecessor. In addition branches arise on the flanks so that the **juvmte** beecYi exposes mote or less horizontal fan-like expanses of foliage to the strongest Light (Figs. 2, 3). Thus the little plant does not grow swiftly up towards the light; its policy is to spread its foliage and utilise to the best **advantage** the dimmed light in which it lives.

The dominant character influencing tht- Beech-tree's distribution is that it can endure more shade than any other broad-leaved (dicotylous) British tree. And its shade - bearing quality is reflected in its smooth thin ba.rkT in its form, in the density of **shade** it casts, and in its >l"\v rate of growth in height (at least up to ati ;ige of twenty years). As regards composition of the soil the Beech is complaisant. On dry soils it is naturally stunted, but on heavy soaking soils it refuses to grow. Owing to the POULT of **producing** long and extensive, shallow, lateral roots it can lKv on shallow soil.

Among the more obvious diseases from which the Beech suffers is om- revealed in brown patches on the leaves; these patches are caused by the burrowing larvae of a CLT- **tftin** weevil *{Orchestes fagi)* winch locally excavate the interior of the leaf.

Among several varieties of the Beech, possibly the Weeping Beech {Fig. 258) **is** the most interesting, because it represents merely an exaggeration of the young Beech's mode of, growth, and of the mature tree's habit of prodvtrivig **twigs** nwte or \<?⇒s drooping at their ends. But more familiar is the Copper Beech (analogous dark red-leaved varieties of Ha^eJ. and **Cherry,** also occur}. Finally, varieties of the Beech occur with narrow or **divided** leaves, the latter **being** foreshadowed by the deeply-toothed leave? <U>lilLiyed by some ordinary specimens of this tree.



Fife, *25***— Weeping Beech.

## CORYLUS AVELLANA *{Linn.).*— HAZEL *[Bctttlaeea)*

The Hazel is instantly recognisable by its fruits, or by those buds from which crimson styles project in tufts at the same time as the male catkins hang on the leafless bush. Additional features to note are the stipulate leaves arranged in two ranks (except on the suckers or stool-shoots), the hairy one-year-old twigs, and the characteristic bark,

1 '.-- 339.—Stems of H;i/it,

The root-system of the Hazel shows no true main root; **its** place has been usurped by a strong lateral one. Many of **the** roots are shallow and horizontal, and can send up foliaged suckers. By decay of the parts R w ^ of the roots connecting the main plant with the suckers, **the** latter may become separate individuals.

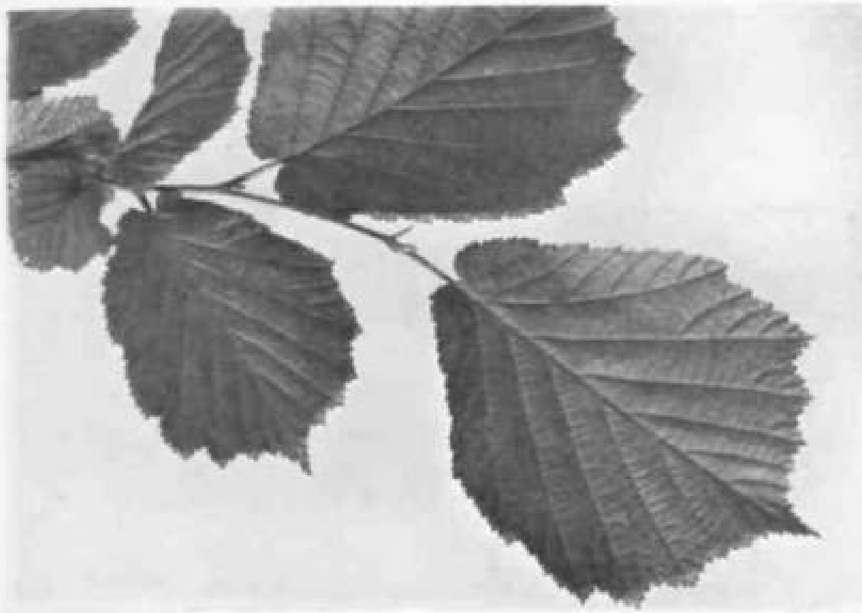


**Fig. 260.- Leaves of Hazel.**

The Hazel is a bush rarely exceeding **twelve** feet in height, and has, in place of **a** main trunk, a number of strong brandies springing from its base. The shrub owes its form to the limited growth in length of nil the shoots, and to the habit of throwing out from the roots or stool **vigorous** erect shoots (Fig. 259), which in one season may attain a length of six feet.

The bark (Fig. 259) remains smooth for years, and is marked by thin transverse lines (lenticels) w-hidi recall those of the Cherry; eventually at the base **a** furrowed scaly bark may be formed*

The stalked, simple, **stipulate** leaves are arranged spirally **00 the iiong erect** sm-kers and stool-shoots, but on the other long-shoots and **dwarf-**branches which are not erect they form two rows along the flanks (Fig. 260). In shape the long-tipped blade varies considerably, for the leaves on vigorous erect shoots tend to become lobed and to show three tips. The blade is not perfectly symmetrical, the one half being slightly larger at the base; its margins are indented with double or single saw-like teeth. In the bud the blade is simply folded along the mid-rib—that is to iviy, its right half is applied flat against the left half. Though the blade when young is coated with silvery hairs, it **becomes** nearly hairless when mature. The bud-protecting stipules (Fig. 260) may faC soon or hang on till late in summer.

Leaves.

The resting-buds (Fig. 261) **are** slightly compressed, and externally show brown <tverI;Lp{ >iDg scales, within which lie two ranks of leaves, the lowest of these latter being represented only by pairs of silvery stipules, and the higher ones by pairs of stipules with **the** young blades already **between** them. The **bods are naturally** arranged on the **ordinary** branches in two rows, *and* incline slightly to the upper face of the branch, while the leaves (or leaf-sears) **are** slightly displaced towards the lower face. This feature in horizontal **branches** is shown still more clearly in **many** other trees. If, in fete spring and **afterwards,** v. watch the behaviour of **a** leafless hairy twig **produced** during **the** previous year, **we** see the topmost bud opening, growing out to a long-shoot, which in summer dries up **at** its end **and** sheds the **terminal** bud. The place of this is usurped

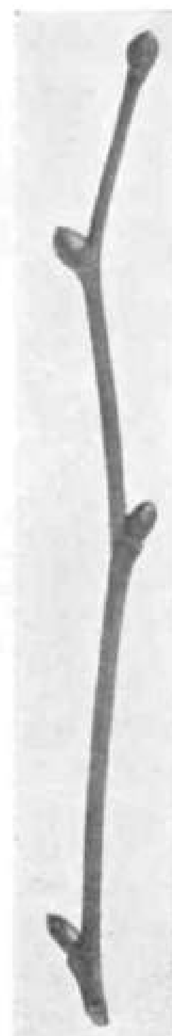


**Fig. 361, Twig of Hazel in Winter.**

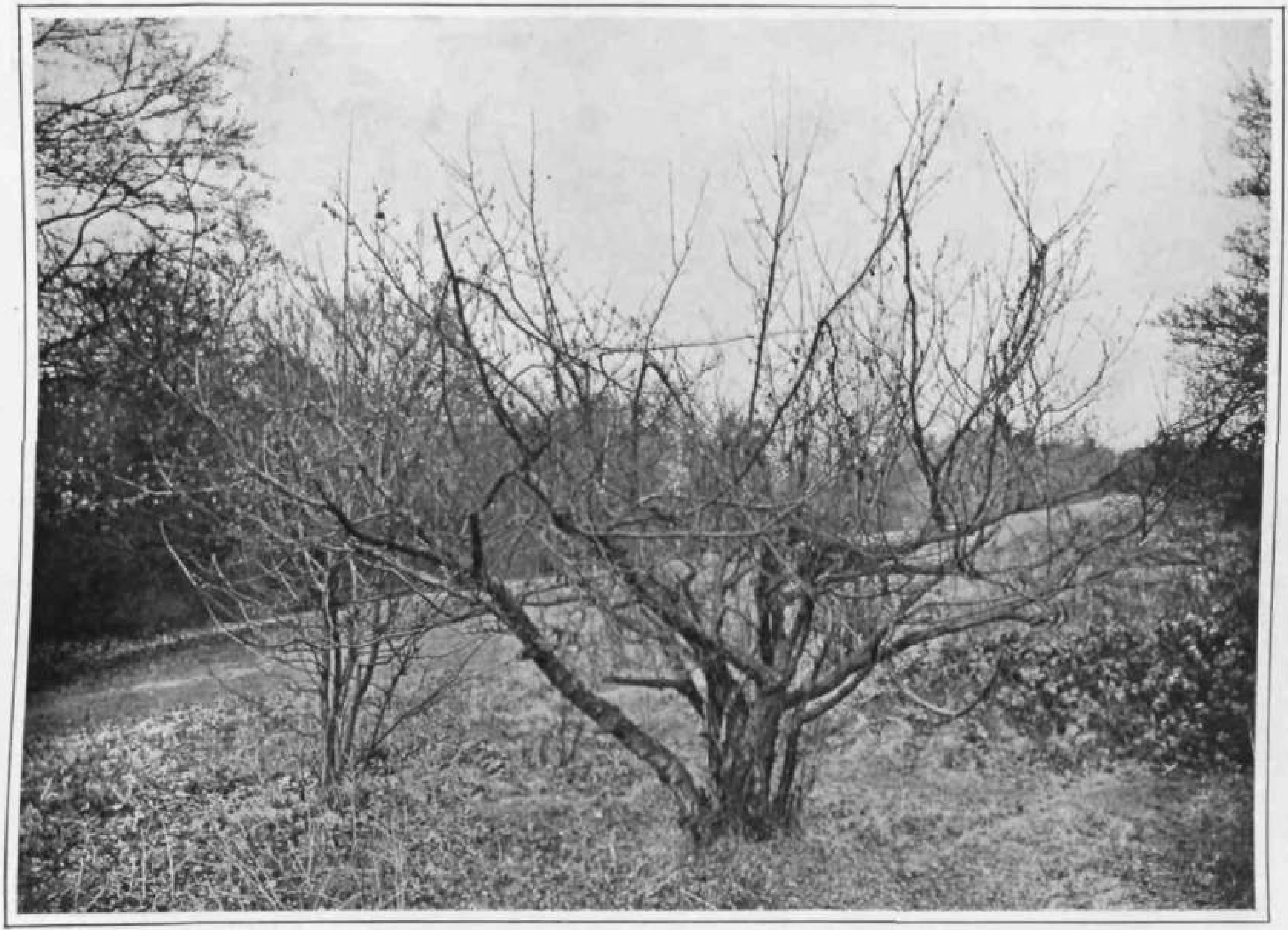


Fig. i6a.-HAZEL-C0*?V/.t;S *AVELLASA:* WINTER.

Fig. 263.—HAZEL—*CORYLUS AVELLANA*: SUMMER.

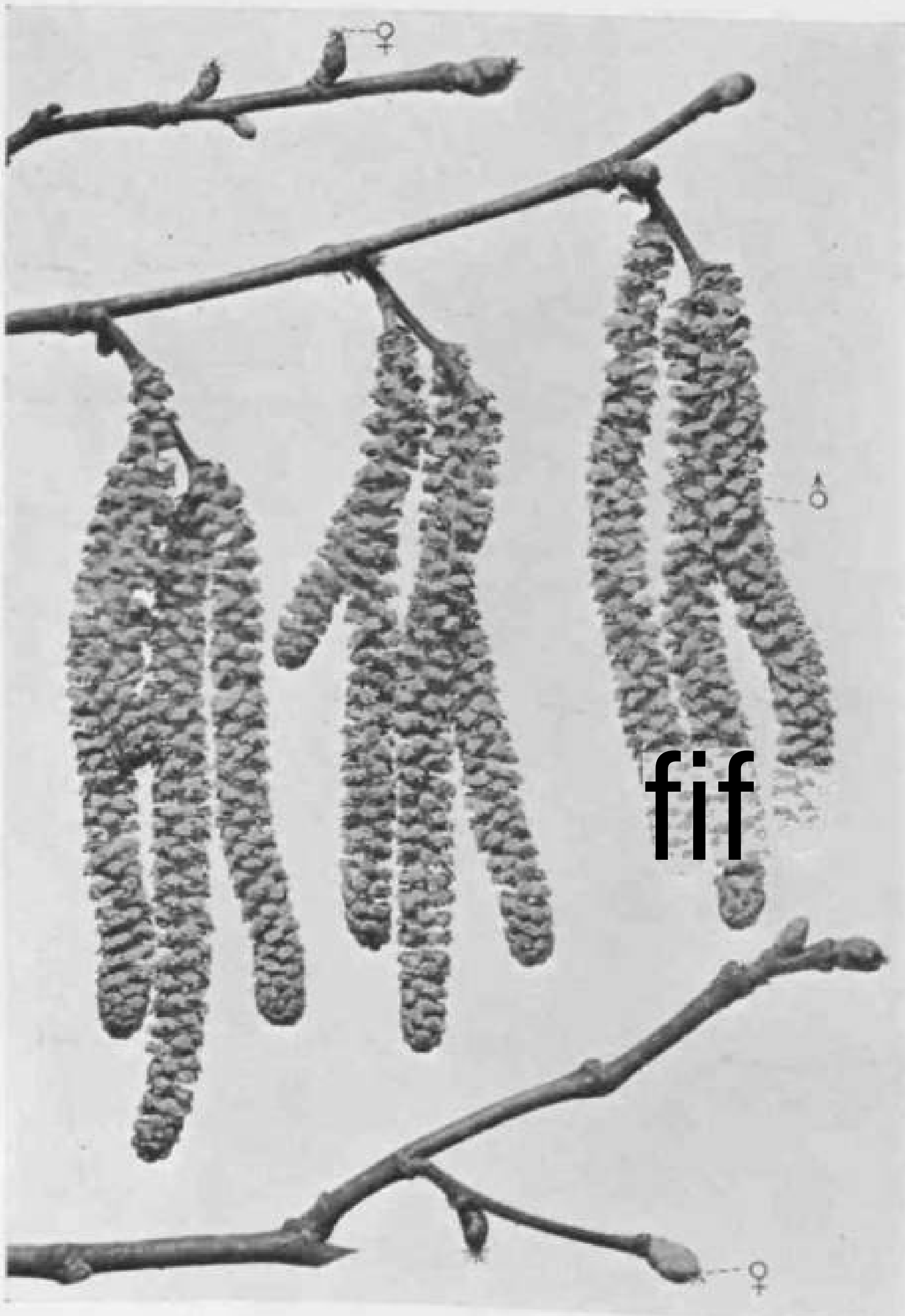


**Fig. a64.-male (S) and Female (*) Inflorescences of** Hazel.

by the topmost lateral bud, which is so displaced as to present the false appearance of being truly terminal (Fig. 261). The other lateral buds, for the most part, develop into dwarf-shoots bearing a **few** foliage-leaves.

The Hazel begins to bear flowers and filberts quite early in life, at the age of ten **years;** in uvU-]ight,d situations it b]ossoms every subsequent year, but in **shady woods** lime of allI(>ws **intervals** of three or four Flowering. years to pass without flowu- tl . -, . mg- AtTM>ng native trees and shrubs it ,s *m* first to **flower ; oftea** in January and sometimes even in December >ts catkms open long before the leaves unfold. This early flowering is possible, thanks to preparations ma.de during the preceding summer.

tk)irtg back to this summer, the shoot produces some lateral buds destined to develop into foliaged dwarf-branches, and others destined to produce inflorescences. Buds of the former nature remain inactive until the following year, as do those enclosing the female inflorescences; but the buds responsible for the production of the male inflorescences grow out in the year of their production, and give rise to branched dwarf-shoots. Each dwarf-shoot of this List kind ends in a. male catkin, and bears at its sides from one to lour others; moreover, near its base may be one or more resting-buds that will produce in tht: following year female inflorescences or vegetative branches. Tims in July or August may be seen on dwarf-shoots groups of little cylindrical male catkins. These rest naked during the winter, but, even when the soil is frozen, they may be aroused into activity by a day or two's direct sunlight, and thus cause the shrub to blossom in mid-winter. When growth commences the axis of the male catkin elongates, becomes Mnccid, droops over, and the yellow jHill.-n is shed : while "ii the same bush the tufts of red stigmas are thrust forth from the female buds.

The pendent, cylindrical male catkin (Fig. 264, t) shows a number of green bract-scales spirally arranged on a long axis. Each concave green catkin-scale bears on its (true) upper face, towards the sides, two little scales, and towards its centre seemingly about eight stamens. These stamens represent a single stalkless flower, which is thus devoid of any perianth. The stamens are peculiar in structure, for each short filament terminates in a one-lobed anther, wliich is capped by a tuft of hairs, so that the anther represents only half a complete anther. Some of the stamens are often approximated in l>airs» sometimes two of their filaments am joined at the base, and. rarely one filament (occupying the place • >f two) bears at its top two anthers. It is therefore supposed that the eight apparent stamens with half-anthers really represent four stamens, divided down their centres into eight halves, and this view is confirmed by comparison with other representatives of the Hazel Family.

Male Catkin

The female inflorescence at flowering time is mainly concealed within a bud which closely resembles an ordinary resting-bml, but shows, projecting from its tip, from sixteen to twenty-four curled crimson threads, which are the stigma-bearing styles (,Fig. 2^4P ¥ )• Dissection of this bud reveals successively:

Fif. 265.— Fruits of Hazel,

brown scales, pairs of silvery stipules, then from three to five tiny stipulate leaves (in two ranks), and finally several spirally-arranged, silky, white bracts (catkin-scales) in whose axils are the female flowers. To anticipate for a moment: as the fruits are ripening the axis of the bud will elongate, the tiny foliage-leaves grow out, and the minute flowers change to nuts. Thus in reality the female inflorescence is catkin-like in design, and terminates a foliaged dwarf-branch.

The female inflorescence itself has from four to six bract-scales. In the axil of each of these stand two female flowers which are extraordinarily simple and immature in structure. The flower consists of two long crimson styles joined at the base, round which there is the merest trace of a ring representing the future perianth. Beneath this is a minute, hairy, white, cup-like envelope which will become the cupule, but is now shallow and may already show from four to six very minute teeth. Of ovary or ovary-chambers there is scarcely a trace, and of ovules no sign whatsoever. Yet this is the condition of the flower at the very time when pollen is conveyed by wind to the stigmas. Not until six or eight weeks later does the flower reveal its true structure. By this time the perianth has become distinct as a very small, toothed fringe ; below it the swollen inferior ovary has grown and now shows two chambers, each with one ovule; while surrounding the base of the ovary is a clearly-lobed young cupule. [The two female flowers represent a stalkless forked inflorescence, of which the terminal flower is missing and only the two lateral flowers (2 and 3 in Fig. 224) are formed; sometimes the middle (terminal) flower actually does appear.]

Female flowers.

In the whole female inflorescence only few flowers will develop into complete nuts, and there is a further waste of ovules in that usually only one of the two ovules in an ovary gives rise to a seed (though sometimes a hazel-nut includes two seeds). The ovary-wall becomes hard and woody, forming the nut-shell, which, when young and green, still shows the circular line marking the former insertion of the perianth. The seed, being thus adequately protected, has only a thin papery shell of its own. The fruits are not ripe before October or November, at which time the green cupule is very evident (Fig. 265).

Fruit.

The fruits are dispersed by animals, especially by squirrels which apparently either forget where they have stored the nuts or die before exhausting their store.

The seed contains no food-material outside the embryo, which mainly consists of two large cotyledons that are gorged with oil and starch. In germination the hard shell cracks, but the cotyledons, bein reservoir of food do not come above ground; so th l t the first green leaves are foliage-leaves.

Seed.

The Hazel mt, «nAure * certain amount of shade_3. T... grow on various kinds of ground, thou h it * ^ of thoroughly wet

One intprpc+ir, A-
filbertS S f u ^ which the weevil, possesses a ZZ snl T, JSf is nearl as long as her hnri and A · I desi g eu to aid her' in th ^ nu * g deeply Z Z . ^ Theigg tvel^ into the maggot so familiar in rf^e filberfs,

## CARPINUS BETULUS (Z.i«tt.).—HOKNBI-AM *(Bctulacca)*

This tree is recognised by its hanging catkins of ribbed fruits concealed by large three-lobed bracts, its thin smooth bark is distinguished from that of the Beech by its broadly-fluted character (Fig. 266). The tree rarely in this country attains a

**FljC. J06.—Bark *ot* Hornbeam.**

and fluted trunk, as well as by its pendent m[illegible] and female catkins, [illegible] at the time when the leaves [illegible]. From the usually small root- there rises a smooth-barked trunk [illegible] height exceeding seventy feet, or a diameter of trunk greater than three feet. The [illegible] may or [illegible] remain straight and distinct up to a considerable height; in any

*Fig,* a67.-HORNBEAAl -*CARPINVS BETULUS:* WINTER

Fig. S68. -HORNBEAM- *CARPMUS BETULUS :* SUMMER.

case, **relatively** low down it gives off many rather slender bouglis **which** ascend sharply and give to the crown, when leafless, a besom-like appearance.

The bark **remains** remarkably thin and smooth, and is universally described as being of a light grey colour ; but frequently, at least, the gr^yness is due to lichens. and the bark is often of a very dark shade, recalling by its markings black watered silk. Associated with the behaviour of its bark is the exceeding longevity of the resting-bnds, which may **remain** living artd attached to the stem for eighty years, It is largely due to these aged buds that the Hornbeam **can** emit new branches from old parts of its bole or stump.

**Leaves.**

The alternate, stipulate, stalked leaves (Fig. 269) are arranged in two ranks as in the **HazeL** Their narrow form, sharp tips, and, above all, **their** sharp double teeth, are noticeable. Hairs are absent from their upper faces, though some are present near the nerves on the lower faces. The folding of the leaf in **the** bud is entirely different from that in the *Hazel,* as the blade is not folded along the mid-rib, but is plaited along its lateral **nerves,** which are parallel (Fig. 271). The bud-protecting stipules soon full. One **peculiar** feature the Hornbeam shares with the Beech : the autumn-tintetl, rusty-yellow leaves to a large extent are apt to remain attached to the twigs all through **the** winter.

**HC st i ti c* b iiu s**

The narrow, elongated resting - buds somewhat re- „ , . semble **those** of the Beech, but differ tYnm those in **being** shorter and in that the lateral ones are pressed against **the** stem (Fig. 270). Though **the** Hornbeam bears numerous leaves, and consequently numerous axillary buds, it often produces between the leaf-scar and the true axillary bud an **additional** ("accessory '*) bud. To the presence *oi* **these** the Hornbeam largely owes its power of **forming** dense hedges when **clipped** (and the persistence of the dead leaves during winter still further adapts it for **this** use). But, quite apart from these peculiar buds. the Hornbeam **]i.is a gp ii** power of throwing out -hi »ots from **puts** *above* ground or under **grcwEod, and** of thus withstanding browsing animals or pollarding.

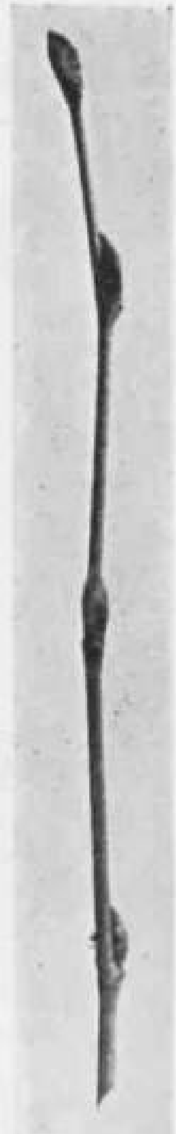
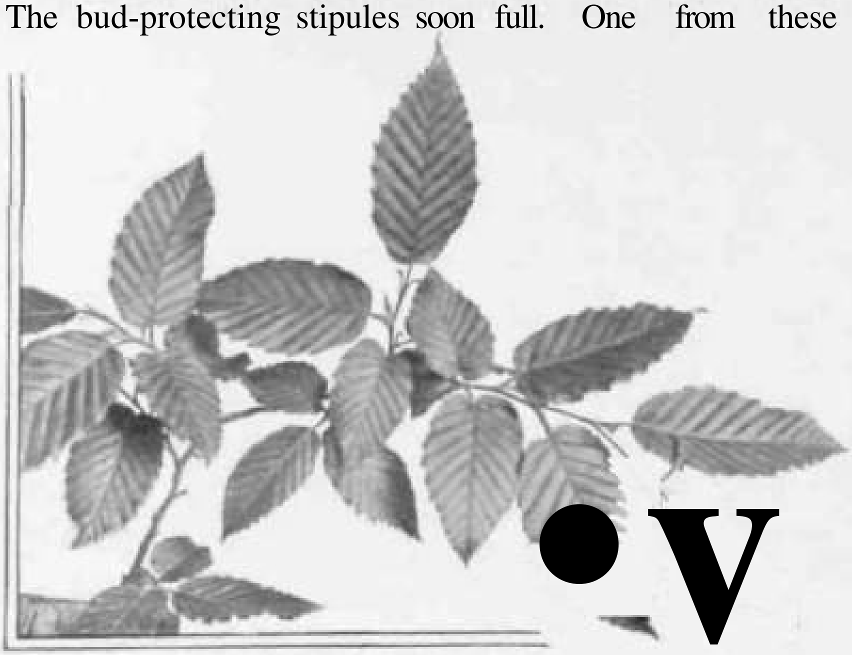


Fig. 270. Twijf of Mnrnhcam in Winter.

**Flowers.**

Flowers **appear** on **the** tree before it has reached an *& of tw«nty years, and **there-after** they occur nearly every **year,** both male and female flowers being seen on the same individual tree. The Hornbeam, in fact, shows



**Fig, 369.—Shoot 0* Hornbeam.**

extremely abundant flowers, so that in spring ill- **hanging** male catkins may give to the as yet fcebly-foliaged true the appearance of a fountain whose spray shimmers with stiver and has the faint gleam of pure yellow gold; while at a later period of the year the large three-lobed bracts of the ripening fruits may be so bountiful as to take no small share in forming green foliage.

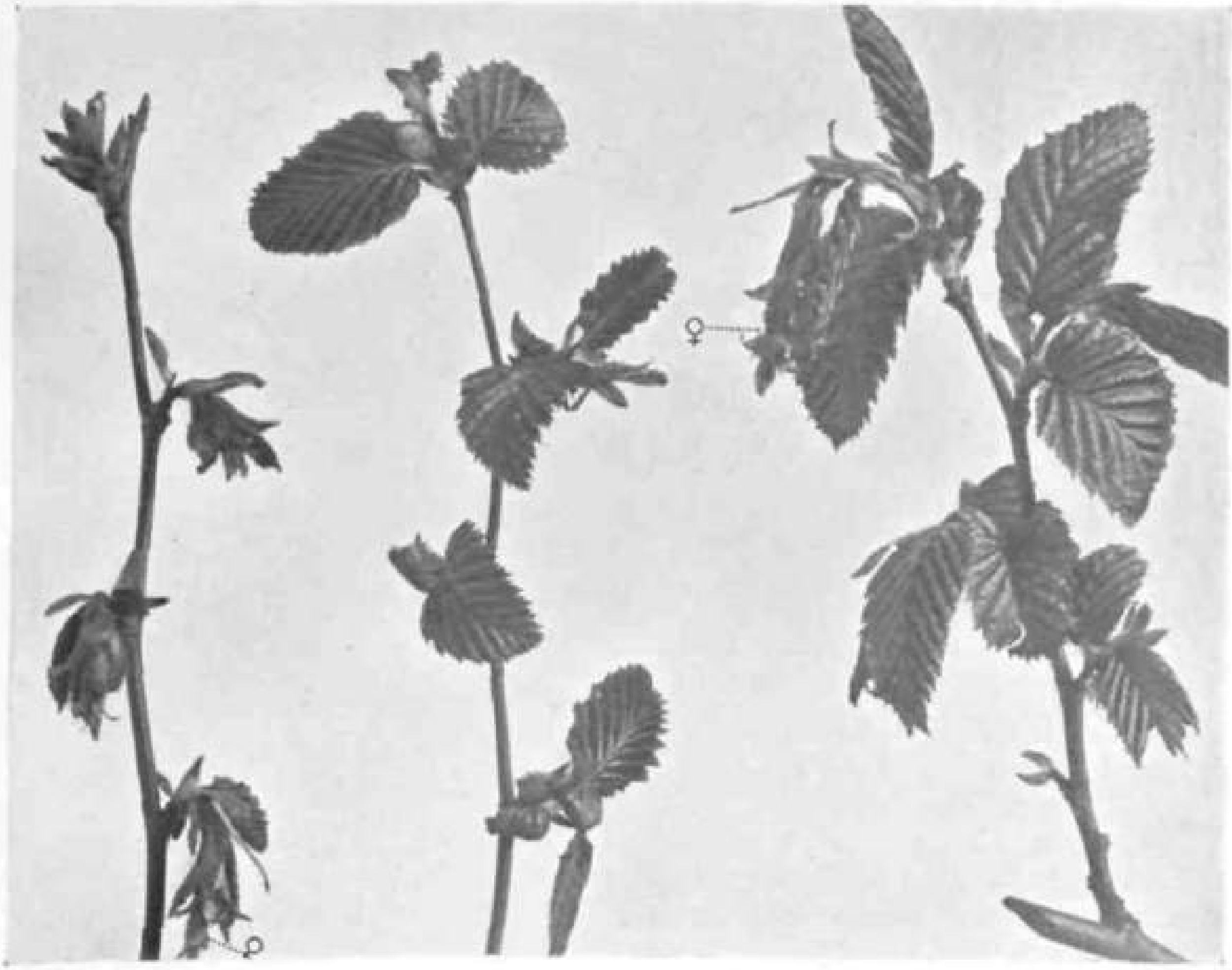



Fig. 271.—**Opening Buds and Emerging Calkins of Hornbeam.**

The male and female inflorescences are solitary catkins, which emerge at the same time as the leaves, They form **the** tcrmin-Dimns oi dwarf-shoots, and develop from *buds on shoots* that were produced during the preceding year,

The male inflorescence lies young and **bidden** within a resting-bud all **through the** **Winter** (contrast the Hazel). From such a bud there develops a short stem bearing at **its*** base a few scales and very rarely a *couple* of *fcehla* foliage-leaves, and terminating in a pendent male catkin, **which** shows many spirally-arranged green and red catkin-scales (Pig. 272, £). The concave, r.ither large and broad, oatkin-scale supports on its upper face nothing bevond from four to twelve characteristic stamens. The stamen consists of a deeply-forked filament, and each of the twu arms of the fork ends in a half-anther which is capped by hairs. Though at first glimpse there seem to be from eight to twenty-four stamens, it will be evident that the stamens are not so **completely** divided as in the HazeL

*Fig.* a?*.—Male *(6,* and PemaJe iJ) Catkins of Hornbeam.

**The** female catkin usually springs from a lateral or terminal bud higher up the twig. Tin- bud develops into a dwarf-branch, on which scales and foliage-leaves precede the very slender, pendent, and loose, female catkin that ends **fcbe** little branch {Figs. 271-2). Thus the whole design of the dwarf-branch is like that of the Hazel, but there are two points of difference in reference to its behaviour: first, the catkin completely emerges from the bud ; seciindly, the foliage shoots forth at the same time. In the axil of each narrow green catkin-scale, ajid embraced by its base, are two flowers, which agree in structure with those of the Hazel, inasmuch as each shows two long red stigmas, and eventually a two-chambered ovary surmounted by a four- or five-toothed little perianth, which is very dis-

Catkins,

t'»<* '" **the** fruit. But beneath each flower there is no cupule; in place of this is **seen a** narrow.silver-haired scale with two **tiny** lateral lubes at its base. The two thro-bbed scales, respectively belonging to the I™ . f l ™ * * a catkin-scale, stand within the latter and are placed right «* K·ft l 't- The catkin-scales soon fall, but **the** three-lobed scales (bractlcts) subsequmh become very large. l ul »»$

After pollination has been effected bv **the** agency of the wind the ovary *J££* mto • nt>^d, dry, one-seeded fruit winch is p;i,tly concealed bv the larg, three^lobed bractlets. Thus the pend-ent frmtmg catkins present a unique a L ar- '"- ^ fjg- -73). When the fruit falls, in Novemb or in spring " V""?' it carries with it tl B b,g bractlet, which acts as a sail

Fruit.

and thus facilitates its dispersal by the wind.

The seed only contains the embryo, in

**Seed.** whose large cotyledons the food foil and starch) is stored. In germ-

ination the shell of the fruit splits into

Fig- **273.—Fruits of Hornbeam.**

**two** valves, but romains **below** ground, **whereas** the green cotyledons force their way out of the soil and are succeeded by foliage-leaves.

The Hornbeam is, first of all$_T$ a shade-enduring tree, as might be surmised from its low-pitched **branching,** its smooth bark, the deiiseness of shade **east** by it, and its *slow* rate of **growth.** The

Re mei,'''/6'' seedling **actually** seems to demand shade, but this may be at least partly to avoid desiccation.

As regards soil the Hornbeam is not exacting, **though** it avoids very **heavy** or dry, as well as marshy or peaty, soils. Altogether the Hornbeam forms **a** sharp contrast **to** the light-loving Birch.

## **BETULA ALBA** *{Linn.).*— SILVER BIRCH *(Bctulacea)*

**Rg, 274.—Bark of Common Birch.**

Silver Birches are recognised by the thin. white, silvery bark, which is smooth and shows dark transverse lines; by thdr slender twigs; by their cylindrical male and female catkins ; also by their catkin-like collections of flat winged fruits·

*Betula alba* includes two sub-species or should be divided into two species, *B. pcmlula* (Roth) [or *B. verrucosa* (EHr.)j, **the White** Birch$_{t}$ and *B. pubescens* (Ehr.) [or *B. alba* in the narrow sense], the Common Birch. These in turn include and are connected by a number of forms varieties Va rieties and crosses that are **difficult** to distinguish. Ht>nce in the following description of these variable species

\"\%, 275. SILVER BIRCH-BErt/£./4 *ALBA :* WINTER.

I shall give the common and easily-observed characters usually **distmgtfehing the two.**

The root-systfcm is both weak and shallow. The Birch

perhaps t(;n years, after which they are **£ Jfi** w **£** the peeling bark.

The slender trunk, which continues dis- to the tip, usually attains only a

**Ft*. 376.** Rough **Bnrk at liase of NVIiitt Birth.**

quality *oi* producing on its roots resting-buds which can. remain passive for years before shooting up into vigorous suckers. **Tnepcw**es-sion of these buds is of particular **importance,** because the resting-biuls on tin- stem are limited in nunihrr, as they liw **only**

lieight of from forty to fifty feet and i **thickness** of **Lets** than a foot. The natively

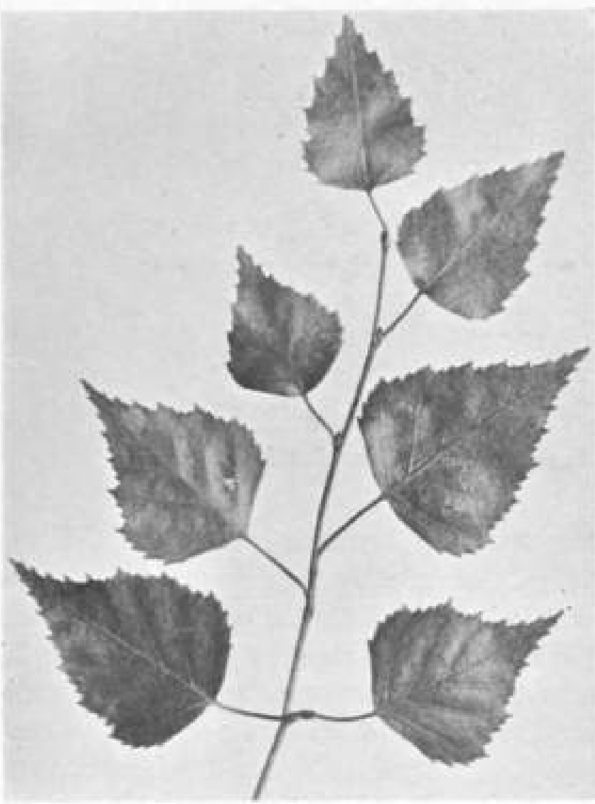
Dimensions and **Form.** give more or less eRg^hapcd crown; tiny and **Owe brandies Eray om** -it their **ends** into fin **hrigs, wfakfa** in the White Birch are so thin as more or less to hang down, as do the young thin branchlets. The Common Birch lacks this graceful, fountain-like pattern of growth, as its more close and spreading branches rarely droop ;\t their extremities. Another distinction concerns the surface of the slender one-year-old twigs, **which** are pubescent (clothed **with** hairs) in *B. pubescens,* but show more numerous clear glandular lumps in the White Birch.

Bark.

The bark (Fig. 274) is **silvery** white and marked by long transverse lines (lenticels). As it regularly flakes off in delicate papery scales it remains thin. But rough, deeply-furrowed, dark-coloured bark shows itself **at** the base of the trunk of the White Birch up to a height of four or more feet (Fig. 276). This rough basal bark is kicking or feeble **in** the Common Birch, which also differs in that its bark is sometimes brown, especially in wet situations.

Leaves.

The long-stalked stipulate leaves (Fig. 277) are spirally arranged, **though** on the inclined shoots they, as well as the branches, tend towards a two-ranked arrangement. The variable leaves are doubly-toot lied, and prolonged into a point that is longer *{B. pemlula)* or shorter *(B. pubescens).* When mature they are hairless *[B.* ***pendida),*** or show hairs on blades and stalks *{B. pubescens).* It is worthy of note that on the hanging stems their blades are **vertical,** and therefore cast but little shade.



Fig, 277.- Shoot of Silver Birch.

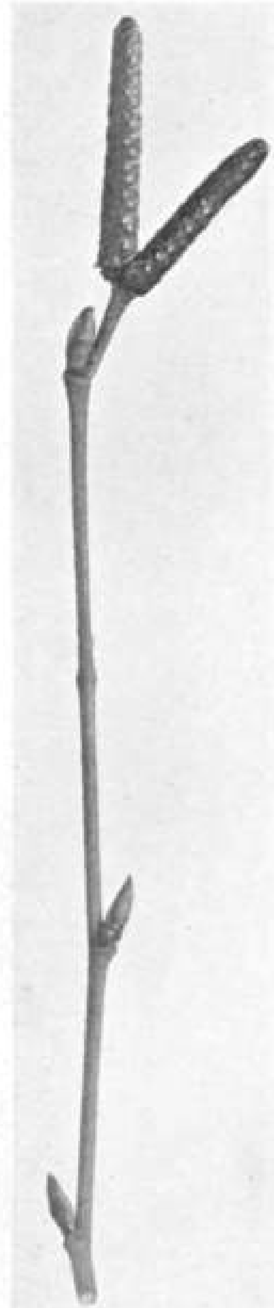


Fig. 278. -Twijr of Silver Birch.

The little resting-buds (Fig. 278) **have** spirally- arranged scales. Some grow into dwarf-shoots and others to long-shoots, and as a rule it is the topmost lateral bud on the latter that continues the growth in length, while the true termination of the long-shoot dies.

Time of Flowering.

The Bircli blossoms at an age of ten years, and thereafter with annual regularity. The catkins open with the leaves in April. Male and **female** catkins occur in the same individual tree, both are cylindrical and bear spirally-arranged catkin-scales.

The male catkins are already visible in the late summer in groups of from one **to** three at the ends of twigs, one being terminal and the others lateral (Fig. 27S)

Fig. 279.—Male (♂) and Female (♀) Catkins of Silver Birch.

In this nafeedj dosed conditkaj ttuy pass the winter, and when they open and droop by Catkins. the dongation «f ^eir axes they still remain StaCdess and dc\-oid of foliage^eaves (Fig. 279, *I*). Each catkm-scale bears on its ujiper face : (i.) tuo little scales forming lateral lobes : (ii.) thret other little scales, which represent single sepals of three flowers ; (iii) three groups of stamens, each consisting of two which are divided completely into four half-stamens (with h … the rev … three minute , ,,l f … S thcre " W * <» ' ona i sepals. «Pnsmting three addi- In such a case each flower consists of two sepals and two divided stamens. Thus a catkin-scale apparently bears twelve stamens, each with a one-lobed anther.

The female catkins arise from lateral buds that nre inserted on a shoot produced in the preceding year. Though the catkins are already prepared during the **previous** summer, they remain tomvaU-d within **rest**ing-buds during the winter. In spring the bud **shoots** forth, produces from one to three foliage-leaves, and terminates in *A* slender erect green catkin (Fig, 27Q, 51 )- EixcLt catkin-scale has at the base of its upi>er face two tiny **lateral** scabs (so that in the fruit these three together form a three-lobed scale). In its axil stands a stalkless inflorescence consisting of three flowers. The flower is utterly devoid of any **perianth, and** consists eventually of two styles surmounting an ovary, which is divided into two one-ovuled chambers.

Fig. 280. **Pruilinx Catkins: of Silver Birch.**

After iMilIination by the agency of wind, the ovary **develops** into a ltttle, one-seeded, dry, flat fruit which has its two sides continued into delicate transparent wings. Three of each such three-lubed catkin-scale fruits lie on the upper face. The cylindrical catfcm-Jike collections

I-ruif.

embryo. On germination two small green cotyledons arc raised above the ;uil and Seed. <lre succeeded by green primary leaves, which differ from the ktter foliage-leaves in having single teeth and in

Ft*. a»i. Weeping Silver Birth.

p| fruits (Fig. 2S0) may hang on for months after ripening in late autumn; but eventually the scales tumble off separately and release the winged fruits, which are blown about by tin wind.

The seed is wholly occupied by the

being more hsdrv fbnt the vigorous suckers of the mature tree also possess hairy leaves). The growth of the seedling and youne riant very rapid; in extreme cases the seedling may attain a length of one foot in its first year.

A> regards requirements, **the** dominant feitnrc of the **Birch** is that it demands more light than any other British forest-tree. This **denjand** is reflected in its excessively rapid growth, frequently in the relatively considerable length of its bole, in its loose branching, and the feeble shade that it casts. The bark, **though** not thick except at the base of one **species,** is **nevertheless white** and thus **reflects light.** It is interestingtp note **that S*** *i>ubcscens,* which is stated to endure more shade **than** ***B pMJbda,*** has usually little or no **thick bark** at its base, and easts ;i deeper **shade** than tlii- hitter tree because of its closer branching and horizontally (not vertically) extended leaf-blades. Tiie Birch is **most accommodating** as **regards soil,** *HA* it **can grow** on rather dry, light, sandy soil and dry heaths, 01 on marshy ground and in soaking moors that are soitr with peat. **In unfavourable** soils or **donates** it **dwindles** to **a** shrub or dwarf, so that in Finland a little **centenarian** "tree" was observed to have a **stem** less than three feet in height, and four **inches** in thickness. The Silver Birch extt'nds very far north in **Europe and Siberia.**

Requirements.

*Fig.* **28a.-"Witch's Broom " on Silver Birch.**

A very common and **obvious disease En** >m which the Common Birch **suffers** m:mit- • itself in the form of "witches* brooms." **These are due** to a fungup, ***Exoascus*** *hrtulinns,* whose **threads permeate the** young growing twigs, causing them to remain short **but to branch** repeatedly in all directions, **and thus** to produce large, irregular, nesttikf **complexes** (Fig. *282).*

Iiv 'in **raaggeraikin** of **the** natural tend-< nry of *B. pcnduli* there has arisen the **Weeping** Birch (Fig. 281 *i.*

## ALNUS GLUTINOSA *{Gaerl.).*—AU>ER *(Betulacea)*

The Common Alder is re**Qgnsed** by its woody mnt.'-liko nillcrvi^ns of fruiis. ***cyBa***drical brown male catkins, snuill **tone-like** female inflorescences, and stalked resting-Fjuds, **as** well as by its leaves.

The variable root-system shows one **marked peculiarity,** in the form of **obvious** loc•1 **swellings caused by** micro-organisms **which** live inside these. The **microscopic** organism, which is a very simple fungus or a **bacterium,** probably confers upon the Alder a **very** exceptional power of utilising **the free** nitrogen of **the** atmosphere as a **source** of food.

Fig. 283.—ALDUR *ALNUS GLUTINOSA*... **WINTER**

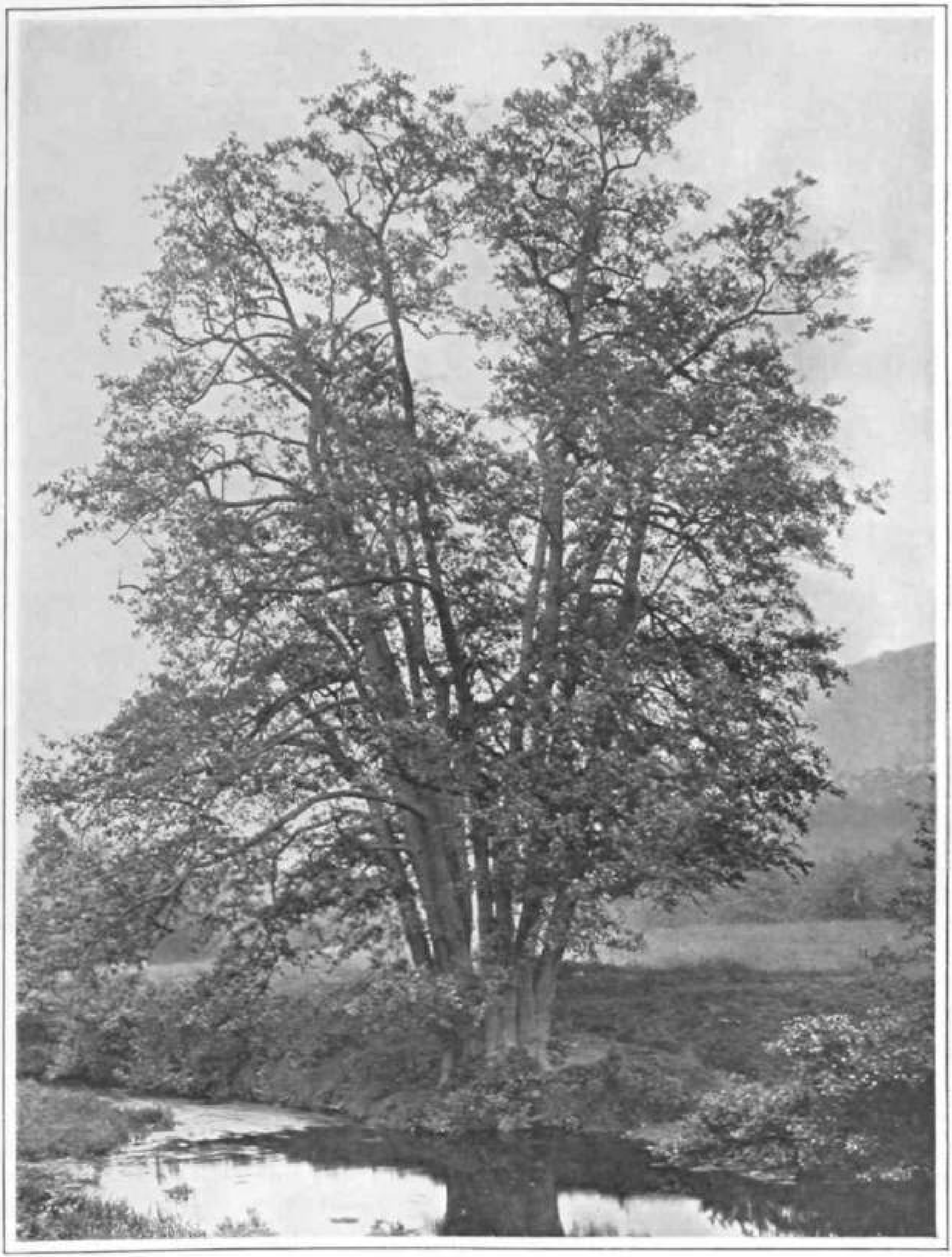


Fig. 384.—ALDER—*ALNUS GLUTINOSA*: SUMMER.

The Common Alder varies alike in **shape** **and** stature, being a bush or a tree, usually from twenty to forty **feet** in

**Dimensions and Form**

**seventy** or ninety feet), :nul possesses a tnmk only one or two feet in

**owed** it? several trunk-like stems to stool-shoots). Such shoots arise largely from resting-buds, and to little or no extent

The bark *(K\g,* 2S5) eventually becomes **nearly** black, also **farrowed** and scaly.

**Pig, 285.-Bark of Alder.**

**diameter.** It has a great power of throwing out vigorous shoots from the base of its trunk or from its stool or stump. This partly accounts for the frequently shrub-like habit {the tree shown in Figs. 283-4

The spinUly-.trr.uij^d, simple, stipulate leaves vary in **iorm** (Fig, 286). Tin- leaf-

Leaves

blade is usually **brand,** and broad-ended with a tl- •• . 1 **notch** in pki<* of **a** tip. \.-\ it mi,y taper to a

Fi*g*, a86.—Shoo{ *ni* Alder showing Young Collections of J-ruits.

**distinct** point. One general **feature** ***h*** that near its base the blade is devoid **of** teeth, but **elsewhere** possesses double **indentations.** Though hairless for the most part on both **faces, the blade** shows **on** its **cinder face** in the **angles of** the larger lateral nerves little tufts of hairs. Among **these** art; often to be found **Entente** mites which, for in- **afleqnate** reasons, have been **supposed** to act as health-officers **that** keep the; **leaves** free from infectious fungal **spores. In** the bud the blade is **foMed** along its **side-nerves** and when it emerges is sticky (glutinous), as Jive the young twigs.

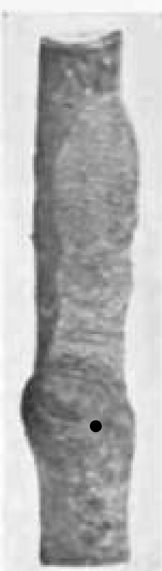


Fig. 287. Stalked Resting bud of Alder.

**The** ivst ing-buds show one character **that** is nearly **Unique** among our woody **plants: they** are stalked (Figs. 287-8). The **relatively** large and blunt **reddish-brown** bud generally shows **a whit*** bloom mi its surface (as do the twigs). It presents the false appearance of being clothed by only-one scale. **In reality** there are two or three visible on *the* **outside,** and these are really **stipules** of **the** lowest two **leaves.** The projecting **leaf-cushions** give to the leafless stems of the dwarf-shoots a knotted ap-pearance.

Resting-bud.

The Common **Alder** first bears **flowers** at the age of from fifteen to twenty years in the open or in « uppity, but not till riper iL'e (**perhaps** forty years) in **high-forest.** Tin- flowers **open in** February or Maivh, one 11 r two **months** before **the foliage** is **revtaled. As** in the H&zel, **tfaej wwe their appeafanrc** early in tin- **season** to long prepara-tion ; for **the** male and **female inflorescences** are **not** only in existence, but are actually **visible, at** the oud of the **preceding** summer. Both kinds **pass** the winter in a naked condition, and may be **seen** close together on **the** bare shoots, with **tin** - cylin-**dricaJ** male catkins **occu-pying** the terminal part of **the** shoot (Fig. 2S9}, and the female rone-like in-florescences standing close beneath them.

**Rowers.**

The stalked male cat-kin droops over as it opens, and has **many** spirally arranged catkin-scales

Catkins.

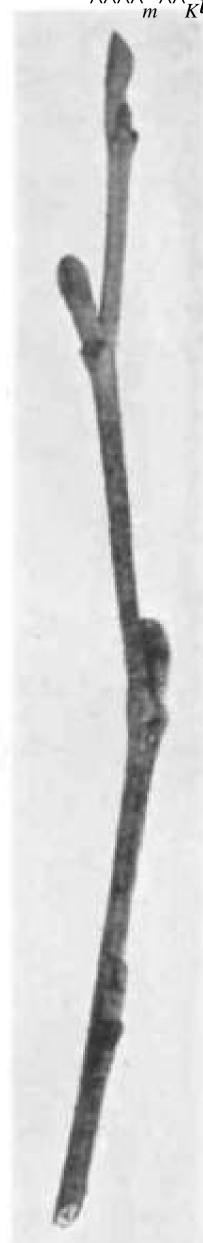
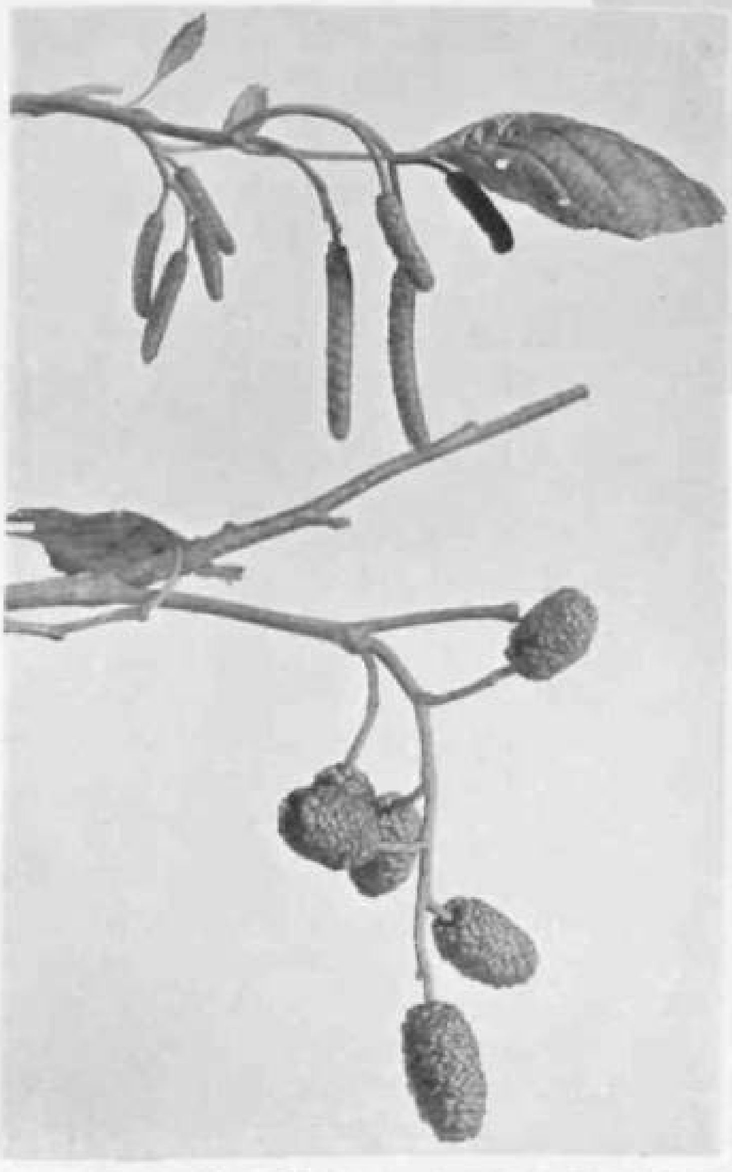


Fig. 288. Twig of Alder in winter.

(Fig. 2cjo, <?). Each •atkiu-srale is **shaped** like **a** broad-headed nail, and is blown on **the** outer face, s<) that the catkin is of a characteristic brown or rusty colour. The catkin-**seale** bears on its upper face **two** pairs of little scales, and an inflorescence comprised of three **flowers.** The flower consists of lour green sepals joined at the base, and **Eotd** complete stamens **exactly** opposite to (not alternate with) the four sepals. Thus, as **seemingly** in the Birch, the catkin-scale shows on its **upper** face twelve stamens, but in the Alder the stamens are provided with whole anthers.

**Fig. 290.—Male (£) and Female (9) Calkins of Al.k-r.**



***f'\g.* 389.—Alder In Autumn, showing next year's Male Catkins (above) anil closed ripe "Cones" (below).**

The small stalked cone-like female inflorescence (Fig. 290, ?) remains orect, or often tends to become so. Each of its spiral*ly*-arranged catkin-**scales** is flat, and bears on the **opper** face two pairs of little scales and two **flowS** The female **flower** is like that of the Hazel, except that there is no perianth, and agrees **even** in the **absence** of **ovules** or any distinct **ovary** chamber at this timt\

After pollination by **the** aid of the wind the two-chambered ovary

Fruit. changes into a light-brown flat fruit **which** is one-seeded and dry, and for a time preserves traces of the two **styles.** But in **the** interim great changes have also overtaken the femalo inflorescence as a. whole. **It** has **attained** the size of a filbert; every aitkiu-scalt: hus acquired a st;ilk and become brown **and woody,** as **have the little scales perched** nn it**;** so **that** each **hard** fruit-scalu **evinces** signs of being composed of five scales joined together, and **carries two** flat fruits on its upper facu. This **cone-like** collection of fruits, though ripe in September **Gt October** (Fig. 289), usually **remains dosed** during the **ensuing winter. In** spring **the scales** gape **asunder** but do n<»t fall {Fig. 291). and tin[1] link **flat** closed **Jhrita** are blown ;ibout by the wind. **The empty** cones may remain **attached** to the iree for many months, but **sometimes** as they are opening the twig bearing them **becomes** brittle and is **easily** snapped by the wind.

The seed is wholly **occupied** by the embryo. In germination the tiny seedling sends its cotyledons above ground.

**Fig:. 39'.—Open "Cones" of Alder.**

**Hahlts.**

In regard to its habits the most marked **feature** is the Alder's **selection** of moist situations; for it is usually found on the bunks of rivers, streams, or pools, or growing in or near marshes and bogs; **yet** the tree is capable of existence on drier soils so long as the air is **sufficiently** moist.

# JUGLANDACE^

THE **Juglandaces** differ from the Sali-cacot. Rtgacea and **Betake^** in structure of ovary which » one-chambered with one ovnk, aLso in having the **^mlly** o>,n-pound leaves **devoid** of stipules **The char-**acters of the family *. suffidemlv illns-trated by tlxe single r,prt,sentatuv £ * £ £ In tins mnntry-^the Common Walnut

## JUGLANS REGIA *(Linn.)*.-.W.LNUT (*Juglandaceæ*)

The **WalilUt** ta» itself is ra'^misablc by its familiar **fruit,** its thick male catkins and simple t,r,ninal f,,male inflorescences its alternate compound 1, ,v. >. ;Uid Venilnr

**Fig;. 2Q3,—Bark of Walnut.**

Fig. 293.—Twig Of Wnlnut in **Winter.**

**large, chambered pith, The** last **character** ivndt-is tht- **Walnut unxDistakable among common** trees.

**Trunk an J Bark** The **short** trunk breaks up into large ,. , ascending and spreading 1) nighs, whirh with their branches **are** tortuous, and give rise !•• an ample broad **Grown.** F.ven the **smallest** twigs have a coarse appearance. Th" rough bark (Fig. *H)2)* is furrowed often in *A* net-like nmuntT, and is frequently of a light-yellowish **ashen colour,**

**Leaves.** The exstipulate stalked **leaves** (Fig- -'H) show from four to nine **leathery,** ti;iirless leaflets, usually **arranged** in **opposite** pairs with an odd terminal leaflet; the leaflets are not toothed at their margins. The leaves are spirally arranged, so that **the** Wnlnut is **easily** distinguished from tlu- opposite-leaved Ash.

Fig. 294.—Leaf of AValnut.

**Resting-buds. The** resting-bud (Fig. 293) displays only few scales—in fact, two large scales **often** nearly conceal the **others.** The **terminal** bud is much **larger than the** lateral buds, beneath ieaeh of **which** there is often a **second** sin; 1 Her one. The broad core of the thick young twig **is divides into a series of compartments,** because the wide pith is broken up **into separate** transverse partitions, so that the pith **is described as being** "chambered" (Fig. 295).

**Flowers and Hruit.** The Walnut blossoms late: in April or in May at the same **time as the young** nisset ,, tinted leaves emerge. ( K >od crops of **fruit** succeed about every alternate year, and ripen **late in** Si **p**tembcr or in **October.**

**Catkins. the** pendent nn!- **cat**kins **are** in tin- axils *Q{* fallen **leaves** tm **the twig of the preceding year, while the creel female** inflorescences terminate; shoots produced during the current year. The **differed** • in position of the two

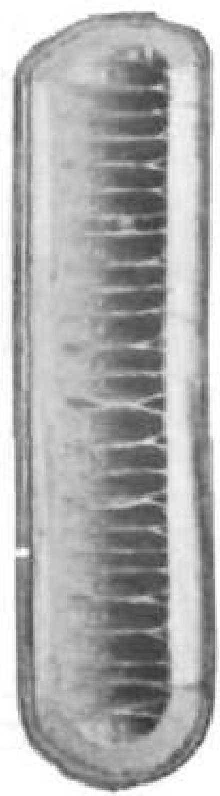


Fig. 295. **Chambered I'M li <if Walnut.**

Fig. 296.—WALNUT—JUGLANS REGIA: WINTER.

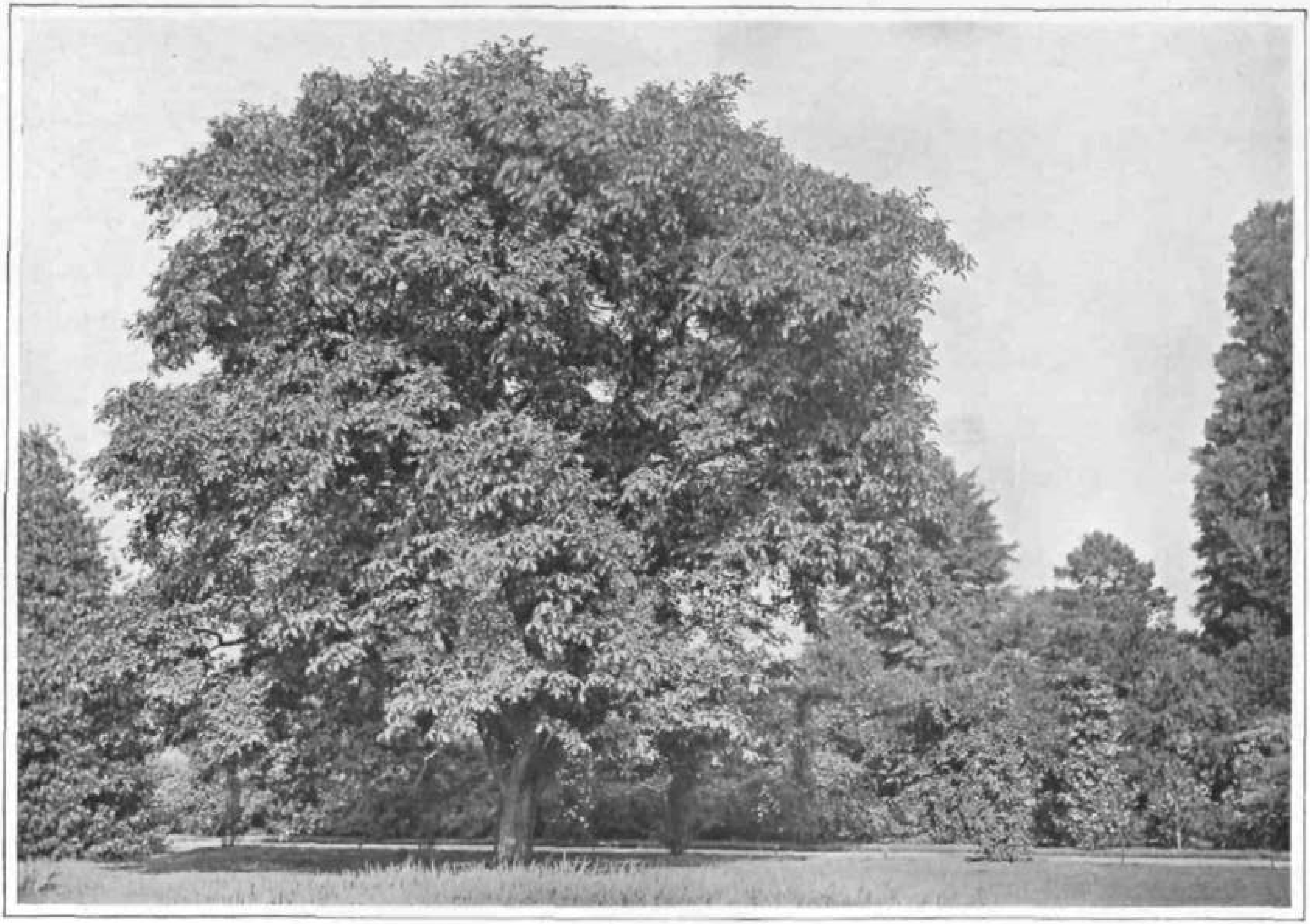


Fig. 297.—WALNUT—*JUGLANS REGIA*: SUMMER.

Fig. 29S--Male *ft* and Female ft) Inflorescences of Walnut.

kinds of **inflorescences** seems loss remarkable when the **matter** is **re-stated** as follows; Both kinds arise from rcsting-**buds** produced during the preceding **season ;** the **lateral** buds concerned grow out into <KvLirf-branches—the male catkins—bearing no foliagc4eavcs; **the terminal buds** concerned develop into **dwarf-branches beanng foliage-leaves,** and **terminating** in ;L **sample** "spike" of female flowers-.

**The** thick, cylindrical, green, male catkin> (Fig. 2gS, $) bear many catkin-scales and J-lowurs. **Each** catkin-scale shows on its upper ^ two Literal scales, as well as from four to two

**Male Catkin.**

seate-hk« segmeilts **representing** the perianth. MHhin the blu·r gfend f i ur gfend from six to twenty ***steam****. There is no trace of a pistil.

I,,,,,! **fafioresceBGe** (Fig. 208, C V **the m..l** . is a simple "spike," but is mHi > :iml includes *tm\y* ^rom one to four flowers. The flower has a single !li : ! t '• ''-^->vd ovary, containing **one ovafe attached** t, its base; **it « sur**mounts by two stigmas, as well a* **bv a** perianth consisting of fonr scale-like "s,paIs. Bu attached below and ontside the perianth .s **an envdop«** with minute rod teeth

**Female Inflorescence.**

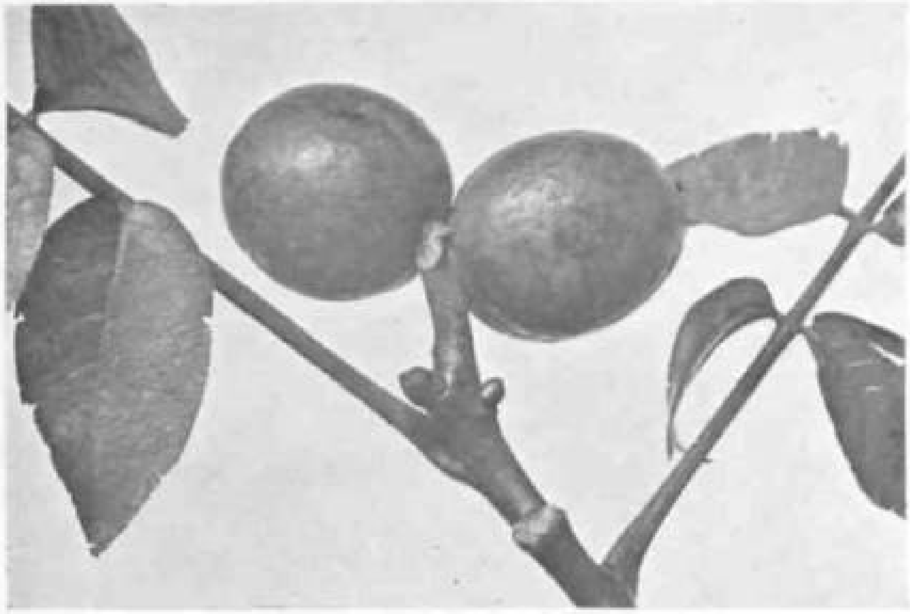


Fig. 39p,-Fruits of Walnut.

resembling an outer perianth bat representing fused bractlets: and **below** this, At ill attached to the ovary, is the catkin-scale* So that we can only theoretically spunk of the single flower *as* being in the axil of the catkin-scale.

After the breeze has carried pollen on to the stigma, the **flower develops** into **a** peculi.it fruit (Fig. 299) which is **not** a nut, but is intermediate between **an opening** fruit and **a** stone-fruit. The wall of the fruit has an outer green,

Fruit. somewhat fleshy, layer which splits open spontaneously yet irregularly, and an inner woody layer (-'stone") **which** is familiar as the two-valved shell of the **walnut** brought to the dessert-table.

The seed consists of a thin **seed-coat** and a peculiar embryo ; **the** latter i* mainly constituted of two coarsely wrinkled thick-

Seed. cotyledons, which are two-lobid because two incomplete partitions projecting inwards from the woody ^IK-II '" partly divide each cotyledon.

When germination takes place tin- hvu valves of the nut-shell are forced apart, and **the** food-containing cotyledons remain **below** ground.

The Walnut is not a native of Gi> I Britain ; it **has** been introduced inf<i **Europe,** probably from Asia Minor.

* As the ovary is inferior, both stem and carpels Nike part in **the** construction of its wall, but the minute braclMs *urn* perched high up the ovary, and the caikin-si-ide springs from it, so ilmt these leaves contribute to iis fiiriuuitoti. Thus the fleshy part of the fruit is to^ some eiteut comparable with, the cupule of the *I*agates.*

# MORACEÆ

## MORUS NIGRA (W).—BLACK MULBERRY (*Moracc.*)

THE Black Mulberry-tree is recognised by [illegible] the [illegible] (Fig. [illegible]) thick, rough

Fig. 300.—Bark of Black Mulberry.

sexual flowers, and by its blackberry-like collections of fruits, as well as by its male catkins and plumper female inflorescences.

The tree attains a height of forty to

The alternate, simple, stalked leaves have stipules that soon fall. The dark-green, tough, rough-surfaced blades [illegible] at its characteristic base three veins tlrat suggest an inclination *for the* blade to become lobed (as it rarely j&); the margin i• coarsely and unequally toothed *(V>n.* 301).

The scaly resting - buds (Fig- ."30.!) grow out into long-*shoots* or dwarf-shoots.

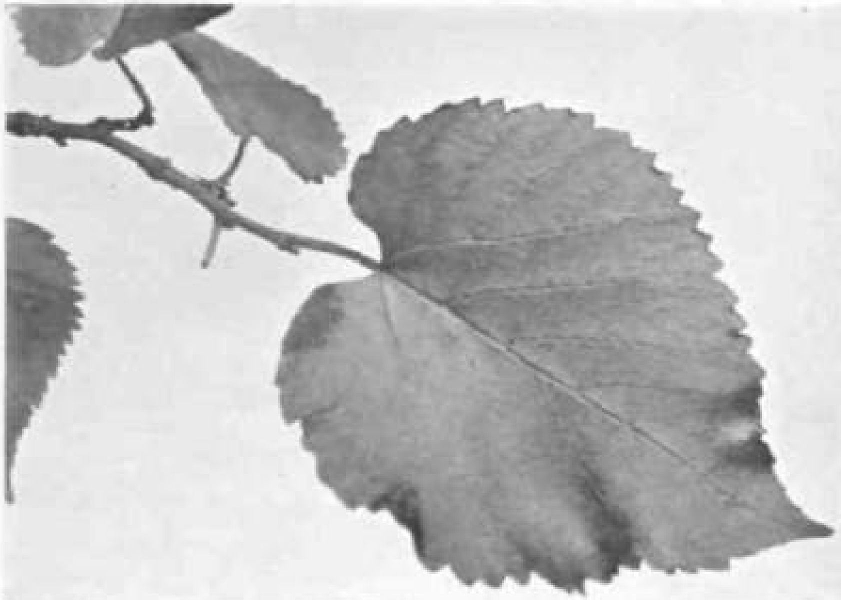
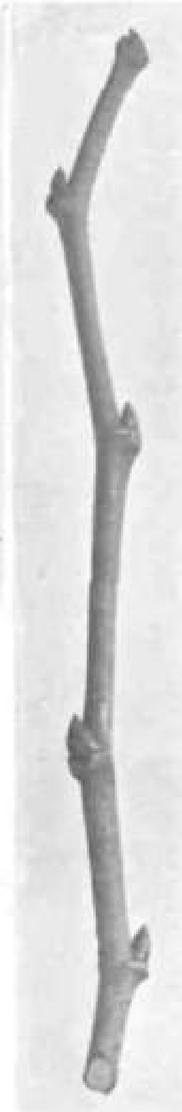


**Fig. 301,—Shoot of Black Mulberry.**



**Figk 303. Twig of Mulberry in Winter.**

**Mowers.** . 1 1

The tree blossoms in April or May. The inflorescences arise (seemingly though not truly) in the axils of leaves on shoots of the current y«ar, the male catkins being at the base of **the** shoot (Fig. 302, *$*), and the shorter-stalked plumper femah: ones tending to on nr higher up the shoot on the same individual tree (compart Fig. 302, $ ) **which** is of the White Mulberry). Each inflorescence shows an axis bearing ;t number of **flowers on** its sides.


**Fig. 301.—Male Inflorescences \1) of Black Mulberry, and Female Inflorescences (Tj of White Mulberry.**

**Male Flower.**

Tin- mule flower lias a single perianth formed of four sepals; inside and opposite to these are four stamens: and in the centre may be a minute

Fig. 304.—BLACK *MULBERSH-MORUS* *MORA:* WINTRR.

Ft*. 305. -BLACK MULBERRY-.MOff£/S *NIQRA*: SUMMER.

**Fig. 306.-"Mulberries" of *Moras nigra.***

protuberance representing the vestige of a pistil.

The female flower likewise has a perianth formed by four sepals, and in the centre is a single pistil. When young the single ovary has two chambers, but only one of these chambers grows and produces an ovule, so that the mature ovary is one-chambered. That the ovary is formed by two carpels is shown also by the fact that the style divides low down into two long stigma-bearing branches. Traces of four stamens often (always in youth?) occur as four lumps in the female flower.

**Female Flower.**

The flowers are wind-pollinated. The female inflorescence gives way to a black collection of fruits **which resembles a** blackberry but is formed by **a** number of flowers. The calyx of each flower grows over the ovary and becomes black and pulpy ; the ovary **iteeb** changes into a stone-fruit which has only I TM fleshy ^yer. Thus the mulberry-rmt is a collection of stone-fruits, each of which **is** encased in a fleshy calyx.

**Fruit.**

T havit T* MUlbGrry {M○TM •*•) differs in on- e? t n n T B***M «- smoother leaves, **and** (se^ 302). 1S Bn^**tad at the base

# ULMACE/E. ELM FAMILY

Two kinds of **Elm-trees** represent the Ulmaceai in **Great** Britain. **They** ur* recogni^"<I by th« **snfoSaged** tufts of **nearly** stalkk'ss green *bisexual* uWi-'-. **which shoot out,** before the leaves, from buds on twigs of the preceding **year; moreover** their tufts of **Bat,** winged fruits, as well as their leaves and bark, aid identification.

Eacli flower has a bell-shaped green perianth, with from four **to** fight teeth ; opposite to these arc from four to eight stamens; and in the centre is the *two-chambered superior ov&ry,* which is **crowned** by two **thread-like stigmas and contains** one **ovule in eada dm**nber.

The dry, one-setdwl fruit, **which** *i** '>b-VMU-.1V **adapted** ***i<a- dispersal*** **by** wind, does **nut Mpcn spii]]tuiu.'i*i^!y. It* actual iipex is at tin base of a deep** notch.

Both trees .ire **rough-barked, and have** great **powers of throwing** out shoots from the stump, stool, and bole.

The simple stipulate leaves are arranged **alternately** in **two** ranks ; the blade **is unequal-sided** at **the** base and double-toothed at the margin.

## ULMUS GLABRA *{Huds.),—\Y\'cn* ELM *{(Jlmama)*

*Clmus glabra* ***[U, montana)*** is distinguished from tlie Common Elm *{U. campestris)* by having the opaque seed-ch.imbcr **at** tlie centre of the fruit; **moreover** its flowers often **have** more numerous (five to eight) perianth-teeth and stamens, and its leaves are usually larger.

**Height and Form.**

The large tree may attain a height of no feet and lias ;m ample crown, which is broader and often has **roore** spreading branches than in the Common Elm ; indeed **the** branches arc often horizontal or even **drooping,** and 1lms prepare us for the **existence** of a **"Weeping** Elm " (Fig. 5).

Tin' h.iik i- i]H'k nnd rougil (Fig. 310}, but not so deeply furrowed as that of the Common Kim.

**Leaves.**

The coarse leaf-blade is rough on the upper face, **Shows** collections of hairs at the **angles** of the nerves on the lower face, and is continued into a long point (Fig. 8). The stipules soon fall.

**Fig. 307.—Inflorescences of Wyth Kim.**

*i-iK.* 308.- WVCH *ELtA-ULMUS GLABRA:* **WINTER.**

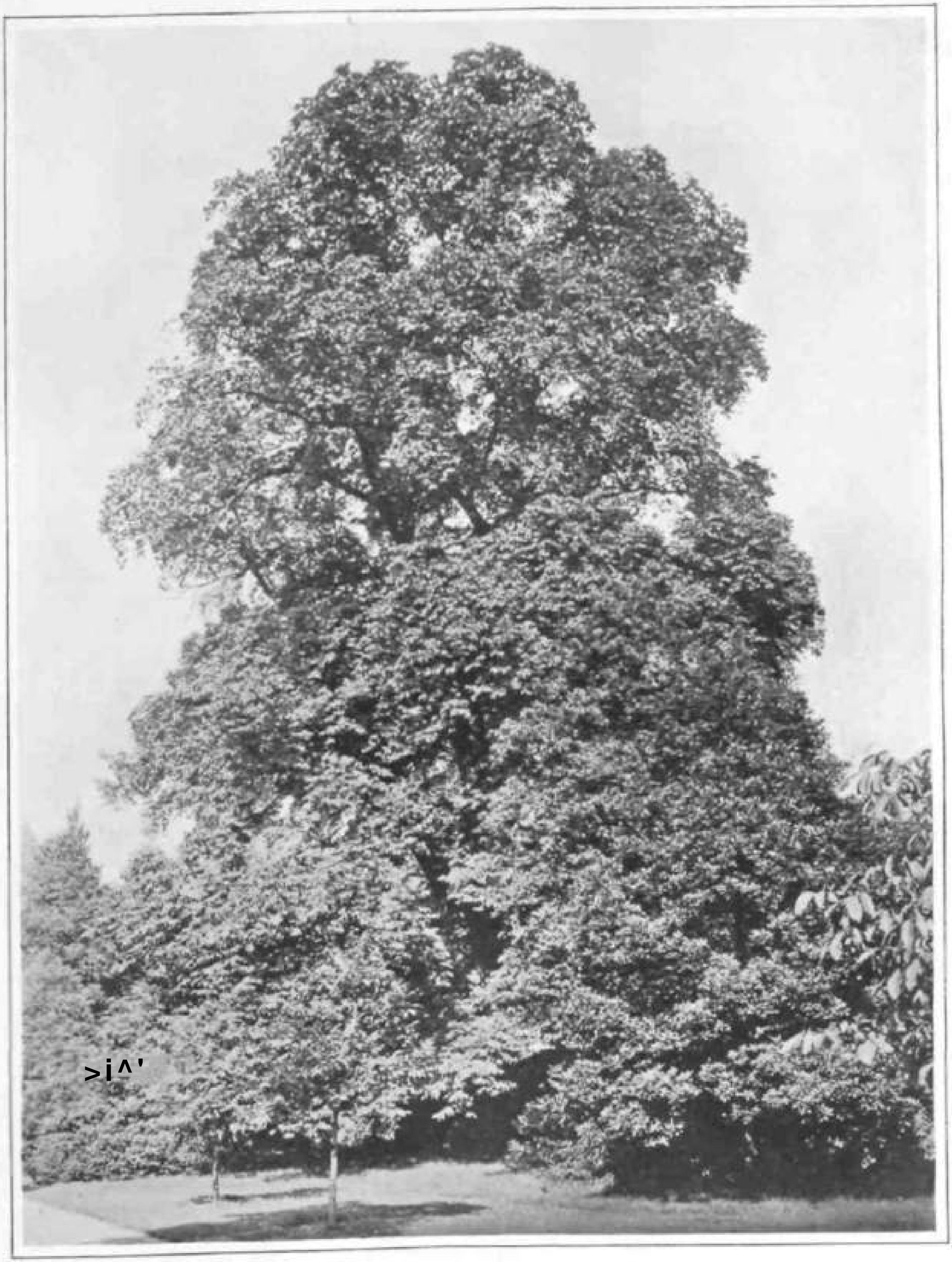


Fig. 3O9.—WVCH ELM—*VLMVS GLABRA* i **SUMMER,**

**Buds.** The resting-buds are of two kinds—spherical buds that produce infl... igher on the ... shoot, that develop the foliage shoots (Figs. 3...).

growing season the terminal bud dies off, ... axillary bud takes its place. ... develop into long-shoots or dwarf-shoots.

**Flowers.** The flowers open in March or April; and

Fig. 310.—Bark of Wych Elm.

Each of the latter buds shows two ranks of scales. On the inclined branches the buds are not accurately axillary, so that the resting-buds stand very obliquely above the scars left by the fallen leaves (Figs. 311 and 312). At the conclusion of each

are wind-pollinated. The stigmas are receptive before the stamens are ripe, so that when the flower opens its long red stigmas ...ect beyond the five to eight purple stamens, which at this stage are attached to short

Ff|r. **311.**-Resting-hud (if Wych Elm.

filaments. The filaments subsequently **elongate** greatly, und eventually overtop the stigraiis, iind their pol- }en *may* fall *upon* the latter. thus causing self-pollination. The flowers of an infloroscence open successively (see Fig. 307).

Fruit.

Tin' fruits {Fig. 52), **which** are larger than those of t*h*e Common Elm, become brown and ripe in May or **June,** The soed **is wholly** occupied by the embryo, which in Strminution stands its two green cotyledons above ground.

The Elms are well suited to illustrate the mode of life of Bark Beetles (ScolytidaH. **which feed** ;itnl breed in tunnels that they have **excavated** in the bark of various trees. The common Elm l-i.nk Beetle. *Scolyius Gtoflroyi* (GoeUe), which attacks Elm **trees** in England, is 3, brown little beetle only about one-Sixth of an inch in length. The female commences aerations by boring a tunnel straight through **the** Iwrk, thus making an " entrance aperture." which resembles a shut- ii **le** in **Hbape** and size. After pairing, she bores a nmnel along the length of the stem at the junuliun of the wood and bark, scoring both these in the process. This tunnel, the " mother-tunnel," is even fn cnlibre throughout (as the K • Ue does not Increase in size) and short, often only one inch long. From this the beetle may occasionally pierce *A* little shaft through the bark-so as to ventilate the tunnel, ihe position of each shaft being denoted on the outside by a " ventilation aperture." At intervals along th« sides of the tunnel the hectic hollows out minute niches, in each of which she deposits an egg. until there •ire. thirty, forty, or **ewwi** B lumthvd eggs thus lodged. After these labours the tiny creature dies. From the eggs there hatch out minute, white, legless maggots, which possess powerful jaws. The maggots at once begin to **ttm-** ncl at right angles to the mother-tunnel at the junction of Avorji] and bark. As the maggot feeds on the material that it excavates it grows, **and** therefore as it burrows along it constantly makes an incrcLismfjly wide tunnel. The " larval tunnels " thus constructed, therefore, widen mit towards their ends, also gradually divt-rge from their original direction, and attain much **greater** lengths than the uniform motliLT- iiumel. Eventually the full-sized (full-ftd) maggot rests for a time (throughout the whole winter), **aad** thereafter becomes an inert [11] 1 in pa," which, casting off **its OUtsi** akin, emerges as a mature beetle. This burrows straight outwards through the bark, emerging through ;ui " exit-hole " that it has **piensed.** Consequently *U>* each single entrance aperture of the mother there correspond many exit ;ijnTtures of the progeny. In England tin- **beetle** emerges and flies in Way or June: **the** magfjol is full-fed in July, and usually remains resting in the tunnel until the inilmving spring, when it changes into a pupa. But in warm summers the full-fed maggot in July may develop rapidly into a **beetle** which emerges in x\ugust, juid fiives rise to a second brood of young ; these hibernate **witlliB** the tunnels during winter.

**Fi . 312.** Twig of Wych **Kim** In Winter.

Dificrcnt species of Bark Beetles attack Pines, Oaks. Birdies, Ash-trees, and others; each species producing its own pattern of Umm-Is (" galleries") on wood or bark or both. Some species arc polygamous. and show star-lik« radiating " mother-tunnels," each of which corresponds to one wife.

*Pig-* 313 - COMMON *F.LM-ULM US CAMPESTHIS* : Wl Nl H«

*Fig.* 314, COMMON ELM— *fLML'S CAMPESTRJS:* **SUMMER.**

## ULMUS CAMPESTRIS *U.inn*±-COMMON ELM (*Ulmaceæ*)

This tree differs from i i , \ U h Kim in that the seed-camber » „.,,- :•• ,i, tap , | ,i. fnnt (being only sepamted by a distune* t*<*

The Common Him mav bttome a huge trce 125 ,,, m ^^ J ^ * trunk may be e feet • in fera ter r ,,,fr thc base.

Fig. 315.—»ark of Common Elm.

equal at most to one-third of its length). Moreover, the fruits, leaves, and flowers *re smaller, and often there are only four or five perianth-segments and stamens in each flower.

J J 1 ^ TM 5 m.

Like the Wych Elm, the trunk usually is devoid of branches for a considerable height {so that the trees figured in this work are not quite typical). Its crown is narrower,

Fig. 31O.-Twig of Common film.

and its boughs in the crown ascend more steeply.

The bark be-mmes thick mid very deeply ftn-rnwed {Fig. JI5).

Tin* **leaves un-usually smaller than those ol** the Wyiti

Leaves and Buds. Elm, and [1 -s **rough** tin **the Upper** face ; often they do not **tape?** ti> a long **pointed** tip £sw Fit*. ;). The **twigs** and buds (Fit's. **316** and jiS) **are** v.-ry like those **of** f. g/fl/^a, but in **ont?** variety, f'. *campestris* var. sw/^^ftsn, con-spicuous wings of cork give to the twigs a very **characteristic ap* peaxanoe** (Fig. **317).**

Fig. 317,—Cork Wings on Twijjs of *U. vampns.trIs* var. *subetvsa.*

The pollination *' *aiid* behaviour of th<- **BaweS** Pratt p "j in *« \\ **yeh** l-lm. **One** peculiar **feature regarding** the Common Kim is **thai** in this country the fruits **rarely,** if *n-.wr,* produce swds that gcrminati^ This is less surprising when it is remenibtirod that th« Common F.bn is not a **native** >n Great **Britain.**

To atone for this de-fect the tree has a gTv.it

**Suvkers.** I HIVI -i" >f throw-ing up suckers from long, **shallow,** huri-znntal roots. Thus **the** Common Elm *con* **gradu-ally** travel from ])Lire to place, and can **form** ex-tensive hedges or lines of tret^s.

Fig. 318.—Resting-bud of Common Elm.

# PLATANACEVE

## *PLATAMS ORIENTALIS* (*Linn.*).—Plane (*Platanaceæ*)

The Platanaceæ include only one genus *Plotanus,* so that the characters of the family are sufficiently indicated by *Platanus orientalis,* which is easily recognised as a Plane-tree by its alternate, palmately-lobed, simple leaves which have tubular stipules; by its ball-like inflorescences and collections of fruits attached to slender *lunging* stems; and by its light-coloured bark that flakes off annually in large thin plates.

**Fig. ,3r?.-Bark of Plane.**

The deeply-rooted tree may attain large dimensions, not so much by reason of its height, though this may be ninety feet, a& by reason of its immeniit: crown which is formed by a number of irregular, bent, tapBring houghs and finer branches. The

**Dimensions anil lorm.**

more Utan ten. feet in thickness, and at its base may show some persistent small-scaled rough bark (Fig. 320). Bui tiu> bark is generally Hun because every year it casts off large thin plates, and

**Bark.**

**Pig. 330. Old Hark of Plane.**

trunk usually is bare up to a height uf thirty or even sixty feet, and often remains distinct to the summit, so that our illus-Nations {Figs. 321 and 322) by no means represent a typical tree.

The rapidly thickening trunk may become the patches thus laid bare ore very light-coloured (Fig. 319).

The foliage is somewhat Maple-like. But the I'lane is easily distinguished from the Sycamore and Maples by the kct tfeat its patea,t«fy-lobed leaves

**Leaves.**

Fig. 321.—PLANE—*PLATANUS ORIENTALIS*: WINTER.

Fig. 322.—PLANE—*PLATA*[illegible] S[illegible]MER.

Fi r. J23.—Twig of Plane in Winter, nnd one Fruit fupside down[1].

are alternate, and **have** characteristic **stipules** and **leaf-stalks.** The two **stipules of a teal** are **represented by a tube which surrounds the** Bt«Jda and therefore leaves a rinK-lik<> **scar** after its **early** fall *($ec* Pig*- **3²3 and** 324). The leaf-stalk is dilated and pxcivated •*i-t* its base to form a **chamber** which **encloses** and conceals **the axillary** i>ud (Fig. .1-J.5). so that when **thi leaf** fails tli.-**conical** n-sting-bud is **revealed far** tin- first time, and is **partly** sin-rotimh-fI ;tt its base l>y **the** l<-af-srar. The **blade shows five or** ***seven*** **lobes** and **is** hairlrss whrii maturr. though, *when* first **exposed,** it and the **buoVprotectaig** stipulir sheath are clothed **with hairs** coloured like old gold.

The conical resting-bud {Figs. 323 and 324} is apparently invested by a single **sheath,** which, however, divides into tw<» scalfe-tifce halves when the bud opens. The resultant shoot may be **a** slightly zig-zag long-shoot (Fig. 323)'; or a foliaged dwarf-shoot; or a dwMri'-shoot bearing three or four foliage-leaves, and terminating in a slender hanging stem that has usually three or four lateral, stalkless, **globular** inflorescences.

Resting-buds.

The spherical inflorescences, which open **m April** or May, are of two kinds, **male and** female; both kinds ,,,,-ur **on the** same Hfowers. '!IXN but on different **branches.**

1-nh inflorescence consists of **many** small **stalfctess** flowers **crowded** to-pther on tlic rounded end of a short mflorescence-stem.

The female inflorescence (Fig. 527, 2) is ^ distinguished by the thread-like **Mectfng** styles; it include **many one-**cumbered ovaries, each of which (subseq»ently) ac^lte a ***^gk*** ovule and is td by a dander style and stigma.

Th displays many ,nwded erect stamenSj ^ of which& **has a** short ***Bmm*** **aad** an anther that « capped by a **thick continuation** of the connective; in ,],, closed male inflorescence "• these densely-packed shield-liko expansions „f ^ connectives form a protective covering. Among the stamens 2? oV!T arta ]ittl« scai^Bte and other outgrowths.

The structure of the flowers is difficult to observe, and more difficult to inter . The stamens are arranged "I S!'?l}S of frora thre« ^ six ; each roup is surround -like

FI£. 324.—Resting-bud of Plane in Winter,

*fig.* 326.—Leaves of Plane.

bodies, and an outer circle of from tlircc to six hairy scales ; aU these compose one (lower. The pistils arc similarly arranged in groups oi from fotir to eight; e<ich group is surrounded by two or even **three** circles of scaks and dab-like bodies; these, with the grouped separate four to eight pistil;*, constitute a femule flower,

Pollen is conveyed by wind to the **female**

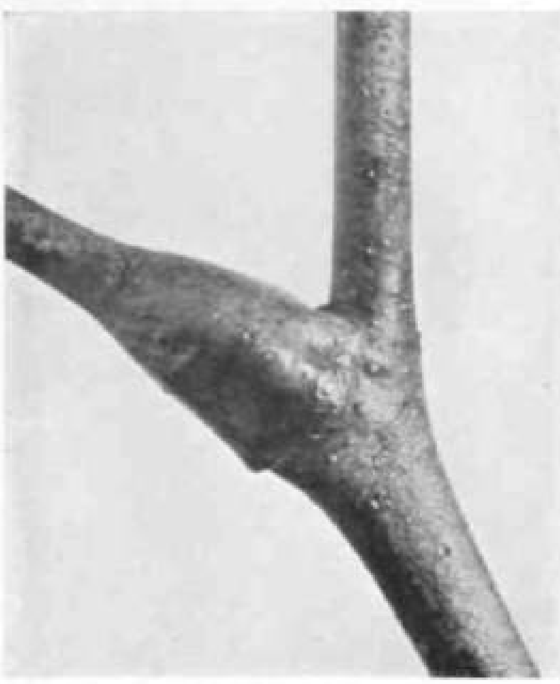


Fig. 325-—RestinR-rnid of Plane in Summer, concealed by Leaf-stalk.

inflorescence which gives rise to the **larger** spherical collection of fruits from which the **persistent** stylos **project** (Fig. 328). The M.It (issue of the **hanging** stem **thai** bears these spiky balls di-;int<-grates aad leaves behind merely a loose strand oi coarse hair-like threads. It is not until the **following spring that the** ball-like, **closely packed** collections of fruits commence to loosen and set **free the** separate fruits. Each fruit (Fig. 32.1, above) is shaped like .1 four-sided rhih ; at it« broader bulging tip is the **style** ; **on** its sides are **short,** deep-golden hairs **which** at its base become long, stiff, outstanding hairs that form a device for **dispersal by the** wind. The one-seeded fruit remains closed, like **a** nut, until the time of germination. But many of these nut-like fruits are steril*- in Great Britain, for this tree belongs to the warmer south (extending from Greece to Afghanistan).

Varieties.

There are several varieties of ***Ptatantts*** *orientalis,* but one Plane known as P. *accrt-fnlia* **requires** brief notice, as it is not uncommon in England, and is usually **erroneously** regarded and described in books as being the **American**

Plane {*P. occidentalis*), which is exceedingly rare in Europe. *P. acerifolia* may be a hybrid between *P. orientates* and *P. occidentalis,* and differs from tfie former in that the leaf has broader, relatively **shorter**

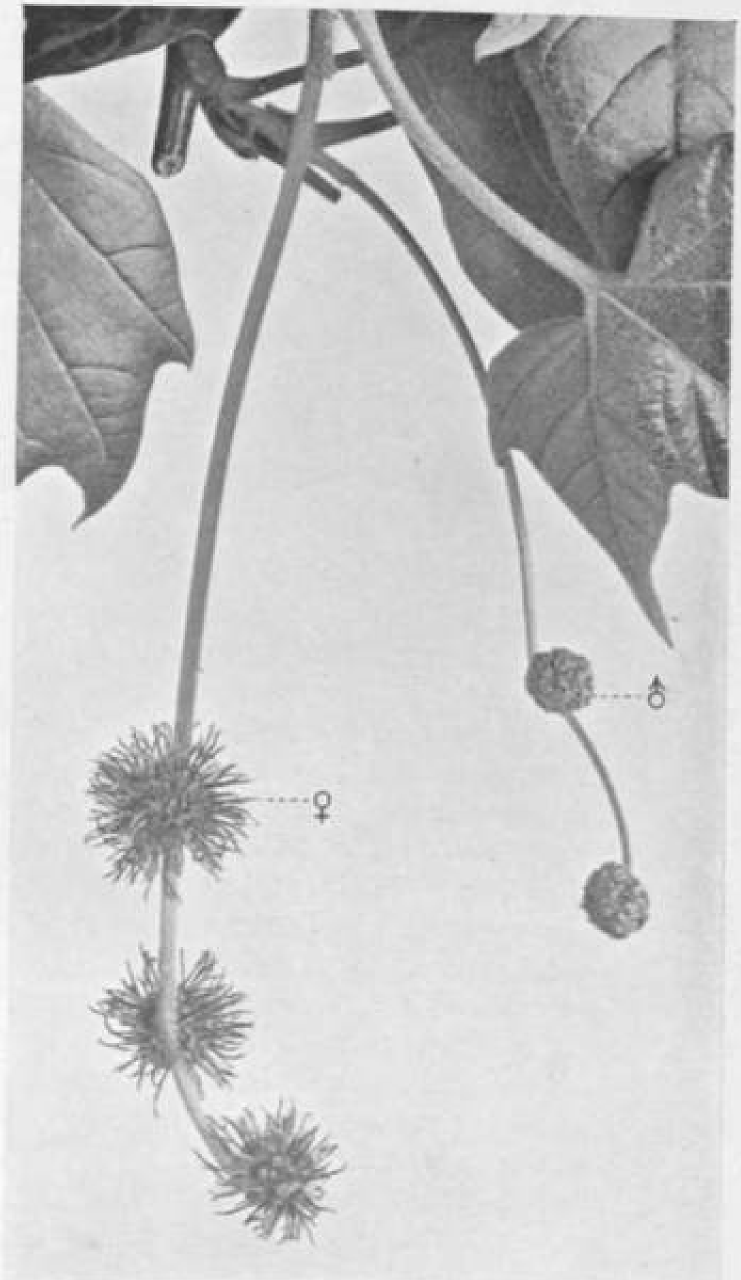



**Fig. 327. Male [&) and Female (9) Inflorescences of Plane.**

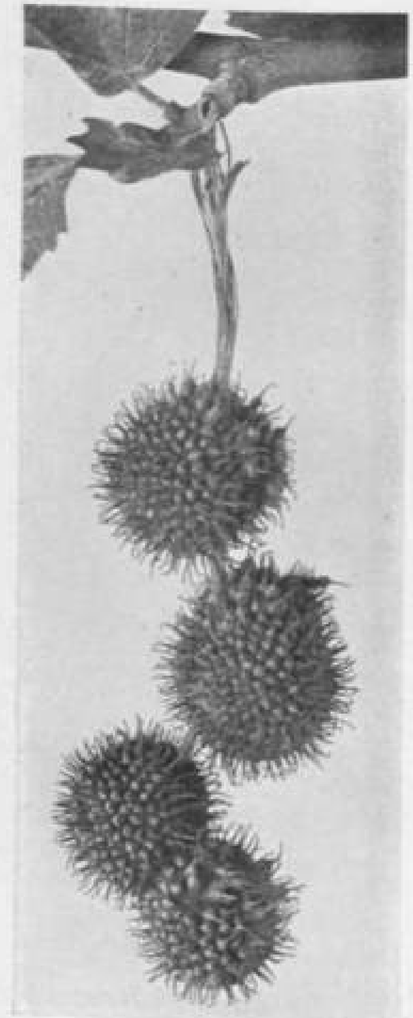


**Fig. 328.-Collection of Fruits of Plane.**

and usually fewer (often three, sometimes five) lobes, also in that **the** inflorescence-stem bears only one (rarely two) spherical collection of fruits.

[Fig. 327 and possibly Fig. 326 **represent** P. *acerifolia,* whereas Fig. 328 certainly represents *P. orientalis.]*

# BUXACE^

## BUXUS **SEMPERVIRENS** *{Linn.).*—Box *{Buxacem)*

The evergreen Box **displays** a strong likeness to the Privet. For its simple green leaves are opposite, and the successive pairs til tern titc. But the Box differs from the Privet in that **the fear-ranked** acnmgenient of the leaves is **associated with the** four-sided (not cylindrical) form of its twigs, as there is a leaf-ridge continued down the tnternode from each leaf. In flower and fruit **the** two plants ;trc **easily distinguished; the** Privet

Fig. *$2tt.* — **Bark of Box-tree.**

Fig. 3J». Inflorescence! showing Male Flowers *of* Box.

the blade **is** more oval than in the L'rivet, and often has a notched tip.

The scale-clad restiug-buds are particularly **small. The** young four - singled twigs bear hairs, especially n **the margins** of tltc **kaf-**ridges.

**The axillary** dense **dumps** of stalkless

Flowers.

flowers open in April or May, and stand out from the **green shoots as** lit Lie has s;alked ti-rminal *bad*lorescences **of Creamy** biaexual n^wers which give way t«i bl.i-k berry-like fruits; whereas the Box **has** crowded axillary dusters **of** uni~**sexual flowers** devoid of petals, nnd **the** central **female flower** of the cluster gives rise to a dry fruit tliat opens by three valves.

The Box is **a** ektsi-ly-bramiuil shrub <r small **bcee** not **com-**

Dimensions.

monly rX err dim,' eight or twelve feet in height, though sometime? it is as much as twenty **feet.** The trunk may acquire a thickness of eighteen inches, and has a light-yellowish scaly bark (Fig. 329).

**lie** short-stalked **leaves arc** devoid of stipules. The **leathery,**

Leaves.

hairless blade is **deep-green** and **glossy** on tin upper face, but paler and didler on the lower; it is not only free from **teeth,** but has lateral nerves so fine as to be indistinct ; finally,

Fig- 331.—Inflorescences showing (cmale Flowers and Unopen Male Flowers of Box.

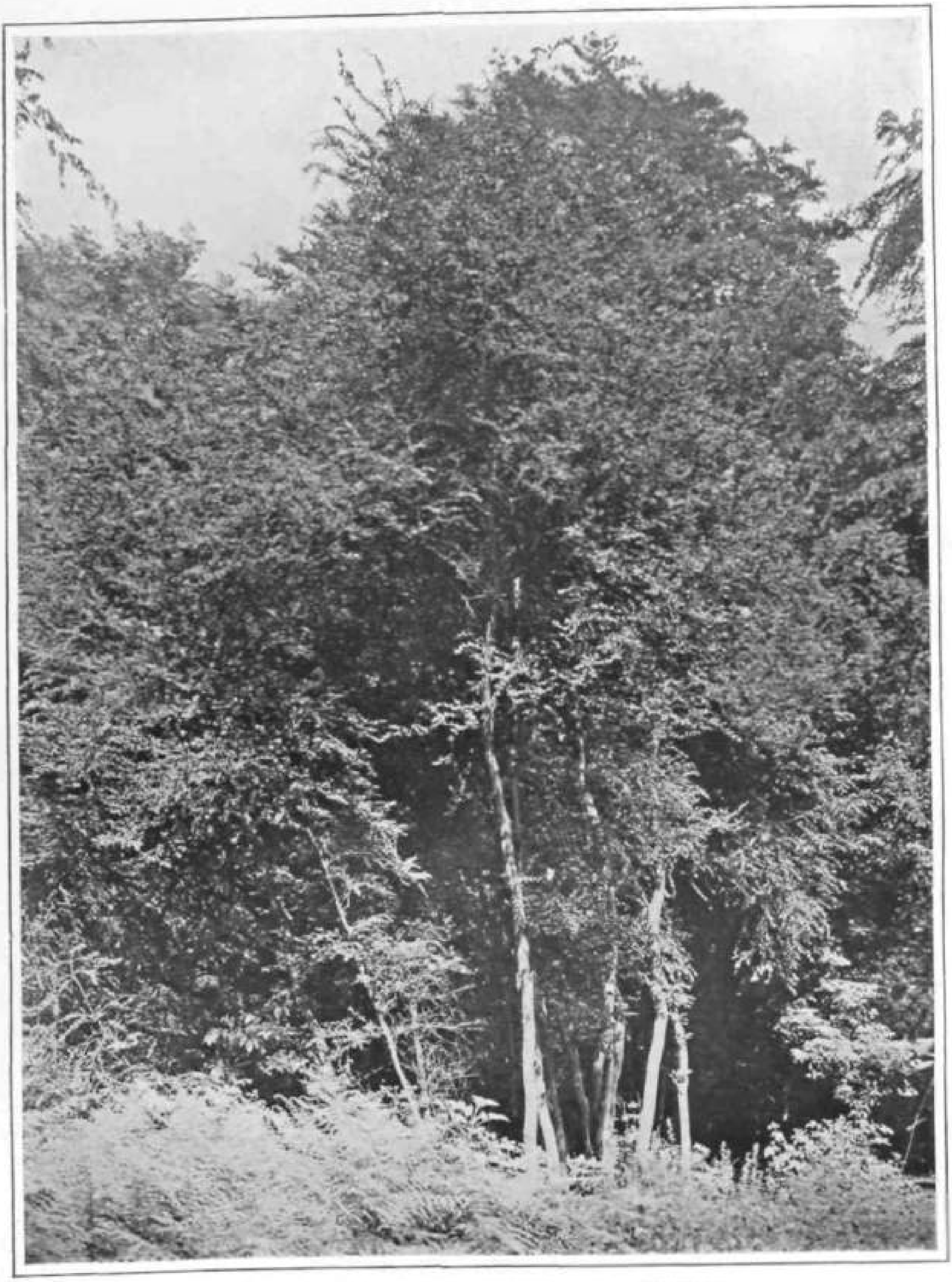


Fig. *332.-KQX-TREZS-8VXUS SEMPERMRESS.*

light coloured patches. Each cluster (Figs. 330-1} arises from a bud in **the** axil of **a leaf** formed in the preceding year. It includes a number of srmill **scales** {bracts) with single male **flowers** in their axils, and terminates in a rosette of scales ranged round a solitary female flower. As the female flower opens

I is- *333>* Open Fruits of Hox.

at **a time** when the males are rinsed and bud-like (Fig. 331), cross-pollination is at first (•iv.mred (sometimes the **female flower** is absent from the cluster).

The male flower consists of **four** sepals, **with fot£t** stamens opposite **to them,** mid a central lump which pours out nectar **and** may represent **the vestige oi** a pistil.

T***he* point at *which* the fenwle flower** exactly commences is not cosily **determined,** There is **a** small **rjerianth-Kks obUectSon of** scales, the inner ones of which probably represent a perianth, Apart from this **the Sower** consists solely of an ovary surmounted by three styles **which** arc two-lobed at **their** ends. **Alterrtattag** with the three **styles ran** the roof of the ovary are **three** lumps from which **drops** of nectar **exude.** The **ovary** is three-chambered, and in each chamber hang two •Allies.

Pollination is often accomplished by the aid of insects, **esjwda&y** Hies, which sip the nectar, and are **doubtless** attracted by **the** disagreeable scent of the flowers, as well **as** by the projecting light-coloured anthers. But to some extent wind may *ind* in pollination, **especially a& male flowers** arc **more** numerous tlian it male.

The **ovnry and styles giv* rise to a characteristic drv** fruit winch **usfualh contains six black**

Fruit. . • .,' , , ,..:,.

**seeds. \\ ftten** the fruit is **ripe** the outer part **of** its **wall Bepaxates** from the inner and splits **longitudinally** down the three styles, iluis producing three two-horned **valves** (Fig. 333} • **but** the innor part • **if the ovary-wall** suddenly **5pHta longfrnriw •1l1. down** six lines **and** flinns tint seeds to some dis- **fcmoe.** Tii- ***Box hat* an** caeplosive fruit.

**The** B ox-Tree l is often found **growing an dry sloping ground, and** in **this country** frequently on .hulk **hills.**

Hahits. ^ rasts il '"^'l* *shzdto** **grows** very slowly, and **can** form the **onder-wood oH forest,** .-^ Uuit it **probably** should **be** rlassih'ed ;is a distinctly **shade-endiuting** species.

Again, in connection with this tree we note the tough, thick nature of **foliage that** is evergreen • - in this country (compare Firs, Holly, **the** *ev* **rgreen** species of Oaks and of *Pntnm),*

Fig. 334-- Young Hox-trees on Box Hill.

## TILIACEJE

### TI LI A EURO *PJE* A. — L i M K-T K E E (*Tittaccce*)

**The lime-tree** is most easily **recognised** by its **characteristic** stalked **inflorescences and collections** of fruits **which** seem **to bo affixed** to elongated bracts; as well as by **the** greenisii-ydlow regular **flowers** with separate **petals** and numerous **stamens;** but the **resting-bud** is also (juite distinctive, **as** it presents a humped appearance, because it **shows only** either **two** or three scales of which the bulging **outermost** one is considerably the shortest.

The Lime-tree may be seventy or more **feet** high, its trunk rising bare and unbratiched to a considerable altitude in forest, but being branched close to the grnund in the open. The very shady **oval** crown *h* closely branched and heavily foliaged. The tret has a marked faculty of throwing OUt shtH)ts frUITl tlle *StooX* or bole (Fig. 336), so that the trunk is apt to be raised into large bosses where shoots were formerly attached *(sec* Fig- *337).* Often the thick base of the **trunk** (sometimes six feet in diameter) is raised into thick broad ribs or ridges.

**Height and Form.**

The bark **remains** smooth for from **twenty** to thirty years, but **subsequently** becomes longitudinally fissured, and eventually rough and thick (Fig. 335).

The alternate, stalked, simple leaves are

Leaves.

ranged in two rmiks (Fig. 339). Each has two well-developed long stipules which fall as the leaf opens. **The** blade is more or Its* strongly unequal at the base-, where its veining is distinctly palmate in suggestion; the margin has saw-like tooth, and the tip is sharp ; on the lower face there are tufts of hairs at the angles of the larger nerves *{see* page 235 for the significance of these tufts).

Resting-buds.

The resting-buds seen in winter are all lateral because the true termination of every **twig** dies during the **previous** summer. Each bud shows an outermost small bulging scale, and a larger inner one that either encloses **the whole Of** the **other** bud-structures or is succeeded by a still larger innermost one that di <es so (Figs. 340-1), The topmost axillary bud, which **has** pushed itself into a terminal **position,** • "Mtinues the growth of the shoot. The branches are either long-shoots or dwarf-

Fig. 335--Hark of Lime.

shoots, and. as the leaves are ranged in two lines solely on the flanks of a branch, the brartchlets lie in one plane (a horizontal plane when the shoot is horizontal). The opening bud usually **bends** slightly downwards. **shoots** out its leaves which shed their large scale-like **stipules** as they **expand,** and **the gradually** unfolding young leaves form sunshadf-Irkc or nmf-like, arched, screens over their juniors (Figs. 24 and 25).

The Lime-tree **commences** to flower at the age of twenty cjr **twenty-five** years, The forked inflorescences arise in the axils of foliage-leaves **on** shouts of the current year. Close to the **base** of tliu inflorescence, and (only) **seemingly** in the axil of the same kuf. is a rest ing-bud which in the following year m;iy sprout to produce **a** foliaged **branch,** The main stem of the inflorescence is **joined** for some distance upwards to the yellowish-green, **tongue-Eke** bract, and **terminates** in a

**Fig. 336.—Shoots at Base of Lime-tree.**

Fig. 337—LIME—*TILIA EUROPÆA*: WINTER.

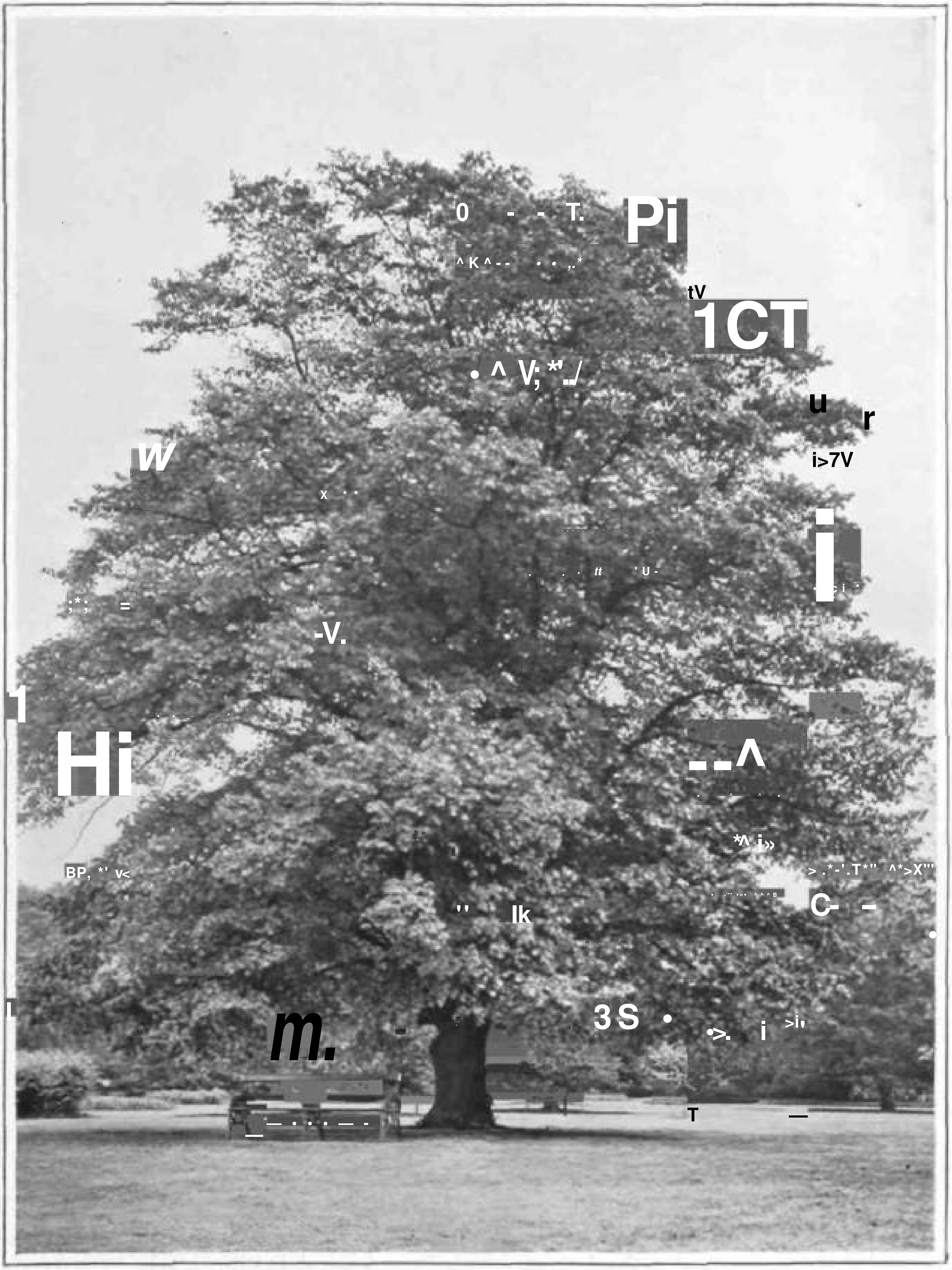


Fig. 338.—LIME—*TILIA EUROPÆA*: SUMMER.

s

more or less flat-topped inflorescence, **which** includes only a few (from two to **eleven)** stalked **flowers.** The Lime does not open its flowers **before Eke** middle of June or July.

The flower is regular and bisexual. The five green sepals, five separate, light-yellow petals, and the numerous stamens are all attached below the >hif;t. white-haired ovary; the flower is therefore hypogynous. Despite of the fact that each sepaJ bears **two** nectaries at its base and is hollowed to **act** as a **SugaMfcceptacfe,** the sepals

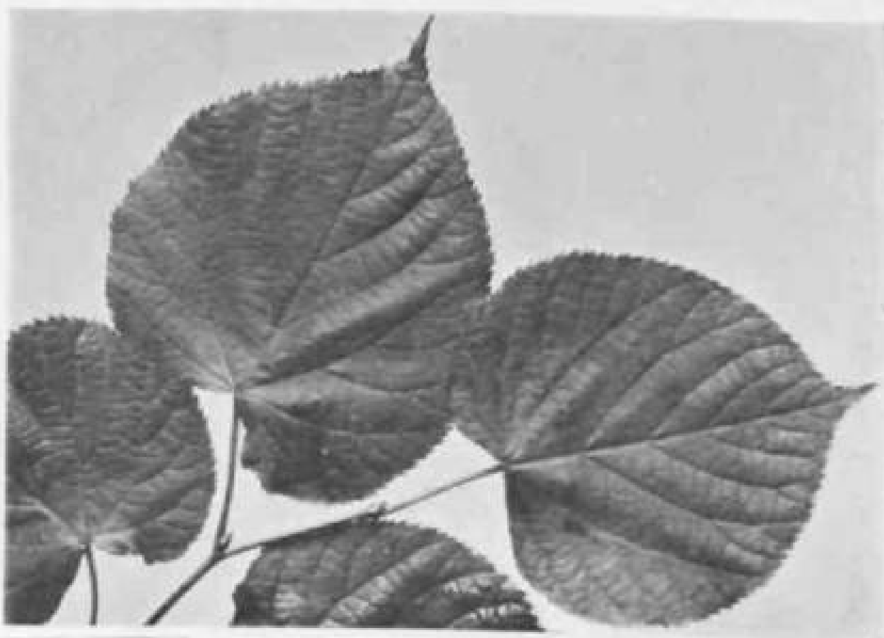


Fig. 339- - Leaves qf Lime.

*Fig. 340.—Resting-* **Bud of Lime.**

soon fall from **the** open flower. The pistil consists of a single superior ovary which contains two ovules in each of its *five* chambers, also of **a** single style capped by five distinct stigmas.

The scented **nectar-**ladon flowers, hanging under the leaves, attract crowds of bees which cause cross.p-,] 1. nation, **Self-pollination ir- nearly** impossible because the anthers open before the stigmas are ready to receive th- pollen ; num-over, when **the inflorescence** is **pendent,** the **position** of tin- anthers renders it well-nigh impracticable for the **pollen** to fall **directly on the** stigmas of **the same flower.**

**Fijf. 341.— Twijf of Lime in Winter.**

The ovary **tfpens** into a rounded, one-seeded, onc-ch;,mbt:n>d nut, in which it is dlffic»lt **to** detect **traces** of **the** other **four** aLmost obliterated **chambers,**

Fruit.

**ine** wind blows away the **whole objection** of fnuts **attached to** one bnict, **winch thus** nets as a **sail**

U ithin the rounded seed lies not only the '•'"bryo, but also, outside tins, **a stop** of food-material (endosperm). At **the** time of germination the nut-shell splits open, and the two cotyledons **project** out of the soil, raising **aloft the food-material** and continuing to absorb it **by their tips.**

Seeds.

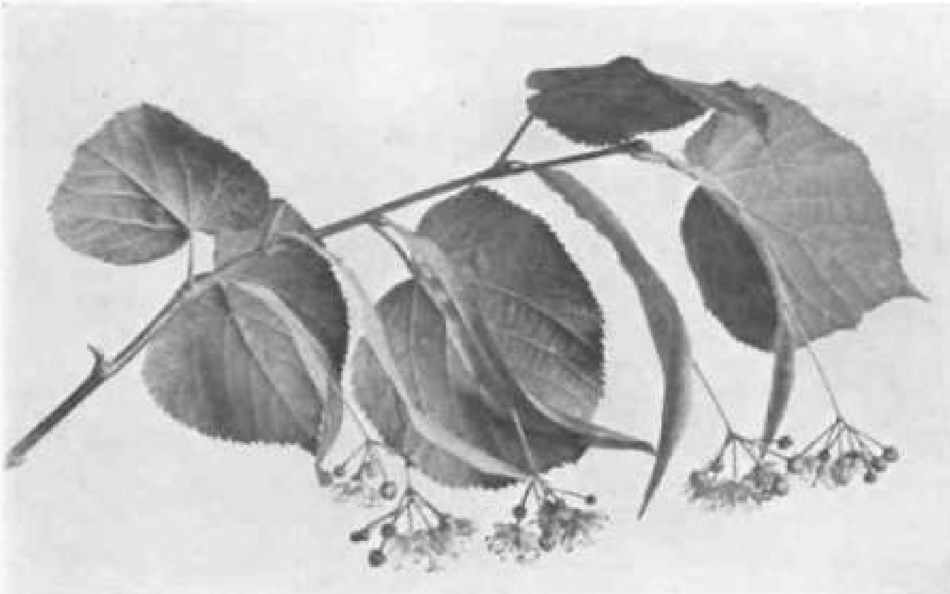


Fig. 34a.—Inflorescences of Lime.

N'ot until they turn* tik<*n in the food thus available do the cotyledons unfurl and reveal their exceptional five-lobed palmate shape.

Under the general, name *Tilia europcta* I include 7\ *platyfihyllus* (Scop,), the Large-leaved Lime-tree, *t. vnlgaris* (Hayne), the Common Lime-tree, and *T. corduia* (Mill.), the Sm:il]-li.::iYrd Limr-tn.'i[1]. Of **fttflBfi** the two extreme forms—the L;trge-leaved and the Small-leaved—are **easfly** distinguished : ***while*** the third ff>m is intermediate in character.

**Large-leaved** Lime.

The leaf of **the** Large-leaved Lim^ is large; its lower face is light (jreen in colour, and shows hairs generally scattered over it, as wo 11 as collected in whitish or greyish tufts at the anglus of the veins. The pendent in**flprescence** includes only few (from two to seven) **relatively** large flower's. Tin; fruit has 0 thick woody **Wall** which is marked by five more or less projecting ribs. The resting-bud lias three external scales.

The leaf of the Small-leaved Lime is smaller; its lower face has a pale bluish tinge,slum's no scattered hairs, but lias tufts of rusty red hairs at the angles of **the VBIH5.**

**Smalt-leaved l.ime.**

The in-florescence is ofli-n erect, and **usually includes** a larger number (from four to eleven) of smaller **flowers.** The thin fragile wall of the fruit is almost or **completely devoid** of projecting ribs. The rest ing-bud lias **only** two scalis visible from the outside.

Fig. 343. Fruits of Lime.

Common Lime.

The Common Lime is intermediate in the **character of** its fruit, infiorescenCe, and the lower face of the leaf, \vlt\di is gr«er\ and has green ish-gvey hairs only at the angles of the veins. The leaf-stalk of the Common Lime is scarcely lialf as long as the leaf-blade, whereas, on the **other** h;ind. in the Small-leaved Lime the **former** is nv-avly 8S long as the latter.

## ACERACEJE. SYCAMORE AND MAPLE FAMILY

**33K** Sycamore and Maples are woody plants with *opposite,* stalked, *simple leaves^* which are ***devoid*** *of stipules,* are *palmatcly veined,* and often *palmatcly lobetL* (The Plane has very similar leaves, which, **however,** bear stipules, and are alternate. One familiar species of Maple has pinnately compound leaves.) The *flowers* art small, regular, often greenish, and **usually** *hyftogynoits.* In each flower there are five 01 fnur sepals, five or four *separate petals,* and usually *eight* (from four to twelve) *stamens.* A thick *&$k* is usually present, and often glistens with nectar; the stamens are frequently inserted in little pits on the disk. The pistil consists of two carpels joined I" form a somewhat *flattened, two-chambered ovary,* which contains two ovules **in each** chamber; from the summit of the ov.ny rise the two **style-branches.** The *fnrii* is **dry,** *tuv-uingal,* and *breaks into two separate one-Kinged halves, whose single closed chambers contain as a rule one seed each.*

Fig. *344.*—**Fruits of Norway Mople.**

**Although** many specks of *Acer* are in **cultivation,** in this **country** only two are very common—the native Field Maple, and **the** naturalised Sycamore—and two are fairly common—**-the Norway** Maple and *Acer Negundo.* The last-named is easily distinguished from the others because it has **pinaately** compound, often variegatedf **leaves, and** its flowers are devoid of petals. The other three can be readily distinguished by their inflorescences, leaves, and fraitSj as will **be explained in** detail.

Among the points of special interest oxhibiled by species of *Acer* are r—

1. The origin of unisexual flowers by more or less incomplete suppression of the stamens or carpels.

2. The intermediate stages shown between male and female individuals.

3. The gradual decline in conspicitousnes* o( the petals as shown by yellowish-green petals, green petals, and finally no petals.

4. The characteristic "breaking fruit" which is adapted for dispersal by wind.

## ACER PSEUDO-PLATANUS *(Linn.)*.—**SYCAMORE** *{Ateracwe)*

**Distinctive Features,** The Sycamore is recognised by its pendent tassel-Hkf; inflorescences ; its **opposite** palmate leaves, **whose blades afce pallid** bluish-green on the lower face, and show wry narrow acute .-ingles between the lobes; and finally by the character of its fruits, whose seed-containing parts are nearly globular, and whose wings diverge obliquely (not in a straight line), and taper from above downwards,

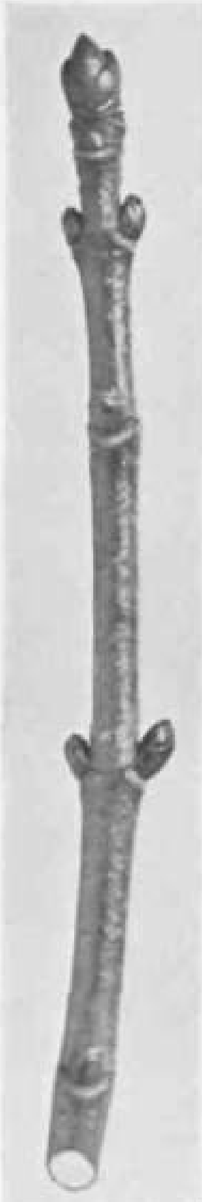
Fig. $345_1$—**Hark of Sycamore.**

The Sycamore, which may attain a height **of sixty feet,** shows a crown of variable form. Its **bark remains** smooth **for** a long time, but finally becomes rougli and flakes **off** in larger or smaller **stales** (Fig. 345).

The **successive pairs** of opposite leaves stand at right **angles to one** another, so **that**

Fig. 34<>'-SYCAMOR[-;-,4CEfl *PSEUDO-PLATANL'S:* WINTER

Fig. 347—SYCAMORE—*ACER PSEUDO-PLATANUS*: SUMMER.



l-ig. 348.-Twig of Sycamore in Winter.

there are four **ranks of** Leaves. teaves, The leaf **possessea** no stipules, but shows a bnxid base which extends so far ifjund tht: stem as to rrn^t that of the opposite leaf. The long, often red, leaf-stalk terminates *in* **a** *hhide* that is usually **Bve4obed,** and is from four to eight inches in diameter. The lobes are shortly **pointed,** indented with blunt teeth, and separated by narrow (acute) angles (Fig. 349).

Fig. **349*—Shoot** of **Sycamore.**

Tlie **blade** is glossy and dark green **on the** upper **face, but** dull arid of a light bluisll-given **on** the lower face, so that this **play** of colour **tenders** the tree recognisable at **a** considerable **distance.** Though the young leaf shows white **hairs fringing the larger veins,** the hair;; ultimately vanish except in the **angles at** which the larger **(secondary)** nerves *mvrt the* **largest** (primary)- **where they** form tufts ("domatia") **comparable with** those of the Alder **and** Lime.

On a **horizontal** or inclined **branch** there are naturally two ranks of I*-;ivt-s along the sidt^, and one rank along the upper face and another along the lower face. The stalks of **the** two **latter series elongate** to different degrees, and bend so that the blades fully expose-their **tipper** faces to the

Fig. 3so.—Opening Buds of Sycamore, early stages.

light; moreover the stomates on the lower face have larger blacks than those on die Upper face.

Tin-! k*V« become particularly stifi wln-n mature; their autumnal tint is yellow.

Fig. 351 •— Opening Buds of Sycamore, later stages.

The large resting-1>urts {Fig. J48) display several pairs of scales arranged at right angles. The lateral buds of the Sycamore stand out from the twig, and are not applied dose against tfce fetter as in thi Norway Map]»\ When the bud becomes active (Figs. 350-1) Sta innermost scales beh&tresomewhat tike foliage-leaves by elongating considerably, and often show at their tips distinct little Leaf-blades, A still smaller leaf-blade is shown by each of thr outer &eaJes in the form of a discoloured narrow tip. The buds at the end and on all four faces oJ the inclined branches may grow nut, hut the branches on the upper and lower faces are usually small and short-lived, so that older inclined shoots merely bear branches on their flanks (just as if the leaves were two-ranked); on erect shoots vigorous branches spring from all four faces.

Umls.

At an age of twenty or thirty years the Sycamore produces Mowers whirl 1 ..p. n in May after the leaves have appeared. The inflorescence is prepared daring the previous year, but during winter remains concealed within a large resting-btid. Such,; bud grows out into a shoot bearing two or four foliage-leaves, and a many-flo\\'erod pendulous grpen inflorescence (Fig. 351-2), The inflorescence shows several interesting features : (1) At its base it is branched, :md the branches thiaaselvus TOAV be ramified, their

**Inflor-escence.**

Fig. 352—Inflorescences of Sycamore.

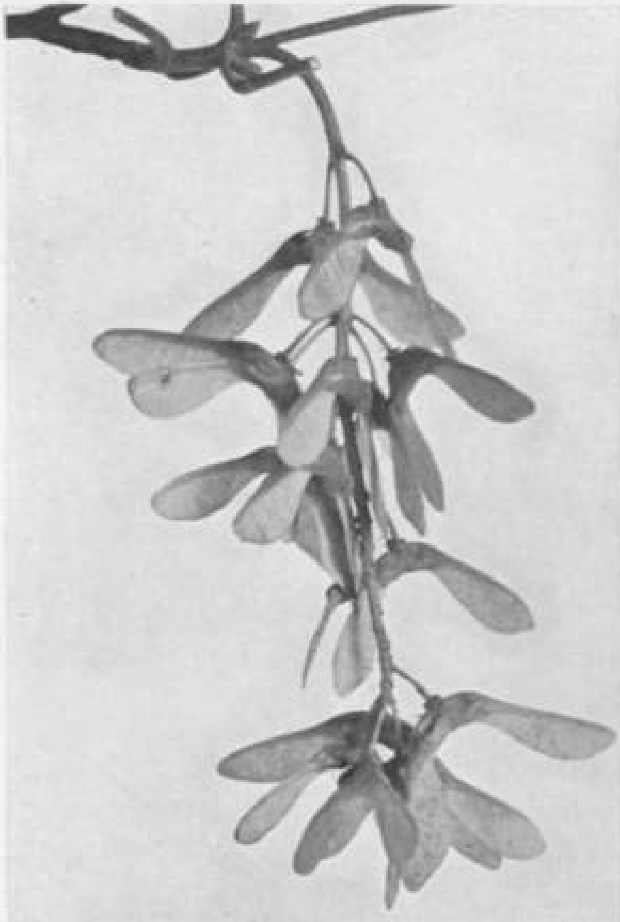


Fig. 353.—Fruits of Sycamore.

ultimate brandies being flowers; but as the main inflorescence is ascended its branches become shorter and simpler, until towards the top they are merely stalked flowers. Thus this inflorescence shows a gradual transition from a branched one to a simple one. (2) Low down the main inflorescence bracts are to be seen as very small scales, but elsewhere they are wanting except possibly in the form of minute lumps subtending the individual flowers. (3) The main inflorescence ends in a flower that is **the** first to open. (4) Some individual trees bear exclusively male flowers, and therefore produce no fruit; others possess both male and female flowers.

Flowers.

Each lateral flower has a long stalk. Its perianth consists of five narrow green sepals, and five narrower green petals. Directly within lies a yellowish fleshy cushion surrounding the centre of the flower—this is the ***disk,*** which glistens with drops of nectar. The stamens are inserted singly in pits on the upper face of the disk. All the flowers show the characters so far described, but there are male and female flowers.

**Male Flower.**

The male flower includes from eight to twelve stamens, whose filaments are long enough to thrust the anthers beyond the petals. In the centre is a green, hairy, sterile lump, which is the only trace of a pistil.

Flower.

The female flower possesses only eight smaller stamens, which have filaments so shortened that the anthers do not project beyond the petals. These **an-thers contain** pollen, yet they never open: here, then, is a remarkable case of a now useless organ which nevertheless preserves much of its original structure. In the centre of the flower are the two united carpels forming a superior pistil that extends completely across the flower. The two-celled ovary is laterally compressed and contains two ovules in each chamber. The single style divides into two branches which diverge and curl outwards. Thus the female flower presents the deceptive appearance of being bisexual, because its functionally paralysed stamens are still preserved.

The flowers are pollinated by the aid of insects. Though the flowers are individually inconspicuous, yet massed together they form noticeable yellowish-green tassels that hang clear of the leaves; moreover, the yellow disk advertises the easily **accessible** superficial nectar. The flowers are visited by bees and flies. Cross-pollination is favoured by the separation of the male and female flowers not only in space, but also in time, for the male flowers mature before the stigmas are receptive.

*Fruit.*

After pollination the sepals and petals close over the ovary which develops into the characteristic fruit (Fig. 353). This, when ripe, has two wings which taper from apex to base, and are not extended **horizontally** in a **straight line.** One **ovule** in each **chamber** has **enlarged** to produce a rounded seed which ftHs the **globular** fruit-chamber. **Whan** *hilly ripe* ***the*** (wo **halves** *of the fmh* ***break*** apart without opening, so that **there** are **now** two closed one-winged, **one-seeded** half-fruits. These, when dropped from a heiglit, descend slowly with **a** spinning **movement,** and are evidently designed for **disperse!** by wind.

The seed is wholly occupied **by** ***the*** embryo. **Which** is green even inside **the** seed. In **germination** the long strap-like **cotyledons anfold** and **appear above** the ground, but tht: **haif-fruit** is **often raised**

**Seed.**

aloft while they are stUl partly inside it. This cotyledons are suc-ce• iled by toothed but unbbed **primary green** ***loaves.***

Its **dead and dying** yellow leaves in autumn often show black patches : these are caused by an internal fungus *[Rfrytivnu nccn'num)* ***which*** **ripens** its **infecting spores in the fallen** de**id** foliage; so that the Sycamore may be **protected** from **infection by** burning the l.-.ives in autumn. Little, hollow, red, erect outgrowths are **very** common on **the leaf,** and are due to a mite ***[Pfvytoptw),***

## ACER PLATANOIDES *(Linn.)*.—NORAWY MAILE *(Aceroceo?)*

The Norway **Maple differs** from the Sycamore in. **the** following **respects : the leaf-**

**Distinctive Features.**

**blades are of** the .same **colour** i>n both faces < ihdr lobes are scpELrated by wide open angles and are Iong-pointed, as are the teeth ; the inflorescences are erect; the hvu wings of the fruit are directed apart, **nearly** in a straight line, and do not taper markedly to the base; moreover, the svt:d-rontainmg part of the fruit is flattened (not **globular).**

The tree *in>* Sycamore-like in form, but its bark instead of becoming scaly is **eventually** scored with relatively fine longitudinal furrow's (Fig. ^57).

The large leaves (Fig. 354), which show Bw or seven lobes, an- hairksn ;HK1 **glossy** 00 both facts. They are **arranged** iis **in the Sycamore,**

The restmg-hiids are also similar to **those** of the Sycamore, but the **lateral** ones **are** closely applied to the stem (Fig. **358).**

Fig. **354—Shoot of Norway Maple.**

The erect inflorescences, which appear in April or **May** before the foliage is **visible,**

Flowers.

**terminate** shoots of the current year. They are richly bra**nc**hed *and thv constituent* **steals** elongate so as to bring all the blossom up to a gently curved surface (Fig, 359). ***The*** **ioSoresceoce may consist** wholly *oi* **male** or female (lowers, or of both together,

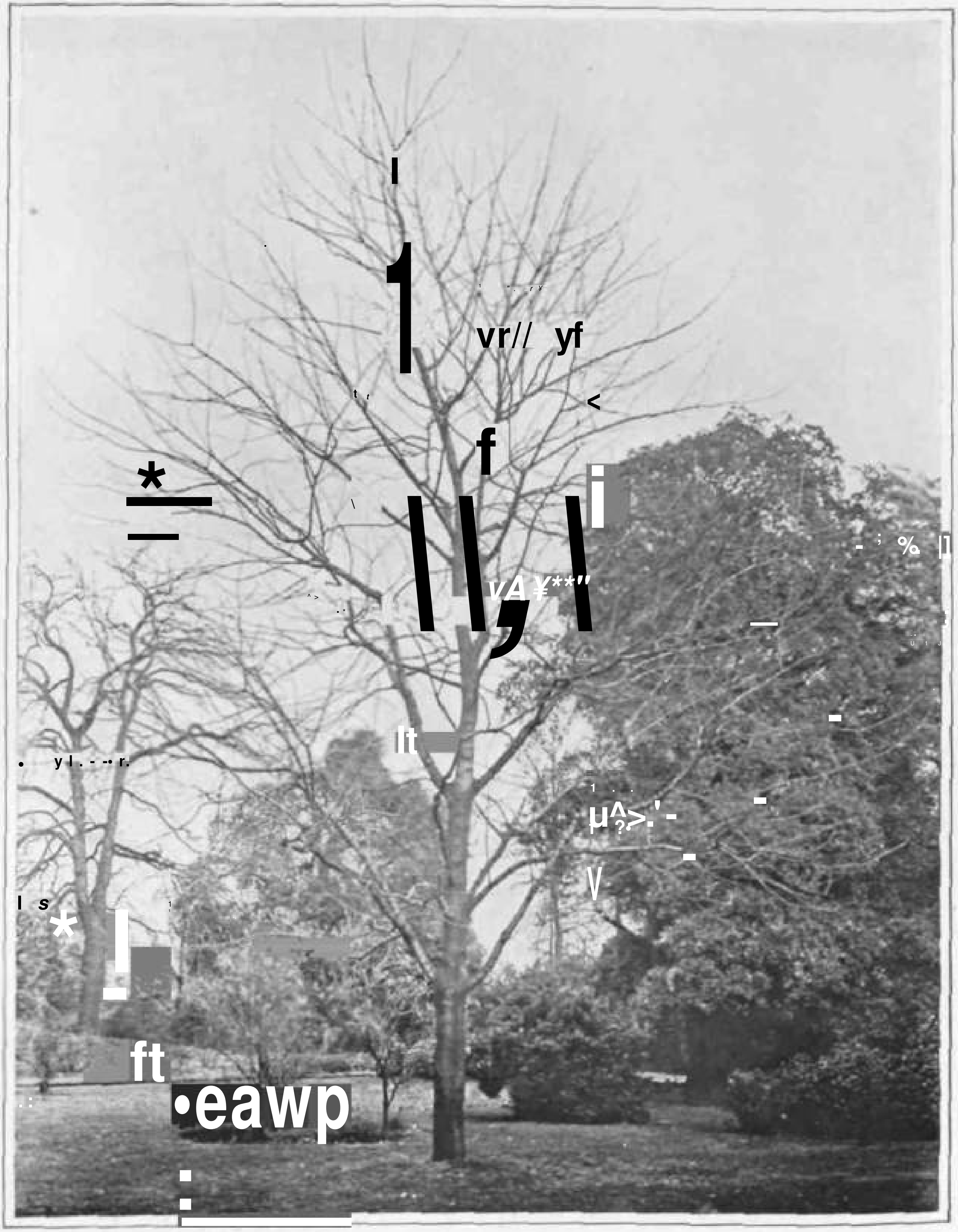


Fig. 35S.-NORWAV MAPLE—*ACER PLATANOIDES* z WINTHK,

Fig. 356.—NORWAY MAPLE—*ACER PLATANOIDES:* SUMMER.

;uid as a rule all the inflorescences on a single tree are of the same type; consequently male, female, and bisexual trees occur. The terminal bud which gives rise foliaged **branch,** and thus atones for that arrest.

In structure and behaviour the flowers agree with those of **the Sycamore,** though

Fig. 357.—**Bark of Norway Maple,**

i." I he inflorescence behaves much as in the **Sycamore,** so that **foKage-Jeaves ultimately** unfold on the year's-shoot, below ilu-inflorescence. As the terminal growth of this flowering-shoot is arrested by **the** inflorescence, often one of its lateral bin Is develops in the same **year** into **a** **there** is a greater difference between the sepals and petals as regards form.

As **the** masses of **yellow-green flowers appear** before the **Leaves** they are **conspicuous** and give to tin- Norway Nfaplo an unequalled freshness of appearance in spring. **Bees are responsible** for crnss-polHnation.

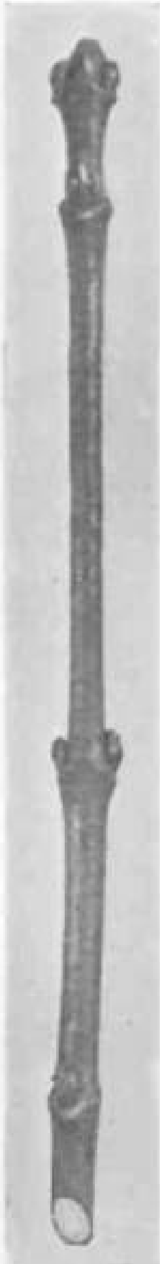


Fig. 358. Twig of *Norway Maple* in Winter.

**Fruit and Seed.**

In general structure of fruit and seed, a? **wfell** as iti type of germina- i i• in, the Norway Maple agrees with **the** Syca- more, though it exhibits **the** iilready-jiu'iit imied differences in shape <'f fruit (Fit:. 544). iindother differences in shape of the primarv leaves. (Occasionally, especially in young trees, the wings Of the fruit intlini[1] up- wards, **and** me in>t horizontal; **but** in tins case their shape and tine flat form of the seed - containing part are unmistakable.)

*Acer -platanmdes* is not a British tree. Its leaves, with long " drip ping-tips " from **which** water rapidly **drips,** suggest .11 ol|i/f to tin t'X- pert what is the fact, **that** it will endure u very moist atmosphere,

Fig. *359'* **Inflorescences of** Norway **Maple.**

Tivo other exotic Maples, occa- **sktsaQy** seen in English gardens, arc *Acer* ***saccharin** urn* (Linn.) *ami A. ntbrttm, which belong* to Canada and the United States. Like the Xqnvay M,ip!e, they **Open** tln-ir flowers in spring **before** the **Lettveo «rt' visible** : but **in** truit tliey ratlier recall the Sycamore. But **cms** interesting and **distinctive** feature is that their inflorescences **pldag** Ini (Tally fi<}m twig* protliicol **dating the bmnediately** proc«!intf year, *A. SJC-* ***ckarimm*** has rwidish or ^rLt'nlsh-vi'Huw sepals, but usually **no p«ta3a:** its **deeply** fiv^-lobcd **leaves** become **yellow** in autumn. *A. rulinnu* **possesses** petals, and deacrvt's it- n.nm- of **"Ked** M.i|>lc- " bi'Caust' *of* its *rpi](])sh* fiowrrs, ami scark;t or orange autumn'tin ted leaves.

Fig. 360.-COMMON *!S\\PLE.-AC£R CAMPESTRU:* WINTER.

Fig. [illegible]1.—COMMON MAPLE—ACER CAMPESTRE: SUMMER.

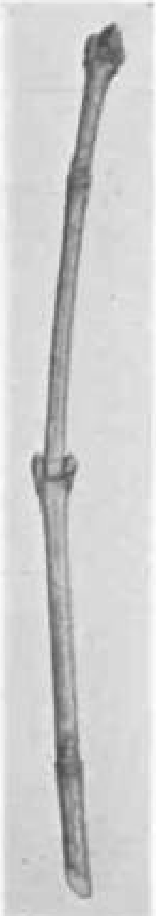
## ACER CAMPESTRE *(Linn.)*.—COMMON MAPLE *(Aceraceæ)*

The Field Maple differs from the two preceding species in the smaller dimensions of the whole tree, and of its leaves and fruits. In shape of inflorescence and fruit it agrees with the Norway Maple, but differs in its small blunt-lobed leaves, which serve also to distinguish it from the Sycamore as their colour is the same on both faces.

**Fig. 362.—Bark of Common Maple.**

The tree rarely exceeds a height of thirty-five feet, and much more commonly reaches only from ten to twenty feet. It Height. has spreading branches, and often assumes a shrub-like form when growing in hedges.

The bark (Fig. 362) is divided into scales by numerous fine fissures.



The small leaves (Fig, 13), only two to four indies in ◁i 1 meter, show three or live lobes, which are scarcely glossy. **They are arranged as** expanded; they are arr•:g«1 and shaped like those of the Norway Maple, Fl e an ru t V^F""*! but are smaller and include **fewer** * flowers. The **flowers** agree in type with those already described. The fruits (Fig.

**Fig. 364.—Inflorescence on Common Maple.**

**FiR.** ***363.*** **Twig of Com mini Maple in Winter.**

in the two preceding species. **The** lateral rest ing-buds are ipplied il'-r!y t" the stem **CKg. 363)-**

The erect greenish-yelloA' inflorescences (Fig. 364) **appear** in **May** if: r the leaves have 365) **have** horizontal or **even** downwardly-curved **vri&ga**; they differ from the simitar fruit-, of tin NMMY.IV M 'H - in **raaaHer size, aad in less Hattcned seed-comaininu parts.**

**The** Common MapU* *h* a **native "f Eti^and** and Ireland.

**Fig> 365. - Fruits of Common Maple.**

## ACER NEGUNDO (Linn^AsH-Lv^ MAPLE (Aceracev)

This American tree owes its popular names of " Ash-leaved Maple " and " Box Elder » to its pinnately compound leaves, each con-

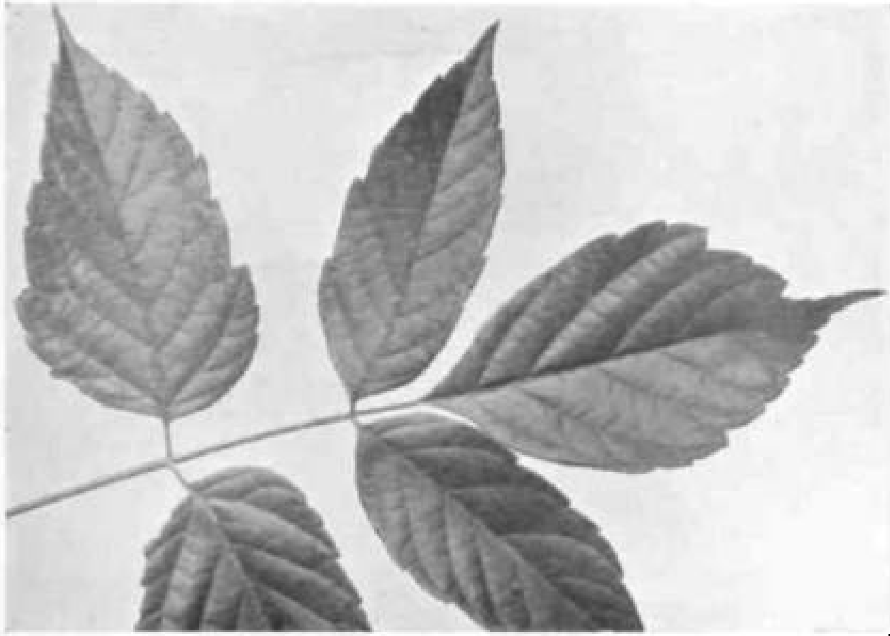
Fig. 366.-Bark of Ash-leaved Maple.

sistmg of three or **five** leaflets. **The** leave., together with the characteristic maple-fruits, and the completelyunisexual flowers which are devoid of petals, render rerognition of ihe tree an easy matter.

The low-branched tree may attain a height of from sixty to s.vvnty feet, and ]acquire a rough scaly bark at the ba^e of" its trunk (Fig. 366), which sometime attains a diameter of four fcet. The wide-spreading boughs bear overhanging **branches** whose drooping habit gives to the tree **a wry** gniwful form.

Leaves.

The opposite pinnate leaves exhibit the shapes illustrated in Figs. 58 and 367, but sometimes **the leaf** has only three leaflets. Each separately - stalked leaflet, when young, is coated with an obvious covering of hairs, which are more or less completely cast off as the leaf matures. One detail worthy **of** note is the conspiniousness of the leaf-scars when the yellow antumiv leaves and bud-scales have **fallen** (Fit?. _'.;).



F'K- 367,—Leaves of Ash-leaved Maple.

**Fig. 36S, Male'-') and Female v Inflorescences of Ash-leaved Maple,**

Flowers.

The inflorescences spring from the shoots in a manner very different from that habitual to the Sycamore, Norway Maple, find Common Maple. :i> they are lateral in position. Certain ivsting-buds on the sides of the long-shoots develop into pendent.flowering dwarf-shoots, **which** take the form of tufted male or **loosely** branched female inflorescences (Fig. 368). The male and **female** flowers are usually on **different** individual **trees,** and open before **or** when tli<? leaves expand.

Tlie **peculiar** feature in the flowers is the absence of petals and of a disk. In both kinds there are five **(occasionally three or** four) sepals. The male flowers hang from long slender stalks; and **each** has a bt'll-shaped calyx, within which **arc** only five (occasionally three or four) stamens that project far beyond the sepals, but there is no vestige of a pistil. The **fantalfi** flower includes no traces of any **stamens,** but contains **a** pistil **which** protrudes far beyond the small sepals.

Fi[illegible] 369.—ASH-LEAV[illegible] : WINTER.

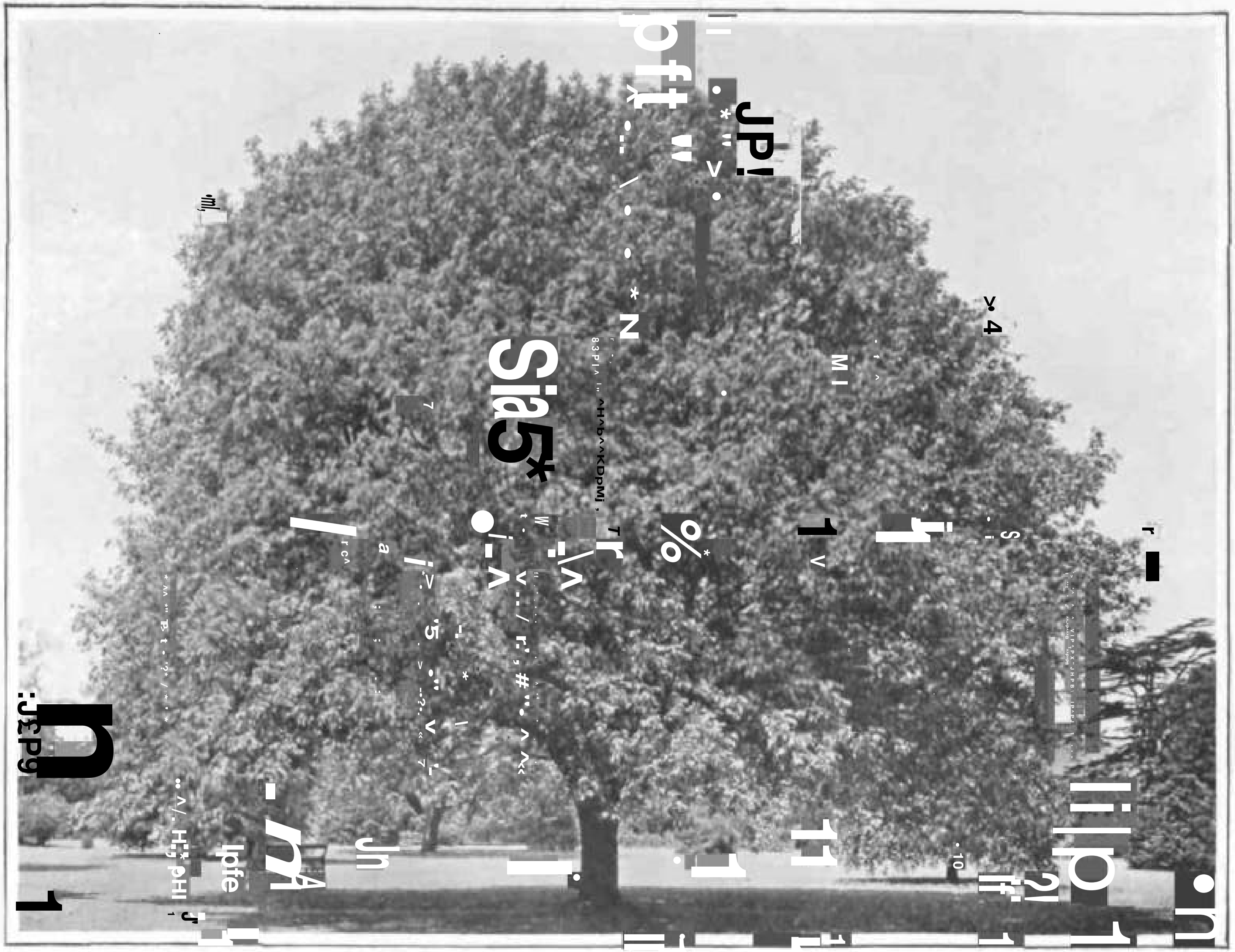


Fig. 370.—ASH-LEAVED MAPLE—*ACER NEGUNDO*: SUMMER.

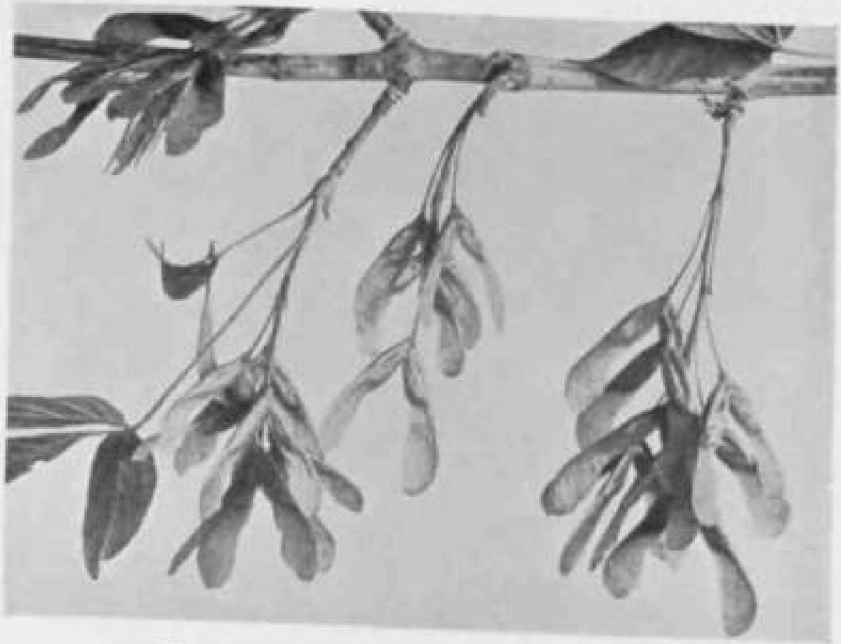


Fig. 371--Fruits of Ash-leaved Mapfc.

The two **wings** of the fruit are directed nearly **vertically** (Fig. 371).

It may here be mentioned that a "variety" with partly white leaves *k* **a** very decorative tree, common in gardens. **The** ancestral typo **of** the Ash-leaved **Mkpl«** is, of **course, the** entirely green form ; accordingly, snoots of the Variegated tree often 'throw back" or revert to the original form in such **a** way that the same individual tree displays many branches bearing variegated **foliage** interspersed with a smaller **ntahber** uf green-fotiaged shoots.

# HIPPOCASTANACEiE

## JESCULUS HIPPOCASTANUM (i»w,).-HoRSE CHESTNUT (*Hippocastanaceæ*)

The **Hippocastaiiacea;** agree with the A< **tr-aces** in many characters, but differ in tli;it the opposite *leaves* are *patmatch compound,* tin- ***flowers*** *irregular and showy,* the ***ovary*** *thrcc-chambercd,* and in **that the** *fruit spontaneously opens by three valves.* The **general** characters of the family are **sufficiently** indicated by the Horse Chestnut,

**the** tree is recognised by the family characters already enumerated, by its large, glistening sticky buds, its beautiful erect **conical inflorescences,** its spiny green fruits, and characteristic large seeds each **marked by** :1 large scar.

The tree rises to a height of perhaps sixty feet, showing a yery shady oval-

Porm. Pyran»dal crown **thai** may extend neariy to the ground. From **the** base of the bole may rise recent **yoaftg shoots.** The bnrk remains **smooth for** many years, but eventually **becomes** furrowed and **scaly** (Fig. 372). **and may dothe a** trunk one yard in diameter.

The large palmately compound leaves are opposite, and in four ranks (Fig. 381), those

Leaves. o* tJie horizontal branches being on the two flanks, and on the upper and lower (aces. The leaves inserted on the lower face of a branch possess larger blades than the **Others.** The leaf lias no stipules ; its broad base narrows above into a long leaf-stalk, nt the somewhat widened summit of which are attached the latter, and by adjustment of **the Etngle** at **wbtch** they stand in reference to it. *In* autumn the leaflets show tints ranging through green and **yellow** to red, and may fall off separately.

**!-i£. 373.-Bai-k of Horse Chestnut.**

from three to nine leaflets. The **leaflets** themselves are stalkless, have double saw-like teeth **and a** sharp tip, and are broadest towards their **ends**; they acquire a horizontal position fully **exposing** them to the light, by **variations** in the length and **direction** of" the leaf-stalk, by twisting of

Buds.

The large resting-bud exhibits four **ranks** **of** balsam-coated, glistening sailes, ***which*** are ranged in pairs **at** right angles. On the leafless coarse twigs **in** winter (Fig. 375) the lateral buds stand in the axils of very large leaf-scars, which, unlike those of **the coarse-twigged**

Fig. 373--HORSE CHESTNUT-*ASCULUS ftlPPOCASTANUM:* WINTER.

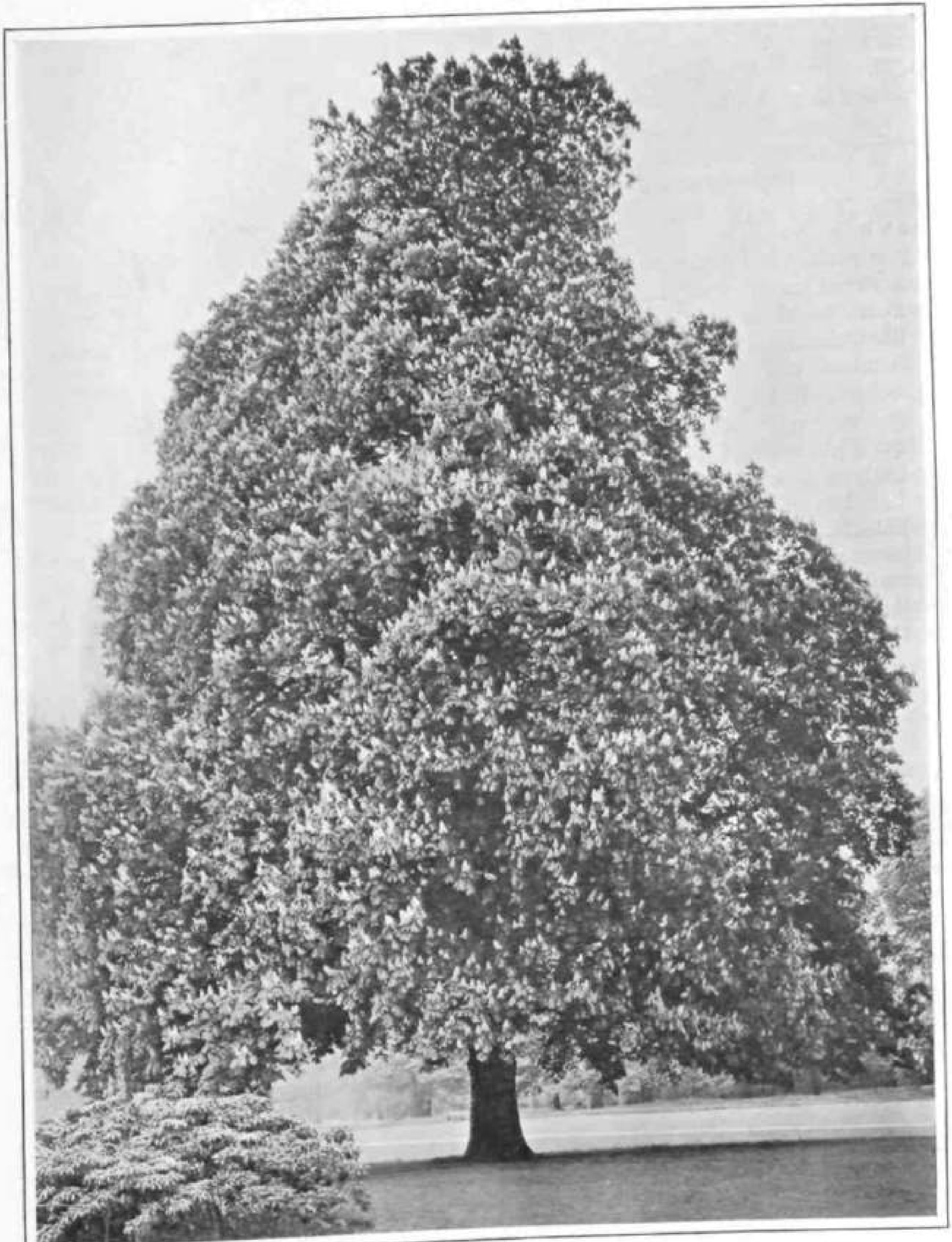


Fig. 37.—HORSE CHESTNUT—*ÆSCULUS HIPPOCASTANUM*: SUMMER.

Ash, are not raised above the general surface.

The terminal res ting-bud encloses a. number of scales, also some foliage-leaves

Opening Buds.

Wltırh are deilsc3v **clothed** in white **woolly** hairs, and perhaps a **young** completely modelled inflorescence. Figs. 376-79 show stages in the **opening** of a bud. As the bud opens its inner scales grow greatly in length and bend back; at the same time the young little foliage-leaves perched on short erect leaf-stalks emerge **with** their erect leaflets closely folded along ihc middle and side nerves {Fig. 376). As the **leaf-stalk** lengthens the leaflets gradually **Spread** open and bend down, so as to acquire a horizontal (Fig. 377) and subsequently a drooping pose that causes the young leaf to present the appearance of a half-closed umbrella (Figs. 378 and 379). **Afterwards** the leaflets rise up, completely smooth away their creases by spreading fully open, and acquire their final horizontal pose (Fig. 381). In the meanwhile the white hairs clothing the young leaves have shrivelled, become rust-coloured, and are then detached, so that **the general coating** of hairs is represented only by **a few** rustv **hairs remaining** at the widened tip of the **leal-stalk.**

The yearVshoot which tims develops from a bud may bear foliage alone or also

Li ranch ing,

flowers. Terminal and lateral buds may grow out into purely vegetative branches; in such a case the lateral ones on **horizontal** branches spring almost exclusively from the flanks, for the buds on the upper and **lower** faces generally remain dormant or give rise to feeble little shoots **which** soon die. Only large terminal resting-buds enclose inflorescences. Sucli **a** bud produces a slioot that bears **a** few foliage-leaves and terminates in an inflorescence (Fig. 379), Thus the terminal growth of the shoot concerned is henceforth impossible, but this disadvantage is atoned for bv the activity of a bud which arises in **the axil** of a foliage-leaf close beneath the inflorescence, and which **sfioots out, even bearing** foliage-leaves in its first year (see Fig. 380, where the bud is denoted by the **mark** 1); the active bud in question springs from the lower face of **the** branch. The horizontal **branches of** the Horse Chestnut are therefore " false stems " made up of successive generations of branches strung end to end.

Fig. 37S—Twig of Horse Chestnut in Winter.

The tree flowers at ten or fifteen years

Inflor-escence.

of age, and regularly thereafter, in April or **Kay.** As the inflorescence is already prepared in **the previous** summer, it **may** precociously emerge in ;i mild autumn.

The erect **conical** inflorescence is compound. The main inflorescence - stem bean* branches, tin- secondary inflorescences, which are distinctly curled at their ends when young. The flowers and lateral inflorescences being adequately protected in youth by the surrounding leaves and by their dose packing, protective bracts become superfluous and are supplied.

The flowers are not all alike. In a secondary inflorescence the lowest flowed, which also open first, are male; above

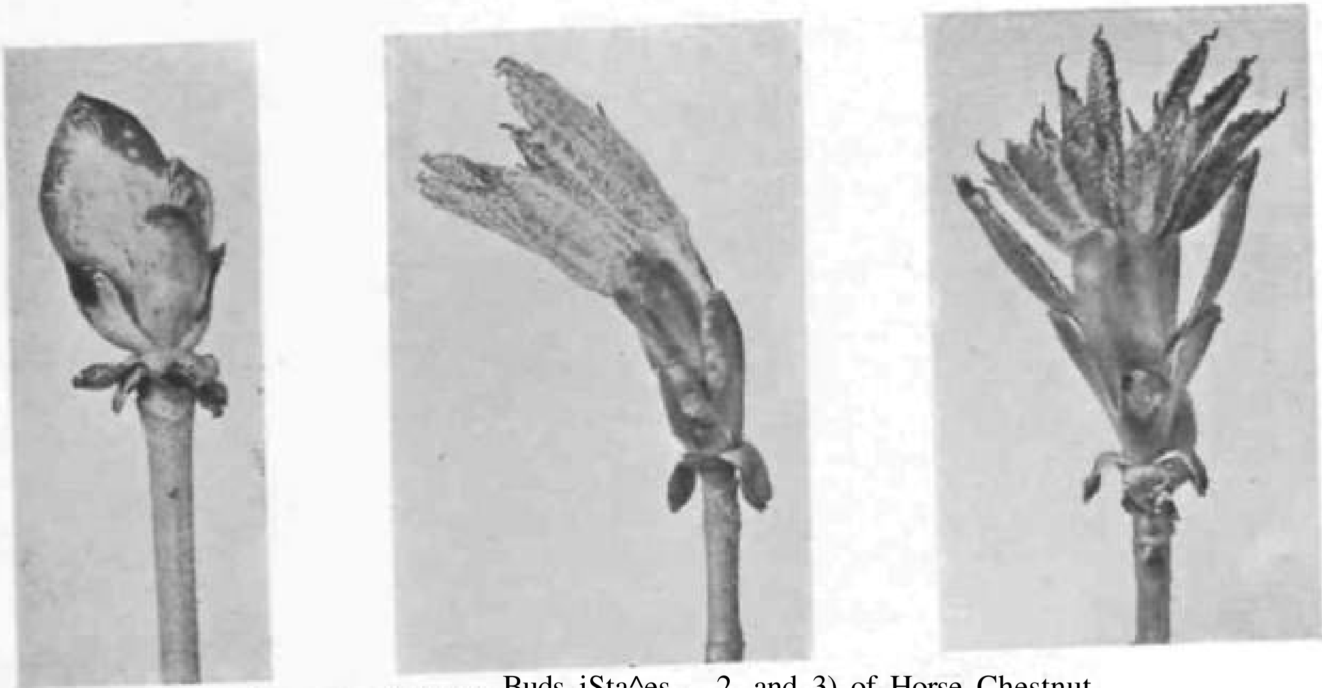


Fig. 376.—Opening Buds iSta^es ., 2. and 3) of Horse Chestnut.

thuse may 1"' flowers with d-r- tilt; (i v **a** ri **es** ; and at the tip there are tiny fl o\v c r - b u d s which never open, but be- come b r o w n and drop off.

**Each** flower, though irrttgu- l;u-, **cao** Flowers* , ji- be di- vided into two equal similar h a l v e s, and stands horizon- *'U&.* The live joined s e p a l s **emheath** t **b e** tinopened flower in **a** bell-shaped envelope, wbidi bursts irregu- larly when the f l o w e r o p e n s. There are nsu-

Fig. 377.—Opening Bud (4th Stage) of Horse Chestnut.

ally only four **separate petals** n o t differing greatly in **shape,** but the two b a c k **(Tapper)** ones **have larger** y e l l o w spots than the two **side** (lower) **ones** **p o s s e s s ; the** *i\i* th **petal* which** should be pre- sent 111 front, is **small or missing.** **The yellow** spots **are seen** only in moderately young Rowers, as they eventu- al ly become pink. Immedi- ately **within the** petals **ties** the ring-like d **isk,** **which** is larger at the back of **the** flower where nectar, wMch it excretes, accumulates. Inserted distinctly within the disk tire from five to eight (usually seven) stamens, **each** of which has a long **bent** filament and a flesh-coloured anther, which easily moves as it is attached to the **filament** by a very thin joint. In the centre of the male flower **15** ;L **white** column-shaped body. **which** has no style, but possesses a feeble, discoloured stigma and a three - tininhered ovary **devoid** of **ovules : this,** then, is a rudimentary pistil. Bnt in bisexual flowers, which also have fertile stamens, and in female flowers, **whose** sterile stamens fall before

**Fijj. 378,— Opening Bud 15th Stage 1.**

**Fig- 379.—Opening Bud (6th Stage), also showing Young Inflorescence.**

their **anthers open, the** pistil **shows three carpels joined** to form .1 **swollen** ilu<v-rh;unb<'rv(l **ovary, a Bangle** l"tu: »tyK and ;s point-**Uke s£%B2fi; and each chamfter of** tin' **ovary contains two ovnles-Uras, ;is in** tin- **Maples, Sewers owe** their **unisexual nature to in-complete dei'dopnuMt of stamens** or carpels.

**Pollination.**

Vt-[\- conspicuous are the flowers **massed together at** the ends of tin- twigs in inII"'i-**escfinces, whose** dorn-in:uit cri-umy-whitL' is **flecked with yeflow** and pink. **They** ;ire pollinated by **the** agency of humble-**bees,** Cross-polliiiLition is favoured and seLf-polHnnlion obstructed by the dr-cnmstanoes: (0 that the inflorescence is practically male at the commencement, as the male flowers open first; (2) that bisexual Sowers are female in early life, because the stigma is receptive before the anthers are ready to open. In these passing to one in its lirst stage, will strike the anthers and stigma respectively with the same part of the uader-surface of its body, as it thrusts its tongue into the space at the bast- of the back (upper) petals,

The ovary develops into a rounded,, spiny, green fruit (Fig. 381), which h:ts a sonu-what

'*£• 3>St>.—Inflorescence of Horse Chestnut.

latter flowers tin- style at first stands out horizontally, while the immature stamens arc* bent downwards ; later on the stamens sweep upwards, and their open anthers occupy a position wry near m tlit? stigma ; finally, the stamens With emptied anthers retreat downwards once more. Thus a humble-bee entering a bisexual flower in its second stage, and thick, fleshy wall that splits into three valves. *The* fruit may contain from one to three seeds, but usually only two. The forge seed is a >xered by a coat which is brown inul polished except where the relatively huge, dull scar is. Though somewhat simi-!;n in appearance to tho edible chestnut, it differs in being a seed, which is produced

**Fruit and Seed.**

Fig. 381-Fruits and Seeds of Horse Chestnut.

insidt- a rijiened ovary (**the** rdibli? cli«tnut is *itself* a ripened *ovary). 77K>* > eed is *wholly* ***oCttipiad*** *by t//r* rtni*nt\ tfcr* greater **port** ***ot*** *vhtrit Us* ***fyna&t*** *t>v* tnc two Liree thick COtyfedOMi and **the** root **of** whi?h lies m a pecufet Me pocket formed by ,],,. infolding of the seed^oat. When the xM tT,- ^ntwiiiHrmB rPtiviin 1, seed germinates the cotyledons remain b,,-**low** ground, and the rapidly-growing mum stem -!+ once j-r'!ii^ i-rdimirv foliage* ve

ltaTh^ II.-se Chestnut is ,,,l! " "li,m, <<f Great Bri tain, |ut was **probably** intro-duced tote I Europe f:c Asia Minor. Double-varieties ' « **of** the **trea BW** in culti-va"<"", and suggest that **the** additional *petals are produced at the expense of the* i l ^ T ^ / * * "/rV7nt>afc/ftl -••wew **fieewcen** ^ am Sta TM n S <>CCnr in surh doublo-

Am<mR lhc Horse **CtestantB** in cultivation. somc ^wtlis **"elong** to **the sob-genus *Popia*** . Uicsc haVer.os,,,^j,,,,.,.,,,u,ri,>,mm. fK.^,Sltsting-buds that ore doS in sut&ca and **urn** sticky, and h»ve their leeflats attacked to the oommoM lefli-**sta&** by distinct, nt.ilks. **One racb rijpedei** Ee the purple flowered *Æsculus Pavia*. This nlust not **bo cpnfiucd with tho cottttnOB red flowered hybrid** by *Pa*.... ami nas leaves Uke lhosc of the former.

# AQUIFOLIACE^E

## ILEX AQUIFOLIUM *(Linn,).*—HOLLY *(Aguifoliacue)*

The Holly-tree is the solitary British representative of its family, the Aqui-foliiiceEe, whose characters are sufficiently indicated by those of its flowers. branches **may** extend almost to the ground, and are themselves densely branched, so that the tme, with its evergreen foliage, casts deep shade. The plant freely **emits** branches from

Fig. 383.-Bark of Holly.

Though often a shrub r the Holly may become a tree forty feet in height and possessing a single trunk which is coated with a smooth ashen bark (Fig. 382). Its the base of the trunk and from younger shoots, and hence endures repeated clipping,

The spirally-arranged simple leaves are tough and evergreen, and live for some—

v

Fig. 383.-Shoots of Holly.

often four—years.* **The** leaf-blade is prickly on the lower parts of the tree, but frequently unarmed elsewhere (Fig. 383). It is suggested that the prickles protect the tree from large browsing mammals Leaves. sudi as cattle> and are therefore superfluous excepting within reach of these. The leaf is stalked and has at its base two minute dark-pointed stipules.

The resting-buds, and especially the lateral ones, are very small. Examining a terminal bud, we see that it is "naked 0l- Buds. open," as it lacks any true bud-scales. The outer leaves covering this resting-bud, though stalkless, possess stipules and have toothed margins; and when the bud sprouts they enlarge and remain green, in place of falling off, while the inner bud-leaves grow to a still greater extent and have larger pointed teeth at their margins. In other words, the leaves protecting the terminal bud are in character intermediate between foliage-leaves and scales.

The Holly can flower at an age of twelve years or perhaps less. Its blossoming Flowers. season is especially prolonged, as flowers may open at any time between May and August. Close clusters of creamy flowers arise in the axils of leaves of the preceding year, and include male, female, or bisexual flowers. The tree may bear only male or only female flowers, but at least clipped garden individuals may bear all three kinds.

The flower (Fig. 386) is regular and hypogynous, and all its parts are in fours. There is a small four-toothed calyx. The four creamy petals adhere at the base, and to this common base are attached the four stamens, which alternate with them. There is no disk. In the male flower the pistil is represented by a central lump which varies in structure, but often is a feeble two-lobed body containing no ovules. In the female flower the four stamens are smaller, and frequently possess white anthers that do not open. The pistil consists of a stigma with four small lobes, a very short style, and a four-chambered ovary containing one ovule in each chamber. The bisexual flowers include perfect anthers and a perfect ovule-containing ovary.

Nectar is secreted within the base of the petals, and is easily accessible to various short-tongued insects which effect cross-polhnation.

The red fruit (Fig. 385} is not a berry, but a stone-fruit containing four stones, which Fruit. are respectively formed by the four chambers of the ovary. The fruits ripen at any date after August, and may hang on the tree during winter. They attract and are dispersed by thrushes,

* The statement repeated in various books that the leaves live and remain attached for only about thirteen or fourteen months is probably copied from statistics provided by Continental botanists, who possibly originally wore dealing with trees growing under a more rigid Continental climate or in towns.

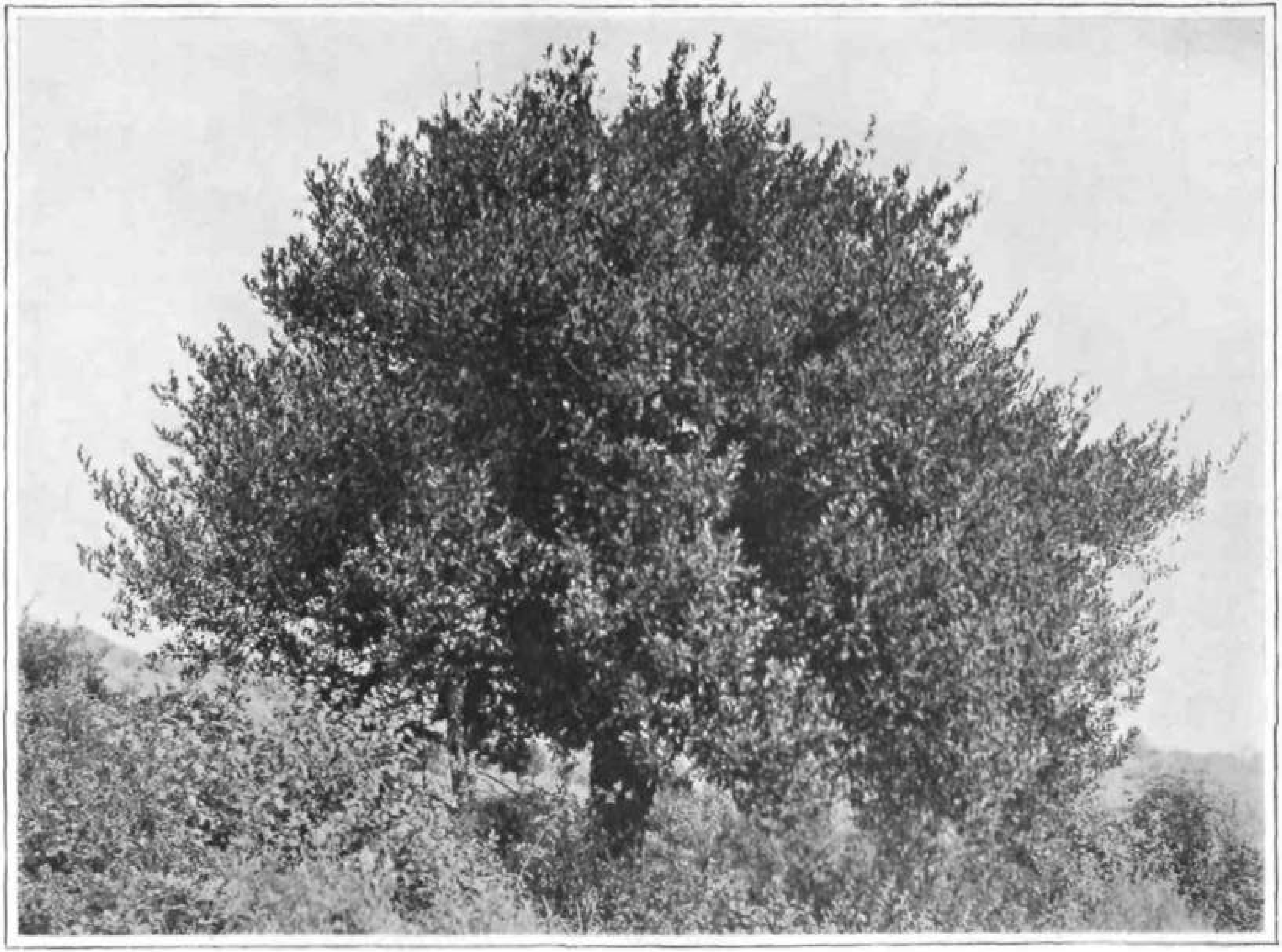


Fig. 384.—HOLLY—*ILEX AQUIFOLIUM.*

wild pigeons, and partridges, which swallow **the** fruit. The seed, protected hy the " stone," passes uninjured through the bird's body, but during **this** passtigc the stone is softened and subsequent germination is thus **facilitated.**

Seed"

The seed contains a minute embryo as well as a special store of food-material (endosperm). In germination tlu- **green,** even-margined, **cotyifr-**dons emerge **from** *Vh* soil, **and** **are** succeeded by small prieklc-edged foliage-leaves. The young little plant **grows** but slowly.

*Pig.* 3S0.—('lowers of Hollj.

Fig- 385.-Frii1l* of Holly.

**Habit*.**

The Holly-tree is a shade-enduring tree, capable of growing in forest, as is suggested by its smooth bark, **its** lmv-P(tcl^d and dose branching, the duration of its leaves, the dense shade that it casts, and finally by its slow growth in height. The Holly again illustrates the fact that trees or shrubs which are evergr.cn in this country possess thick, stiff leaves able to resist excessive loss of **water** during winter when coldness of **Hit Preheats** the roots from absorbing rapidly. But the Holly-tree, though stiff-leaved, is not adapted to a life in dry places; <*m* the contrary it seems to flourish naturallv **Where** the air is moist, as in the island climate of **England** or near ***** on the Continent. I, a continental climate it often dwindles **to** a mere shrub, as its **twigs** are refiu arly nipped by severe winter frosts; in England (•« m the Forest of Dean) it becomes a good-sized *Le.*

**Varieties.**

In cultivation there are many varieties of the Holly- *"*' '"eluding those with yoUow or white fruits, those prick! \ 7^ ^^ tllilt •» variegated, devoid of l.sl or prickly on their faces as well as at their margins.

# CELASTRACEJE

## EUONYMUS EUROPJEUS (*Linn,).*—SPINDLE-TREE *(Celastracae)*

The CelustraceEe include only one British plant, the Spindle-tree, wliich is recognised by its inflorescences, the structure of its regiilar greenisti-vhite flowers, and, above all, by its fcrar-lobed red or purple fruits that open and expose the seeds, each of which has a fleshy orange-coloured ccKit.

The plant is a shrub or small tree, varying from five to twenty feet in height. Its trunk is eventually clothed by a grey, longitudinally furrowed bark *{see* Fig. 387). The opposite, simple leaves are ranged in four ranks. Each has two minute short-lived stipules, a stalk, and a hairless blade with finely-toothed margins (Fig. 391). The rest ing-buds, which are small, show several pairs of opposite scales disposed in four nuiks (Fig. 390).

The greenish - white flowers open in May or June, and arc arranged in forked

**Fig. 387.-Bark of Spiildle-tree.**

Fig. 38S.-SP1N[>LE-TREE-£t/ON™I/S *EUROP^US;* WINTER.

Fig, 389._sP1NDLE-TREE-£t/ONV7W(/S *EUROP&VS* : SUMMER.

inflorescences that spring from the axils of leaves on the current year's-shoot {Fig. 392). Minute bracts are present.

**Mowers.** The bisexual, regular, hypogynous flower has four small green sepals, four greenish-white separate petals, four stamens .ill.Tii.iHn-,; with **the petals** and iiwiin-il mi a swollen green disk, and, rising from the middle of this, tlte single four-chambered ovary. The ovary **terminates** in a single style which i<; capped by a four-furrowed stigma; two ovules are present in each ovary-chamber. In addition to the bisexual flowers, there are, often on the same **individual** tree, male and female flowers in which tile ovaries and stamens respectively are rudimentary.

'ijt' **Wi—Shool** of Spindle-tree.

The flowers are relatively inconspicuous, moreover their nee-

**I'MMination.** tar is easily seen and obtained because it is secreted by the swolkn disk, so **that** cross-pollmation is usually effected by flies of various kinds.

$I_n$ the bisexual flowers the anthers open outwardly **before** the stigma is receptive,

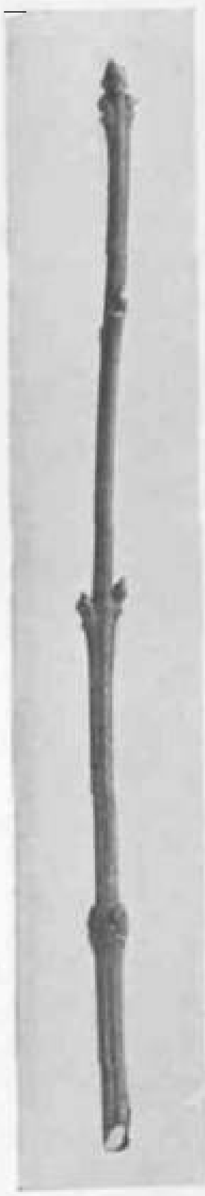


**Fig. 390.—Twig of Spindle-1ret- in Winter.**

**Ptfc. 3J«.—Rowers *at* Spindlc-tree.**

and by this means cross-pollination is favoured even in them; yet srlf-pollination is subsequently possible.

The ovary **develops** into a four-lobed rosy-red or reddish-£ *ed. - purple fruit (Fig. 393), whose wall splits longitudinally into four valves and exposes the bright orange-coloured seeds.

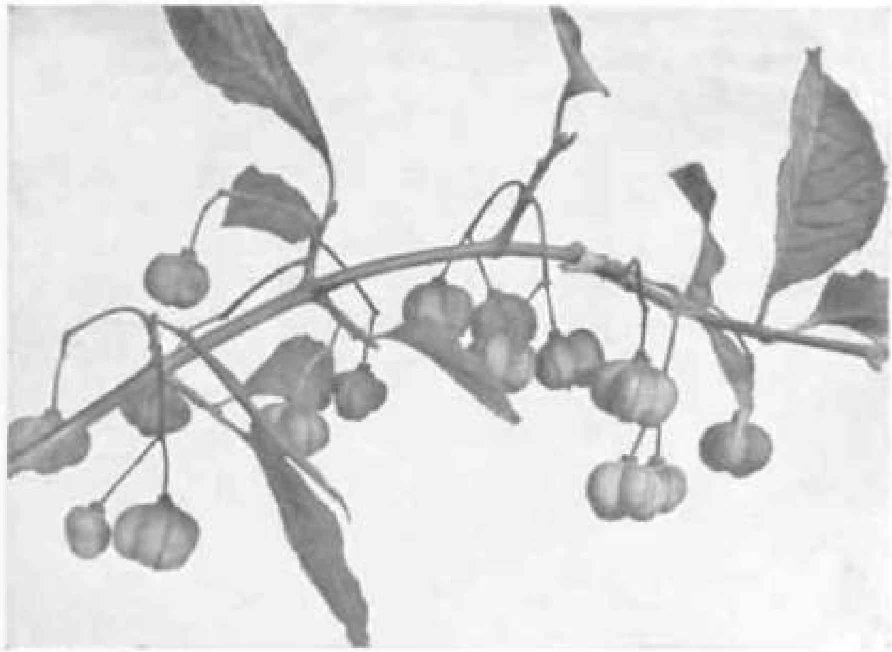


Fig. 3P3—Unopened Fruits of Spindle-tree.

One or two seeds are in each chamber, and owe their orange colour to an additional fleshy coat {false "aril") which covers the true seed-shell (testa).

The seeds are dispersed by birds, which are attracted by **the** red and orange colours and by the pulpy "aril."

## RHAMNACEJE. BUCKTHORN FAMILY

The **BhaimnaceiB** are represented in i.his country by only two native species of * *Rhamntts*, which arc recognisable by their small, inconspicuous, green (and white), regular flowers. The flower has an equal number (four or five) of sepals, *separate petals,* and stamens, all of which are attached to the rim of a more or less bell-shaped receptacle ; but the crucial character is that *the petals are very small, and each stands directly outside a stamen,* which is thus opposite to (not, as in *Euonynms,* alternate with) it. The superior ovary is from two- to five-chambered, with one ovule in each chamber. The flower is thus *pcri-gynous.* The fruit is a small, globular, black, stone-fruit. Both species are shrubs or small trees.

### RHAMNUS FRANGULA *{Linn,).*—ALDER BUCKTHORN *(Rhamnacece)*

This plant is usually a slu-ub from four to twelve feet high, and rarely becomes a trt:u twenty feet in height. As its whip-like shoots are feebly branched, **the** leaves are often largely grouped at the ends of long slender stems. The bark eventually becomes rough.

Leavc*'

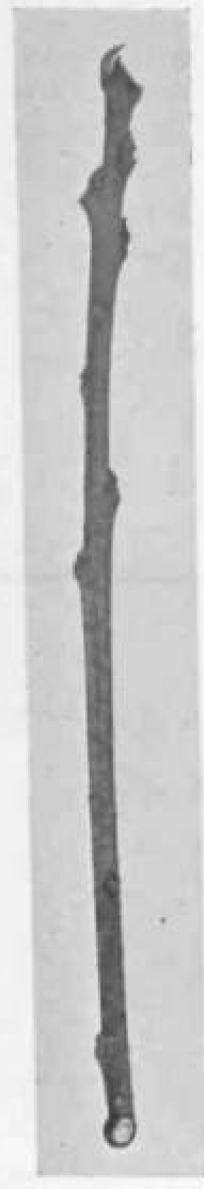
The simple leaves show an arrangement that is rare, as it is transitional between opposite and alternate. On the year's-shoot the leaves at the base are clearly in opposite or almost opposite pairs, tlie successive pairs standing at right angles ; but as the shoot is ascended the leaves of a pair become gradually separated by increasing lengths of stem, thus becoming alternate ; and still higher they may close together again. Each **Sea!** has two narrow stipules, wliich soon shrivel after emerging from the bud. The stalked, nearly hairless, leaf-blade is oval and devoid of teeth, and has **V«ry** regularly-arranged, straight, parallel, lateral nerves (Fig. 395}.

Buds and shoots.

The rest ing-buds (Fig. 394) are small, and show a few narrow hairy stipules which imperfectly conceal the folded foliage-leaves; the condition of ^ buds k therefore described as "naked."

**CJrowth of Shoots.**

If we observe the shoot that develops from a terminal resting-bud, several points of interest reveal themselves: (1) The shoot continues to grow and produce leaves throughout the summer; consequently, the ycarVshoot (and therefore the whole stem) is long. (2) As the flowers are in the axils of **leaves** on the current year's-shoot, and as new leaves are constantly being produced during summer, the plant has an exceptionally long flowering season, which lasts from May to July. {3) The lowest two lateral buds on the yearV shoots frequently grow out into considerable branches in the year of their production, and even produce flowers. Hence the strongest branches on the year's-shoot are often at its base (as in many shrubs), not at its tip



.—Twig of Alder Buck-thorn in winter.

FiK· 3Pg· -Flowering Shoots of Alder Buckthorn,

(as in **most** trees). This habit, as well as the emission, of stool-shoots and suckers, helps to explain the shrub-growth of the Alder Buckthorn. {4) Above the basal branches on the current year's-shoot inflorescences may appear in the axils of the leaves. (5) And still higher up on the same shoot there occur lateral resting-buds that do not sprout until some subsequent season.

**Flowers.**

The inflorescences take the form of tufts of stalked flowers in the axils of foliage-leaves.* In the axil of the leaf there first arises a central flower whose stalk bears two minute lateral scales; in the axils of these arise two lateral flowers. Hence the inflorescence consists of three flowers. But sometimes from the stalks of the lateral flowers in Sike manner other stalked flowers spring so **that** the inflorescence may include iron three to seven flowers. The flower-stalks are bent at certain stages in the career of the flower (Fig. 395)-

The design ol the regular, white and green, flower has already been described. It has jive sepals; five small white petals which **at** first partly enfold the five tiny stamens- The two- or three-chambered ovary is surmounted by a short single style, which terminates in a stigma that exhibits feeble signs of being two- or three-lobcd.

**Pollination.**

Despite of the nectar secreted by the limn* of the goblet-shaped receptacle, few insects are attracted by these incanspicuous (lowers, whose tiny white petals soon become discoloured. **the** stamens open before the stigma **ia receptive,** but as they eventually shed pollen on the ripe stigma, self-pollination apparently also occurs.

* **The inflorescences arc of sptcial interest in that they serve to throw** light upon **the inflorescences in the axils of catkin-scales of the Oak and Hazel families.** *See* **page 184 and** Fig. **2^4.)**

Fruit

After pollination the upper half of the receptacle-cup breaks off, but the lower half persists as a saucer at the base of the spherical stone-fruit, which contains two or three hard one-seeded stones. The Emit is green at first, subsequently red, but finally black, and about the *size* of a pea.

## RHAMNUS CATHART1CUS (Lm«.)—COMMON BUCKTHORN *(Rhamnacea)*

The Common Buckthorn is distinguished from the Alder Buckthorn by the following diameters; the flower has four sepals, petals, and stamens, and is more or less

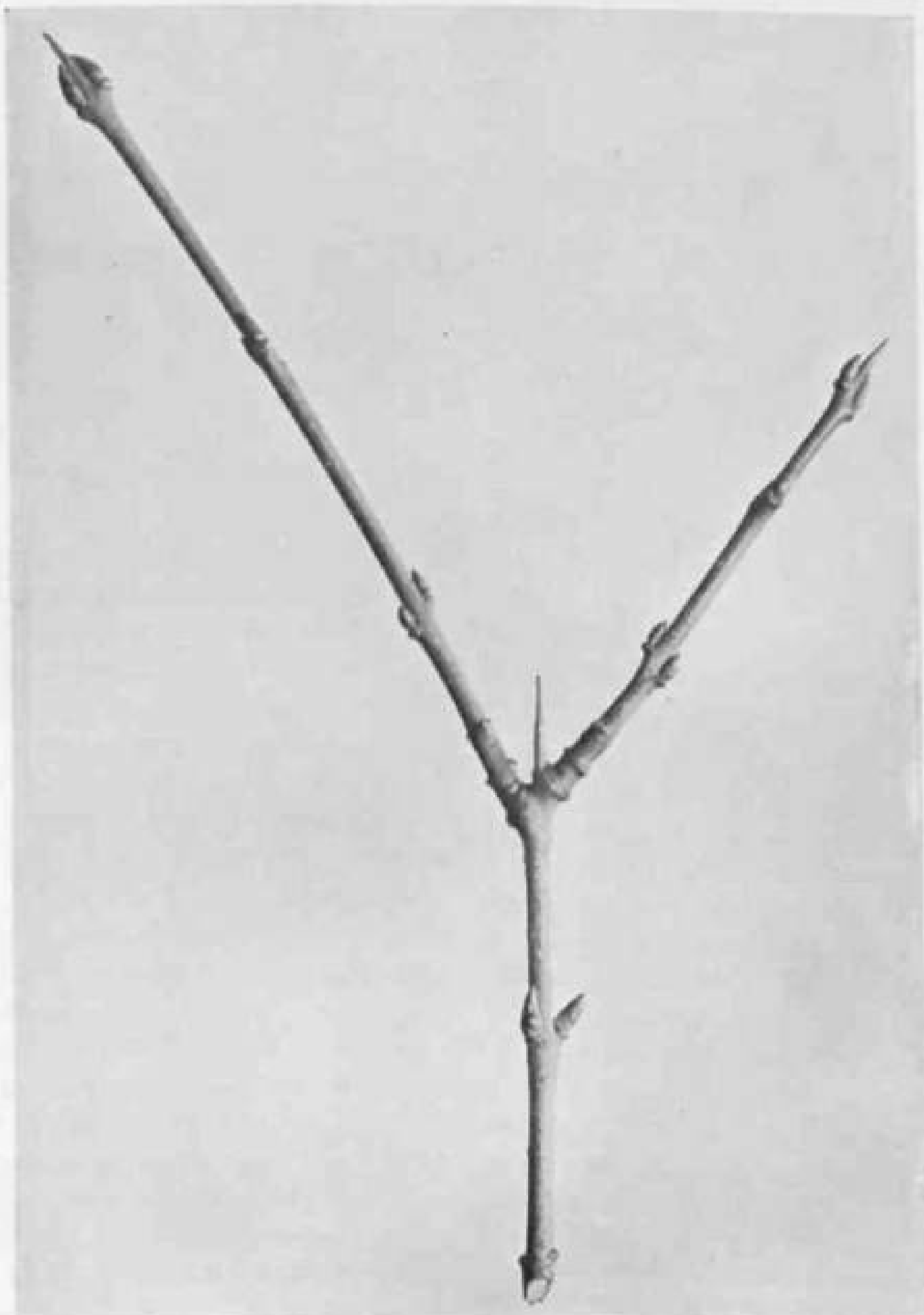


**Fig. 3o6--Twlfc with Spines of Common Buckthorn in Winter.**

Fig. 397—Male (i) and Rmale (V) Flowers of Common Buckthorn.

unisexual; the leaf is toothed, and has arched veins ; the ends of sterns are often converted into thorns. As a hedge-shrub, when nut in **Sower,** it may be mistaken for the Blackthorn (*sec* page 344), but differs in that many of its leaves and branches are opposite.

Though usually a shrub, it may become a. small tree, attaining a height of twenty-feet. The stems become black in colour, and the **trunk** is eventually rough-barked.

Uaus

The stipulate leaves show the same transition **between** the opposite and alternate arrangement as in the Alder Buckthorn, but incline more towards the former disposition (Fig. 400).

Buds.

The brownish-black resting-buds are clothed with scales, and the lateral ones are cIosfil>f applied to the stem {Fig. 396). The buds develop into long-shoots, dwarf-shoots with tufted foliage, or into inflorescences. As the end of the stem often changes into a thorn and the highest two Uteml buds grow out, the stems are repeatedly forked (Fig. 396).

**Flowers.**

The axillary inflorescences are designed and arranged on the same plan as in the Alder Buckthorn, and are limited to the basal part of the current ycar's-shoot, whether this be a long-shoot or a dwarf-shoot (Fig. 397). The inflorescences are crowded together as they arise in the axils of the lowest foliage-leaves (and perhaps of the scales), which are smaller and usually shorter-lived than the higher leaves. Each mnVireaeenn? may have from seven to three flowers, but may be reduced to the solitary central flower. The greenish (and white) flowers open in May or June.

Male Rower.

The male flower {*sec* Fig. 397, .?) has a bell-shaped receptacle, and the four petab mask only the filaments of the erL,Ct stamens> 3o tliat tne h'ght-coloured anthers project freely. Hidden at the bottom of the bell-like

**Fig. 3^8.-COMMON BUCKTHORN-*RHAMNUS CATfiARTtCVS:* WINTER.**

Fig. J99.-COMMON BUCKTHORN-*RHAMNUS CAThARTtCVS;* SUMMER.

cavity stands the; reduced little pistil, which may show a distinct ovary, style, and even stigma.

**Female Flower.**

The female flower (Fig. 397) ?) has a cup-shaped receptacle, and its four tiny petals conceal four minute stamens, each of which has a little filament and anther. The green, (usually) four-chambered ovary is surmounted by a style, and this divides about half-way up into four stigma-tipped branches, which freely project from the flower.

**»|sexual Flower.**

Between the perfectly **male** and female flowers intermediate kinds occur. This and other facts suggest that the ancestors of the Common Buckthorn had bisexual flowers, which have become more or less completely unisexual by reason of the degeneration of the stamens and pistil respectively.

**Fig. 401.-Fruits of Common Buckthorn.**

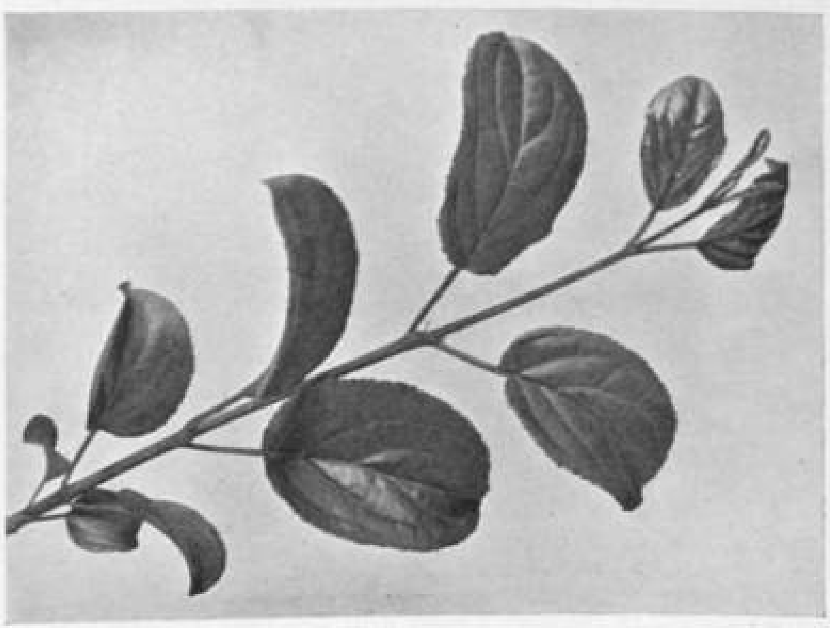


**Fig. 400.—Shoot of Common Buckthorn.**

As the greenish, scented flowers are very largely unisexual, and as the individual plant tends to bear only male or only female flowers, cross-pollination is favoured or even obligatory. Insect vistors seem to be few in numbers and in kinds.

The black, spherical, fleshy fruit (Fig. 401) is in size equal to a small pea, and contains four one - seeded stones.

# PAPILIONACEiE, LABURNUM SUB-FAMILY

The Papilionucece form a subdivision o£ the large family Leguminoste, and include such diverse plants as **Clover, Peas,** Vetches, Beans, Broom, Gorse, Laburnum, and False

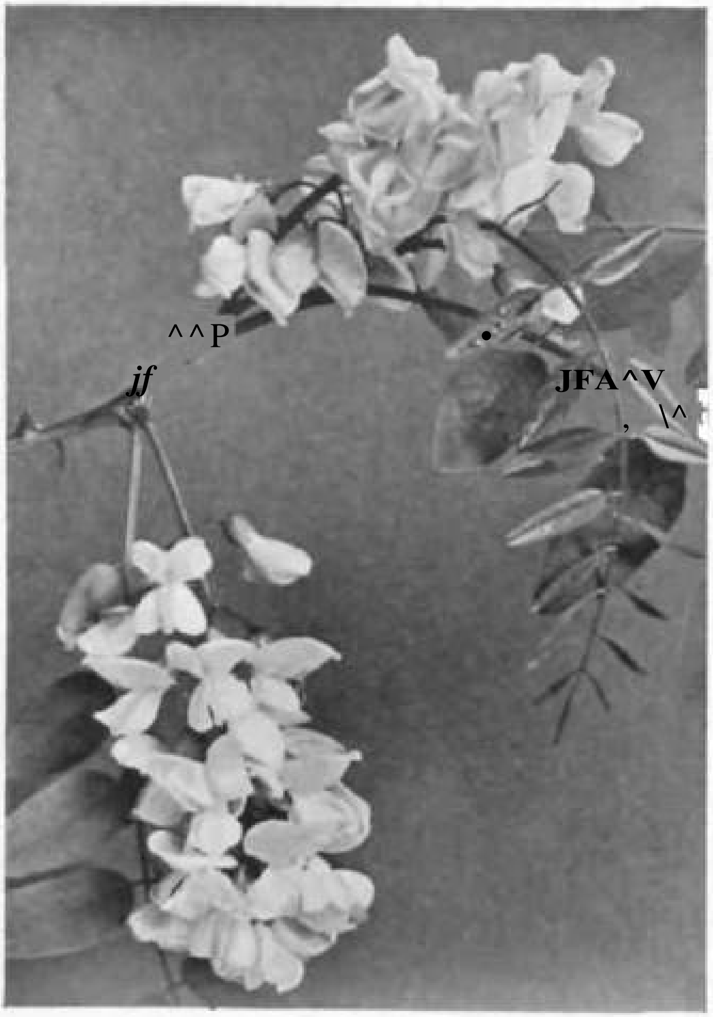


Fig. *4(12.*—Inflorescences of Robinia-

Acacia. They are easily recognisable by the *characteristic shape and construction of the flower.* Of the five petals there is, at the back, one *{standard)* which in the bud **over-**laps the two *(mags)* at the sides, and these in turn overlap the two front petals which form a kind of boat *{kcrt)* enclosing the stamens and ovary. The (lower is **irregular** ; its sepals and petals are slightly perigynous. **The** five sepals are joined ; the five petals more or less completely separate; **the** ten stamens arc all joined by **their** filaments to form a tube, or the tube is open at the back because one stamen occupying this position id separate from the nine others, **which** are joined. Within this tube is the single carpel, which forms **a** onu-chambered ovary, a single style, and single stigma; inside the ovary are **usually** several ovules. The fruit is a pod which, as a rule, splits open longitudinally **along** two lines (and **is therefore** a ***legume).*** The seed is wholly occupied by the **embryo or Ready** so. The leaves are generally **alternate, compound,** and stipulate, the leaflets usually being devoid of **teeth.**

[The Legum.inos.'e include two other sub - families — *C&salfiiniacet?* and *Mimosacav*— which are not represented by any British plants. **"the** irregular ilowers of the C#sal-piniacese are often very simitar to those of the Papilionaceae, but their petals, in the bud-condition, overlap in the reverse direction : that is to say, the two front petals **overlap** the two side ones, **which** in turn tenfold **the** back petal. The **Ceesalpjniacea** include one tree cultivated in English gardens — the Judas-tree *(Ccrcis)* — whose irregular pink-crimson flowers spring from woody shoots that are a number of years old, and **whose simple** leaves provide an exception to the general prevalence of **compound** leaves in the sub-family. The Mimosaceie, including *Acacia* and ***Mimosa,*** differ from both other sub-families in having regular flowers; often, too, the **flower** includes many stamens. l.)imbly-compound leaves possessing many small leaflets are also frequent.]

## LABURNUM VULGARE (*Linn.*).—LABURNUM (*Papilionaceæ*)

The Laburnum is recognisable by its leaves, each composed of three leaflets, its smooth bark, and its luxuriant display of yellow blossoms **ananged** in lianging inflor^ escences (which <:a«se Germans to give to the tree the name of " Golden Rain "), and finally by its pendent pods.

The tree may be from fifteen to thirty feet in stature, but at considerably less height its cylindrical trunk usually gives way to a number of ascending boughs.

Fig. 403.-Bark of Laburnum.

These spread out h, ,1 • m , tllfilr upper parts, "ei«ht *nd TT *&* over> an«l droop at Habit, ?J T ds. , on &Uch a bo^h shoots from the tip b n t ? ^v^' ** i»P, Din from somewhere near

Fig. [illegible].—LABURNUM—*LABURNUM* [illegible]GARE—IN FLOW[illegible].

**the** highest point of the arch ; they grow erect, but in turn droop over at their ends. The drooping Laburnum-trcc thus exhibits a **fountain-like** method of growth.

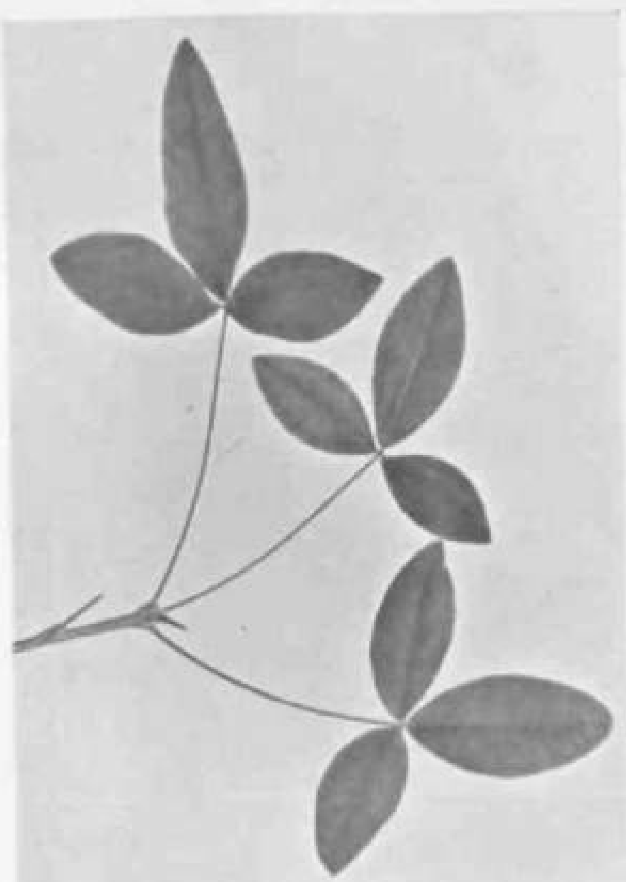
Tin: bnrk (Fig. 403) remains smooth **and** closed for many years, but eventually **peels off** in parchment-like **flakes which separate** by clefts running transversely round the bronfc

The spindly arranged compound leaves (Fig. 405) have elongated narrow stipules that soon shrivel, a long Leaf-stalk, and three leaflets. Each leaflet has a short stalk, and ends in a sudden sharp point, though it has no marginal **teeth** ; its pale lower face is downy.

Leavcs.

The hairy resting-bud shows three scales, and **the lateral** buds arc applied close to the side of the green twig (Fig. 406). Only few of the buds grow out into long-shnots, the vast majority developing into dwarf-shoots with closely tufted foliage, so that the tree bears niiiny knotty, ringed dwarf-branches, but only a few long-branches.

**Buds and Shoots.**



Fijf. 405.—Leaves of Laburnum.

**The** inflorescence (Fig. 408) is the terminal part of a dwarf flowering shoot which arises from a resting-bud produced during **the** preceding year at the tip of a long-shoot or dwarf-shoot. The **inflorescence** itself lms a long, silver-haired, bractless stem from the sides of which spring many stalked flowers, **with** two or three minute bractlets on their stalk*. The inflorescence-stem continues downwards into the stem of the dwarf-shoot, which bears two or three foliage - leaves, in whose axils are buds. These lateral buds subsequently sprout to produce foliaged shoots, and thus act as substitutes for the terminal **bad,** which has been utilised to produce the inflorescence. This mode of growth accounts for much of **the** apparent forking of the main branches.

**Inflorescence.**

FIR, ^06.—Twig of Laburnum In Winter.

The irregular flower has a bell-like **calyx,** which in its upper part divides into an upper (back) often two-toothed lip, and a lower (front) often three-toothed lip. The back petal *(standard)* is **showy** and partly erect, but the other petals as well as the flower itself are horizontal (Fig. **408),** Of the ten stamens five alternate ones have larger anthers than their fellows. **The** filaments of all ten stamens are **joined**

**FJowcrs.**

Fig. 407.—Closed Fruits of Laburnum.

will be instantly evident that this device would be useless if the flower warfl ttpskta down and (lie keel consequently uppermost; yet this is the natural position when the inflorescence hangs down as it does. The flower - stalk therefore executes a twist that restores the flower to its suitable pose with the conspi* tinus si mi d:\ nl uppermost.

The ovary becomes a long, greyish-brown or greyish-yellow pod, which contains from three to seven

F'm it.

to form a tube surrounding the one-cliambered ovary, which contains a double line of several ovules down the one side of its Wall. The long style is bent and raises the stigma above and beyond the. anthers. Stamens and pistil lie within the keel.

The flowers are mainly pollinated by the agency of bees. The nectar is concealed at the base of the standard petal inside a cushion-like swelling on the outer face of the tube formed by the stamens. The position of the nectary is indicated by two dark-coloured lines on the standard, whiff 1 thus act as sign-posts to show the bee whore to thrust her tongue. The bee, in flighting on the flower, utilises the two wing-petals as a ]>l:it-form ; these sink down and drag with them the two keel-petals, thus causing the stigma and ;inthers to come into contact with the lower surface of the beers body. By this means pollination is carefully provided for, (The elaborate arrangement l>y which cross-pollination is favoured cannot be described here.) It

PoM'iniitkm,

Fig. 408.—Inflorescences of Laburnum*

dark brown, or nearly black, poisonous seeds. The fruit hangs on for months, and eventually its wall splits down the two edges (Figs. 407 TMd 5o)>

In germination **the** food-storing cotyledons emerge horn tins soil, become green, but soon i>erish. Even the first foliage-leaves produced each show three leaflets.

There are several varieties of this beautifnl tree, which is not a native of Great Britain, but the most interesting form of Laburnum is *Laburnum Adami,* on which

**Varieties.**

may be seen inflorescences of dirty pink or **purple** flowers, and often on **the** same individual tree yellow blossoms. *L. Adami* is regarded as a hybrid between *L. vulgare* and the purple or white flowered *L. fiurfiwetim.*

## ROBINIA PSEUD-ACACIA *'LinnX*—FALSE ACACIA *(PapiUonaceee)*

Tht: False Acacia or Locust-tree **has a** number of **features rendering racogjnftWB** easy.

**Distinctive Features.**

**Tins** trunk is **deeply** furrowed, and has a **thick** rough bark. The twigs are armed with paired thorns, mid their lateral buds are **completely** hidden from view. The pinnately compound leaves have stipular thorns and a number of pairs of leaflets. The inflorescences of characteristic white flowers are pendulous, as are the flattened **iliirk-ivildisli pods.**

The tree attains a **height** of sixty or eighty **feet,** but the trunk gives **way** in **the** crown into a number of main boughs.

**Trunk and Bark.**

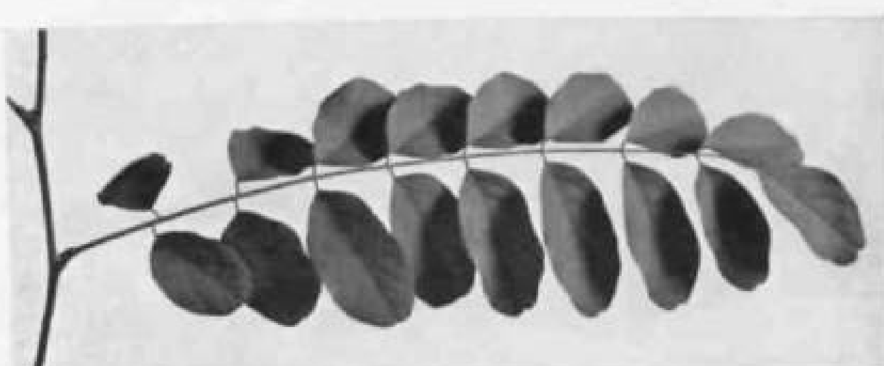
^ .^ base ^e trunk is generally more deeply furrowed and clothed with a rougher, **more** uneven bark (Fig. 411) than any other dit'otylous tree common in this country.

The False Acacia is endowed with considerable powers of throwing up shoots from its stump and suckers **from** its roots. By means **of the** latter behaviour the single tree can give rise **to a** thicket or **little** grove of small trees.

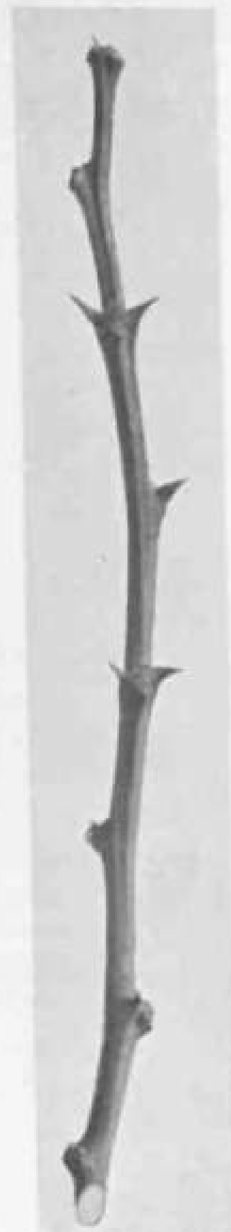
The spirally arranged compound leaves on the non-flowering branches have

**Leaves.**

stipules changed into flattened thorns that remain attached for years (Figs. 409 and 410). But on tht **flowering** branches the stipules are soft, slender, and short-lived. The st.ilked leaf has from five to **twelve paiis** of opposite leaflets, and usually an odd terminal one. The leaflet is more or less oval in form,



**Pig. 409.—Leaf of False Acacia.**



**Fly. 410—Twifc of False Acacia in Winter.**

untoothed at the margin, but generally shows a sudden, minute, sharp point at its tip; and although **silver-haired when** it unfolds, the leaflet is nearly hairless

Fig. 41«.~ Bark of Fafse Acacia.

when mature. At the base of the stalk of **eaeh** leaflet may be seen minute **pointed** stipule-like" outgrowths, termed *stipcls* ; on vigorous shoots, and especially on suckers. **these stipeb** are much larger and shaped like **small** leaflets.

The end of **the** twig dies at the conclusion of the growing season, and during this season the lateral resting-biid in concealed under the swollen base of the leaf-stalk, so as to be invisible. Even when the leaves are shed in autumn the minute hairy buds are **concealed** within depressions in the stem, two or more of them **standing** one above (he other in the **axil** of each **leaf-scar.**

Buds.

The inflorescences (Fig. 40J) open in June, **and** are in the axils of **leaves. They** are white, fragrant, and pendent. The white flower, though differing in detail, is like that

Fl». 4U.-FALSE ACAC1A-S0JW1VM *PSEVD-ACAClA :* WtNTER.

Fig. 413—FALSE ACACIA--*ROtUMA PSELD-ACACIA* : SUMMRIt.

of the Laburnum in general design nnd mechanism, except that the filaments of only

Flowers. nine stamens are linited t0 *iorm* a tube, which is open along the back where the solitary separate stamen stands, This slit in the tube provides for the escape ol the **abundant** nectar, which is secreted by the inner surface of the base of the tube, A yrllow or green spot at the base of the back petal (standard) guides visiting bees *to* the **outflowing** nectar.

The dark-red, flattened pod (Fig. **414) contains** up to twelve sewls, and often hangs attached by its stalk until the; **following** spring.

Fig. *4*14.- Fruits of False Acacia.

The seedling pushes its food-storing cotyledons above the soil.

The titnber of the tree is remarkable for the **small** sue of the light-coloured sapwood encircling the brown heart-wood and for the feature that all the pores (vessels) of the wood, except those lying very near the bark, are plugged with peculiar ingrowths (tyloses).

The home of the False Acacia is the United States, but the tree is widely grown in Europe, where a number of cultivated **varieties** are to be met with. Among these are forms with yellowish flowers, or vamgated foliage, or devoid of **Hiorna**.

# ROSACEJE. PLUM AND APPLE FAMILY

The Kosaceae is a large family including the Meadowsweet, Strawberry, Blackberry, Raspberry, Rase, Cherry, Blackthorn, Plum, Almond, Peach, Apple? Pear, Mountain Ash, Hawthorn, and many others,

It is a family exceedingly difficult to define, and to all the usual characters mentioned below there are exceptions:—

*I:lowers regular :* sepals, petals, and stamens **attached** to the edge of a saucer-like, cup-like, or urn-like *concave receptacle ;* •*petals separate,* usually Jive; *stamens, more than twelve; carpels several, separate from each other and superior ;* one or two ovules in each ovary; fruit not opening spontaneously, **Leaves** stipulate, often **with** toothed blades,

Tiie types described in this work provide exceptions to these characters. *Prumts* (iit-eluding the Cherry, Blackthorn, and Plum) has only one carpel, and therefore only ;i single one-chambered ovary, one stylo, ;md one stigma; but in other respects it agrees **with** Hie **characters** given above. *Pyrtts* (in-**eluding the** Apple, Pear, and Rowan) and ***Cfty-****t&gus* (Hawthorn) differ not only in **having** the several carpels more or ltsss completely joined to form a single ovary, but also in that the **ovary** is *inferior*—**that** is to say, joined on its outer face with the lining of the cup-like receptacle. Thus *Prumts* is perigynous, **Whereas** *Pyms* and *Cratcrg-tts* are ejiigynous.

## PRUNUS AVIUM *(Linn.)*.— WILD CHERKV OR GEAN *(Rosacea)*

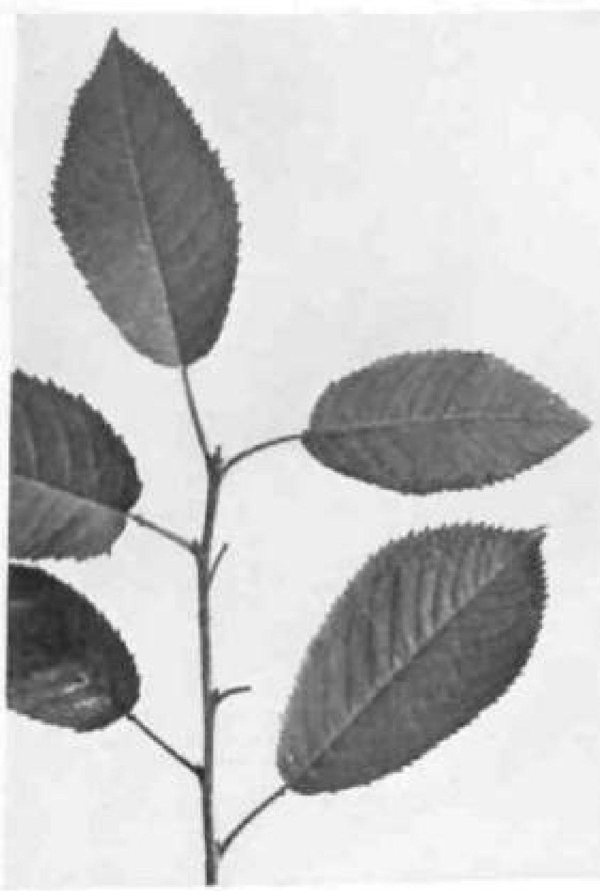


Fig.H 15.-Shoot of Wild Cherry.

The two kinds of Chcrry-trws growing wild are recognised by their tufts of stalked **White** flowers and fruits, and the characteristic bark, which is marked by trans verso lines (lcntlcels) and flakes off in thin strips by splits running more or less round the stem.

*Primus* **aaium,** the Wild Cherry, has spreading and deep roots, **which** rarely send **suckers above** ground. **(Whereas** the Sour Cherry, *P. CcrasuSs* shows an abundance of roi>t-suckcrs rising out of the soil.)

**Height and Form.**

The tree may grow to a height of nearly seventy feet, and when isolated attains it great size. One characteristic feature is the marked manner in which the boughs ascend steeply.

Bark.

The bark at the base of large trees shows longitudinal furrows and is rough (Fig. 41S); between the rough parts **may** usually be seen the bark that is characteristic of the boughs and upper parts of the tmnkt und that is scored

Fig. 416.—WILD CHERRY—*PRUNUS AVIUM*-IN BLOOM.

Fig. 417.—WILD CHERRY—*PRUNUS AVIUM*-IK LHAF.

with transverse lines (lenticels). This latter kind of bark peels in thin strips that partly embrace the stem,

. „ . . ,

The simple, spimUy-arranged leaves droop from long stalks. **Each has** two slender

and are of two kinds; pointed buds (Fie 4ig) that grow out into foli- tmas and ; siioots. «btu- s-iioots, ana blunt, more rounded, ones that develop into **inflorescences.** Those on the long-

Fig. 4!8.—Bark Of Wild Cherry.

**Stipules** which soon become dry and brown. Near **the** top of the loal-stajk stand two red **glands** (Fig. 415). The blade Leaves. ^ g ^^ ^ and s}iarp double-teeth, and **its** lower face is slightly hairy-,

The rcsting-buds are covered with thin chestnut-brown, or reddish-brown, scales, shoots **are** separated by distinct inter-**nocfes (Fig. 419)**; but those on the dwarf— shoots arc clustered near the tip of the short, closely-ringed stem. A vegetative bud, when it sprouts, shows above the sc^s interesting tr,nsitions between scales and fohage-leaves, in the form of green leaves

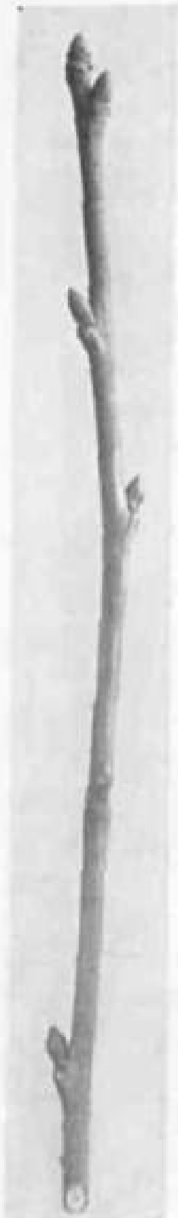


Fig. 419. Twi$r of Wild Cherry in Winter.

possessing titiy, or small, blades and large stipules. **Another** point to notice is that the inner scales bend back as the bud opens (though *they* remain erect in the closely allied *Prtmus Cerasm).* -Each *M'tage-lcaf m* the bud has its right ;md left ***halves*** applied flat together by their upper faces. The teeth of the young blade and of the stipules **are** tipped with glands which pour out balsam, and thus coat the young blade with this glistening substance. **Sodi Vegetative** buds give rise to long-shouts and *to numerous dwari-*shoots.

The flowering buds lire arranged on the sides of shoots produced during the preceding **year* Frequently** they are seen closely tufted on the sides of a dwarf-shoot which ends in a pointed vegetative bud; the tuft of *Intend* bt?ds thus produces a cluster of **inflorescences, while** the **terminal** pointed bud **continues** *the* growl 11 **oi** I he shoot. **Each** single inflorescence consists of from two to six long-stalked flowers {forming .t re-called *umbel).* The resting-bud sends forth flowers at the **same** time as the **foliage-leaves** appear, but produces neither foliage nor **foliage-like** little leaves (and in this last respect **provides** a contrast with *P. Cerasns).*

Flower ^.

The regular flower (Fig. 420) is perfectly *perigynous*—that is to say, its five sepals, five flaccid spreading white petals, and numerous stamens are all inserted at the edge of a cup-like receptacle, from ***the*** *Hoar at which rises* the single, one-chambered, two-ovuled ovary, which is surmounted by a single style and stigma.

**Various** insects, attracted by the showy blossom, its faint scent, and by the **nectar** secreted by a circumscribed glistening part of the lining of the cup-like receptacle, cross-pollinate the **partly** drooping flowers.

**The** ovary ripens to the **familiar** red **glistening stone-fruit** {Fig. 422) which has no

Fig. 420.—Flttwcrs of Wild Cherry.

*Fife. 41«.*—**Double-Flowers of Cherry.**

"bloom" on its surface, and is sweet. The **cupHke** receptacle is thrown off relatively soon after pollination. The cherry-stone is smooth in surface except for a sharp angle and two furrows. The seed is wholly occupied by the embryo.

**Fruit,**

Among the cultivated varieties of the tree is the double-flowered one **(Fig.** 421), in which the single whorl of five petals is replaced by many petals.

**Varieties.**

The Cherry-tree frequently bears "witch's-brooms" on its branches. These are nest-like, erect shoots composed of many short brandies, which are especially conspicuous when the tree is a mass of blossom, for they

**Witch's Brooms.**

alone are groen-ftfliaged shoots ondecked **witli** flowers (Pig. 424). The '"witch's- broom" is caused by a fungus *(Exoascus cerasi);* which livesyear after year in the twigs. The fungus not only **prevents** the shoot affected from flowering, but **also** deforms tlit* stems and leaves. Tie diseased stem is **abnonnaJly** thick at **the** bast-:, while the l–aves concerned are twice their usual size and pale green or reddish glossy tint. In late spring the infected leaf ... show a white coating of spores which are produced solely in the foliage. The spores transmit the disease to other trees, on which they germinatc!, producing fine cotton-like threads that permeate the stem attacked.

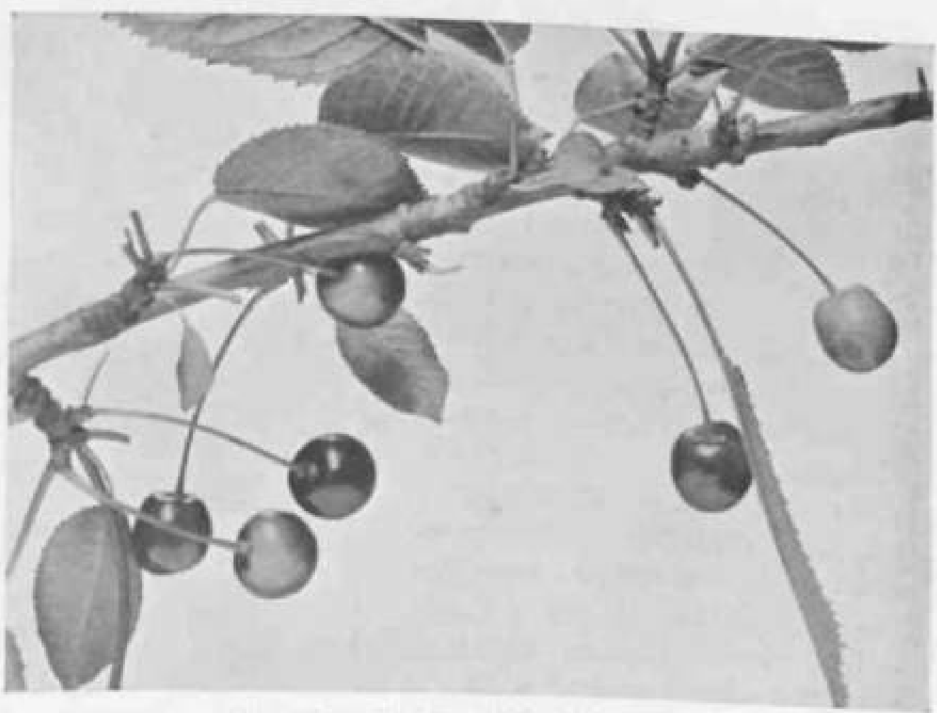


**Fig.** *4,1%.*-**Fruits of Wild Cherry.**

Fig. 423.—CULTIVATED CHERRY IN BLOOM.

*Prunus Cerastts* (Linn.), **the** Sour Cherry, which also grows wild, differs from *P. avium,* not only in having sour fruits and in emitting numerous root-sudcers, but also in **the** following respects : It is smaller, often a shrub, and frequently has .1 ivd<lisli **barfe** Its IIHHV spreading branches often droop. [t> **Leaves** are more leathery, glossy, cjuiti[1] hairless, and stand out with **Shorter** stalks, which often arc gknd-Iess. The flowers conic **out** before the leaves; and the inner scales, **arising** from the bud that produces **the** inflorescence, are foliage-like. The petals are firmer and more erect.

Fig. 424.—Witch's-broom on Wild Cherry.

The different kinds of Cherry-trees which are cultivated by **growers** **(Fig.** 423) for **the sake** of their fruits, are principally derived from the two spec*es which liavr- been mentioned above, namely, *Prunns avium* and /'. *Ccrasws.*

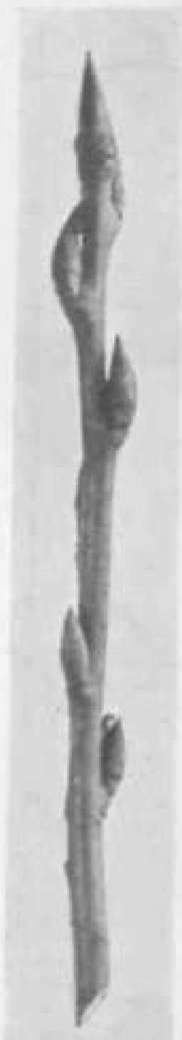


Fig. 425. **Twijr of Bird Cherry.**

PRUNUS PADUS *{Linn.).*—BIRD CHEKKY *(Rosaua)*

The Bird Cherry (which is not *P. avium,* as might be **anticipated)** is distinguished from the Wild and Sour Cherry-trees by its graceful, stalked, hanging **inflorescences** of little white flowers (Fig- *43)*-

**Height and** II.1I:1I.

This **shrub** or little tree (rarely exceeding twenty feet in height} has spreading roots that give off suckers. Its branches **also** **spread Out,** and some of them droop. The dull, dark bark remains smooth for several veal's, and shows transverse lines (Ienticefe) much shorter than those of the Wild Cherry (Fig. 427)'

The spirally-arranged, simple, stipulate leaves each show two glands at **the** t"p of the leaf-stalk, and numerous very fine and pointed teeth at the margin of the blade, **which** has hairs in the **angles** of **the** nerves on the lower face (Fig. 428)-

**Buds a** shoots"'l

The distinctive and rather large resting-buds (Fig. 425) are long, conkal> and often bent; theil polished li'uvr xitliH are tinted brown, and their **upper** ones yellow. From

Fig. *A* a*. - BIRO CHERRY-PJ?(Wt/S *PADUS.*

these buds proceed long-shoots, slender-stemmed foliaged dwa and lateral flow dw are foliaged.

The hanging or, less frequently, erect

fruit 1 a pea (Fig. 429)—Vild Cherry.

gly-scen flower the stigma is rec before any of the stamens have their anthers, and during

Fig. 427.—Bark of Bird Cherry.

inflorescences bear numerous stalked, white flowers along the length of the inflorescence-axis (*see* Fig. 43); the **little bracts** in whose axils the flowers arise fall early. In design the little flower and the bitter, black, spherical

**Flowers and Fruit.**

this female phase only cross-pollination is possible. Subsequently the anthers open while the stigma, if not poll ed, is still receptive, and, during stages of this bisexual phase, the ne. .amens rise from their inwardly bent pose, rub pollen

Fig. 428. -Shoot of Bird Cherry.

that is shed every autumn. (Compare the Larch and Cedars, also the British Oaks and the Holm Oak.)

The Cherry Laurel is an **introduced shrub very** common in English gardens. Its **alternate, glossy,** thick leaves &TC ran toothed or are **indented with** widely separated littie teeth ; **very characteristic of the** *lent* arc the- glandular, **shallow depressions** on the under surface near the base of the blade, one or two occurring on **each ride of** the **mid-rib.** The inflorescences **of this** shrub and of the Portugal Laurel arise in the axils of leaves **produced** during the immediately preceding **year,** and have no foliage-Leaves at the base (contrast the Bird Cherry). The long, erect inflorescences open their white liule flowers in early spring, and are disagreeably **scented.**

The Portugal **Laurel,** likewise introduced **into** this **country, differs** from tine Cherry **Laurel** iti the darker colour and smaller size of *its* **leaves,** aLso in the more close and regular **occurrence** of **teeth** at tbcit margins, and, fmaUy, in the Absence ol any glands from the lower face.

From these two shrubs, two others—" Laurus-tinus " *(see* page **397]** and *Anettba* ***japottica***—which are likewise evergreens common in gardens, **differ** in having opposite leaves.

**on to the stigma,** and **thus regularly effect self-pollination** in **the** absence of insect visitors.

Erect inflorescences, flowers and fruits designed like those of *P. Padtts* are possessed by two familiar evergreen garden shrubs, which are consequently species of ***Primus.*** The shrubs in question arc the Cherry Laurel (P. *Lauto-cerasus)* and the Portugal Lanrcl *{P. lusitanka) ;* both these illus-trate the thicker **texture** of ever-ffrecn foliage when compared with the foliar 1 ,f closely **related** aperies

Fig. 429-—Fruits o* Bird Cherry.

*Fig.* **430,-BLACKTHORN-*PRUXUS SPWOSA-M* BLOOM**

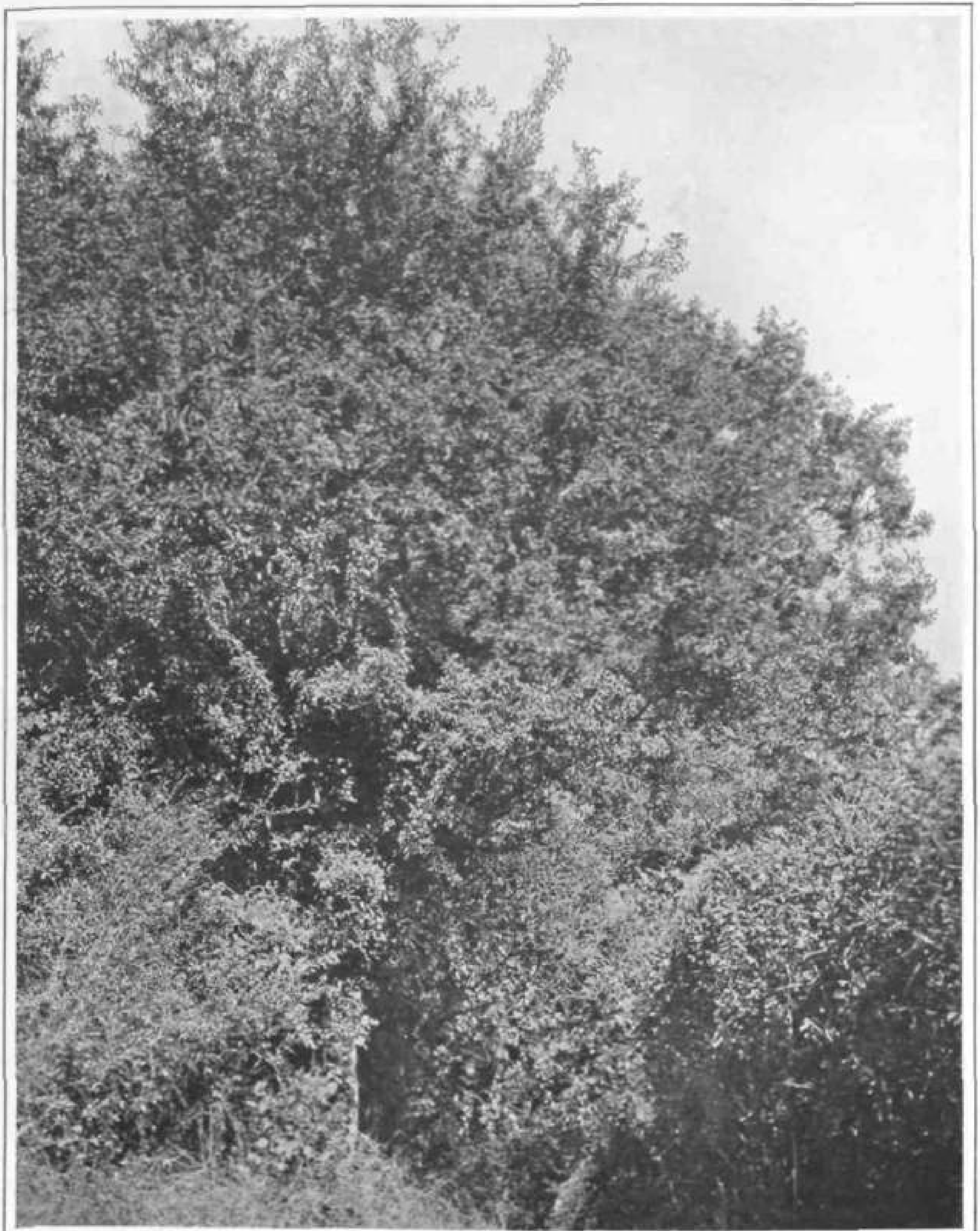


Fig. 43"--BLACKTHORN^ PI? LWUS *SPINOSA-IN* LEAF,

## PRUNUS COMMUNIS (*Huds.*).—SLOE AND PLUM (*Rosaceæ*)

Under the general (usually called) name of *Prunus communis* I include several, more or less distinct forms, which are distinguished from the Cherries by having their

**Three Forms.**

[distingu]ished: *Prunus spinosa*, the Sloe or Blackthorn, *P. insititia*, the Bullace, and *P. domestica*, the Wild Plum. In general design of shoots,

Fig. 432.—Bark of Blackthorn.

foliage-leaves rolled (not folded) in the bud, their stone-fruits coated with wax ("bloom"), and, finally, their white flowers short-stalked and solitary or in pairs.

Three species or sub-species are usually

leaves, flowers and fruit [illegible] with the Cherry.

All are [illegible] trees [illegible]. The Blackthorn, often seen in hedges, is noticeable for its black rind, [illegible] the manner in which

**Fig* *A* 33—Shoot of *Prunus com munis.***

its woody branchlets stand **out** at rig lit angles from erect or ascending shoots, and for the prevalence of thorns which are the terminations of shoots (Fig. 436). **The** twigs of the other two forms are brown, but **the** Wild Plum is distinguished from its **fellows** by the fact **that** its young **shoots** are hairless; tho Bullace frequently, but not invariably, bears thorns, whereas the **Wild** Plum is nearly always thorn less. All **three** run emit root-suckers.

Tilt spirally-arranged, simple, stipulate, **toothed** leaves (Fig. 433) are broadest **in** the Wild Phim.

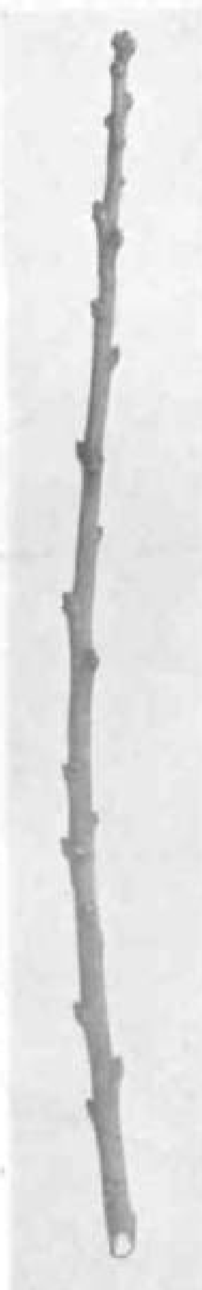
The blunt, rounded, rating-buds of the Sloe (Fig, 4.J4) **contrast with** the pointed ones of the other two (Fig, 435). From **these** buds spring long-shoots **with** distinct internodes, dwarf-shoots with tufted foli.iLir. und inrloniiseences consisting of one or tsvo (rarely three) flowers.

The flowers open in March or April. Tin-blossom is revealed before the leaves, usually in the Sloe, often hi the Bulkce, but never in the Wild Plum; in other cases, flowers and leaves open together. Tht- **lateral** flowers are often solitary in the Sloe (Fig, 48), but in the others they are in pairs.

**F-ltrwers,**

In general structure of flower (Fig. 48) and fruit (Fig. 55), the three plants agret with the Cherry; but the plum-like fruit possesses a rough stone, and in place of having a glossy surface it is covered with **dull** " bloom." The

**IV.nt.**



**Fig, *434*.—Twig of Blackthorn irt Winter.**

**Fig. *438'*—Twig of BIIIOLC or Wild Plum in Winter.**

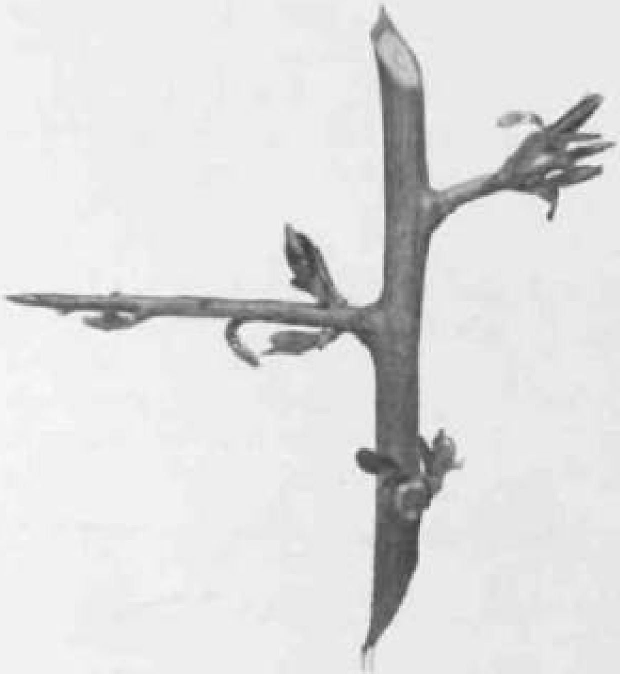


Fig. 496.-Spine of Blackthorn.

frmt of the Sloe Ls erect, also bitti-r **and** sour, and thus differs from those of the **Otha two,** which are directed downwards and are jweet m taste. **The** globular Sloe-fruit is r>iue m colour, and **somewhat larger than a** pea ; the larger Bulkce-fruit (about *W&* inch m diameter) is globular or slightly oval, ;md bluish-black (rarely yellow) in colour; hnaUy, **tba** fmit of **tfas Wild Hum is often** still larger (one **and** a **haM ind^s** in length), frequently oval rather than globular, and varies '« «lour from blui,h-black to violet or ml.

**Between** the Sin, ***,md*** the **Buliace** there are intermediate forms which may be hybrids. The cultivated **varieties of** rium-tri «*t 7 t f ! are Probably derived from the s*i-et-fruited BulL.ce and **Wild** Plum, rather -"'from the bitter-fruited Sloe, though I - * y ***m*** some **cases** they have been crossed with **other** specfes.

Fig. ^37.-Flower of Orchard Pium.

## PYRUS MALUS ( *LimiX*—AFFLfc *(Rosa&æ)*

The Apple-tree is distinguished from the Pear not only by the fruit, but also by its whitish or yellow (in place *oi* red) anthers, and by its five style-brand its being united at the base into a single style.

Among the many varieties of Apple-trees the. majority can be traced back to two different sub-species. These we may term the Crab Apple—P. ***Mains*** *sylvcslris {accrba)* —and the Common **Apple—P** ***Mains*** *pumila* (including the varieties *dmneslica* and *paradisiaca).* Here the Crab Apple will be **first** described, and subsequently the differences **shown** by the Common **AppleWiU** be denoted.

**Pig, 438.—Bark of Apple.**

The Crab-tree is a small tree, only from twenty to twenty-five feet in height, with

Fig. 439.—WILD APPLE—*PYRUS MALUS*: WINTER.

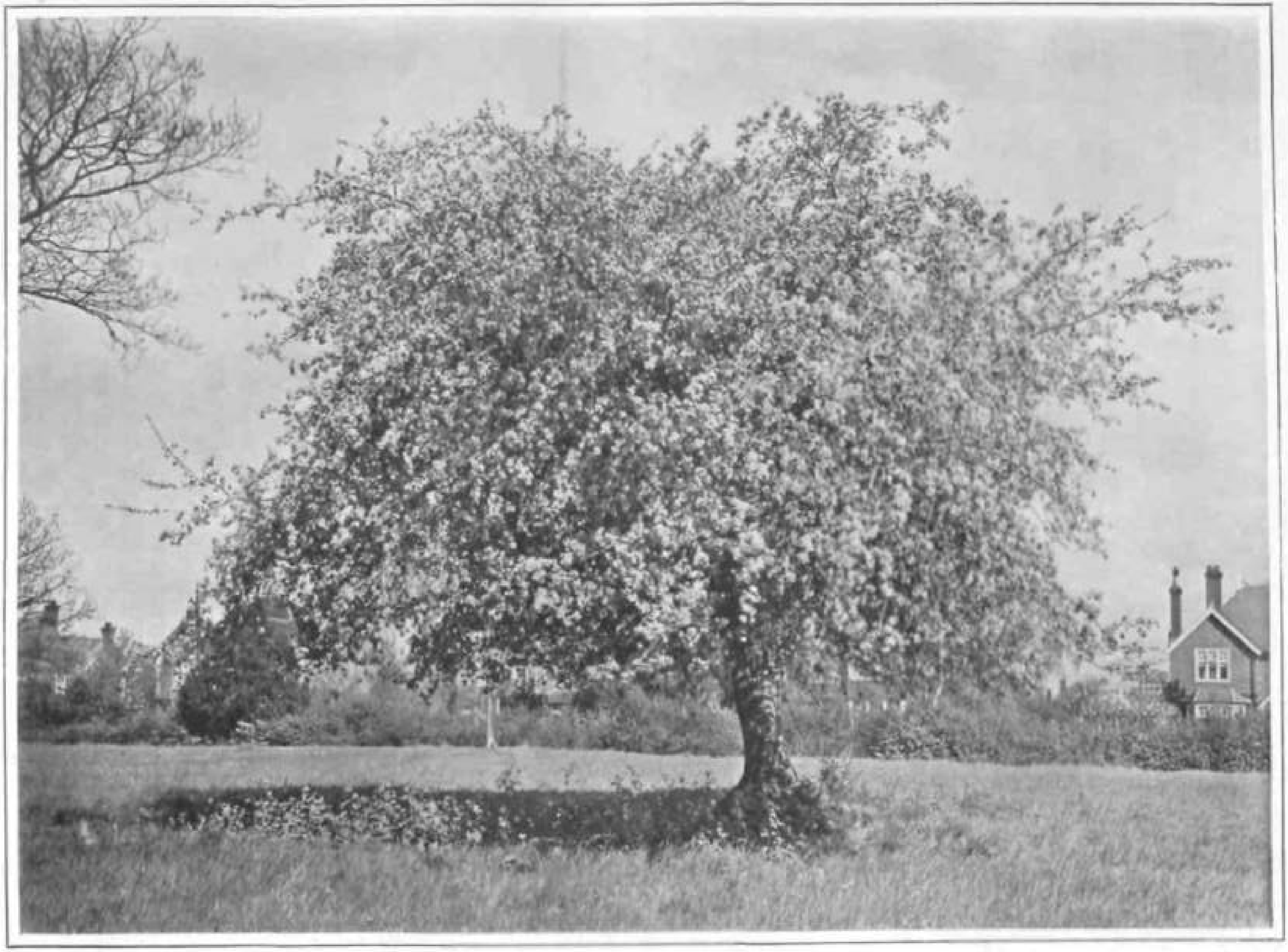


Fig. 440.—WILD APPLE—*PYRUS MALUS*—IN BLOOM.

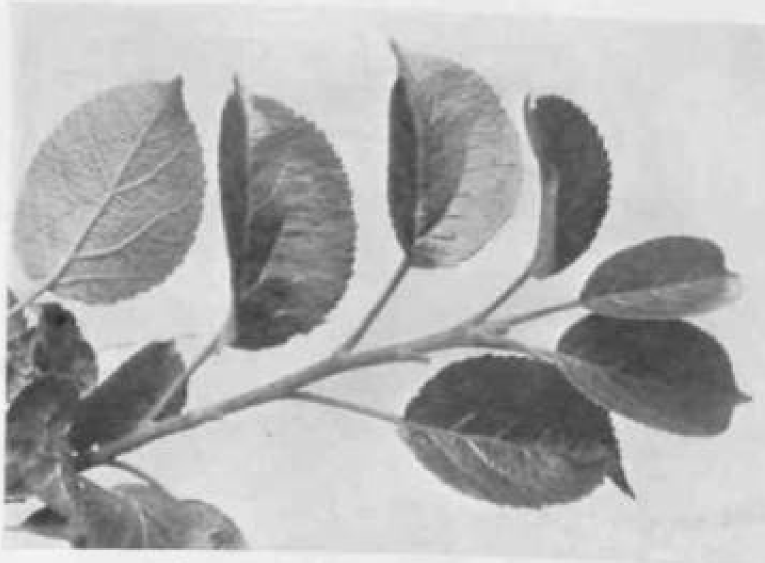


Fig. 441. -Shoot of Common Apple.

spreading branches that forma wide crown. The irregularly ridged trunk is **covered** by furrowed grey-brown bark, which flakes off in thin scales (Fig. *4$).*

The spirally-arranged, simple leaves (Fig. 444) have small, slender stipules that **soon** turn brown. The leaf-stalk is **slender,** nearly hairless, and long. The blade varies in form from a circle to an oval, and **has** a sharp tip as well as *;iw-like teeth ; it is huirless ;md **somewhat** glossy on its dark upper and lighter lower face. In the bud the blade has its right and left halves rolled separately towards the mid-rib on the upper (inner) face.

**Leaves.**

The rest ing-bud shows a few scales and is ntore **or** less hairless, the **lateral** buds being applied to the stem. The buds grow tn.it into three kinds of shoots : (1) **Long-shoots** with separated leaves (compare Fig. 441). (2) Non-flowering dwarf-shoots, which war after year grow very slowly, and show many dosely-arnmged ring-like markings (Fig. 444) as their foliage-lefives and bud-scales are closely crowded together, (3) Flowering dwarf-shoots or *spurs,* which shoot out **from** stouter resting-buds and are tipped with flowers (compare Fig. 443). But a fourth kind of shoot is often seen. The pointed end of a shoot may dry up, become hard and woody, and thus give rise to a **thorn.** Tin- slender twigs, except in their first youth$_T$ are hairk-ss (contrast Fig. 442).

IIn.K

The CTab-treft opens its white, **or** pink and white, (lowers in May. The **inflorescence** . . , **terminates** a uwari-**shoot** that is **visually** lateral, but may be at the tip of **a** long-shoot; the little flowering branch bears a numberof **small** foliage-leaves and a few comparatively large flowers 111'mnted on long un-br an died stalks (compare Fig. 443).

**Flowers.**

The regular flower has five joined sepals whose free segments are hairy on their upper faces. The live petals have rounded M limbs" and are attached by narrow " claws." The **numerous** stamens form a cirele round **the** nwtar-secreting glistening disk; their anth> are creamy or light-yellow in tint. Be**neath** all these pans lies tin* inferior five-dnimbered ovary. which contains two lAules in **each chamber.** The single sty 1« • divides low down into five branches,

*f·g 4^_Twigoi* common Apple In **Winter.**

which are so long that they often raise the stigmas above the level of the anthers.

**Pollination,**

The stigmas are receptive before the anthers open, and cross-pollination is favoured by this circumstance as well as often by the elevated position of the stigmas. The flowers

Fig. 443—Flowers of Apple.

are pollinated by various bees and flies; and probably by night-flying moths, as the white flowers are (always ?) more strongly scented in the evening. But it is to be observed that spontaneous self-pollination may also take place, because the anthers open before the stigmas have withered, and the style-branches eventually may bend back, bringing the still receptive stigmas into contact with the anthers.

The ovary develops into the familiar apple **which** is depressed at both top and bottom, and still carries the persistent calyx. The wall of the inferior ovary gives rise to a thick, fleshy coat, in which three layers may be distinguished: (1) the peel; (2) the thick juicy layer; (3) a thin, tough, parchment-like layer which separately surrounds each chamber. These five parchment-like layers are comparable with stone-layers of a fruit with five stones. Inside each chamber may be two brown seeds, which have fairly thick seed-coats because the parchment-layer of the fruit is thin. The yellow fruit often hangs down, and is sour in taste.

**Fruit and Seeds.**

The seed is mainly occupied by the embryo, whose food is stored in two fleshy cotyledons.

The *Common Apple-tree* differs from the

Fift. 444.—Fruits of Crab Apple.

Crab-tree in the following rejects; it is rmidi more hairy; soft, tit first white, hairs clothe tin- ovary, &S wter (lower) face of each sepal, the BwinstaJk, resting-bud, twig (Fig. 44-0, and lower face trf the leaf WR- 441); it has stouter leaf-stalk*. tw^3, and timver-stalks, the last a* which ..ft.cn hold the fruits erect; the Sowers, and often the fruits, are jffl[1], and the latter are more or less sweet to taste.

*The* Applt-tn-o suffers from ninny diseases: gaping or cankerous wttuaSs Diseases, ™[u]sed by frost, or by an toseet (American Woolly «fflpt) which excretes cottony fluff, or by a fungus *{Nectria dithsitna)* wiioae ted little fract^cations dot the margin of the wound. Various Green-flies and scale^asectssuofc its rakes; while the Jr* f i f iiiiiihs ;itui ••eetles gnaw it s fofi^ge or binrrow in,,, its flowers and fruits, where they aw fiimiliar in «>• form m t a i

## PYRUS COMMUNIS (*Linn.*).—WILD PEAR (*Rosaceæ*)

The Pear-tree differs from the Apple-tree in having the five styles completely separate, in its purplish-red anthers, also in shape of fruit, which, even when not pear-shaped, has no depression at the base.

The Pear-tree recalls the Crab-tree in general form ; in arrangement and even form of its variable leaves ; in design of its branches, which include long-shoots, fotiaged dwarf-shoots, flowering spurs, and often thorns ; in form and position of its inflorescences and flowers. But the following special features may *be* noted :—

FiR- 445—Leaf of Wild Pear*

The tree may be taller, and uswally shows a narrower crown through which the trunk passes without oblitera- tiop. The deeply-furrowed bark (Fig- 446) onLy infrequently sheds small scales.

**Special Features.**

admixture of rose-colour, and in design is like that of the Apple-tree, except lor the above-mentioned distinctness of the styles and darker colour of the anthers (compare Fig. 449).

The (lower may remain **fresh** fur seven or

Fig. 446- -**Bark** ***at*** **Wild Penr.**

The leaves (Fig. 445), **When** mature, and \)\c, resting-bnds are hairless: this instantly distinguishes the tree from the Common . . , Apple-tree.

The flower is usually white, without any

eight days, after which its withering petals fall. **When** the flower opens, trie stigmas are ..•ln.nlv ivrcntivc and nearly . J ~ r \. , , erert. Lrouchmg **DCsneath** them, and concealing ttic ncct;ir secreted

**Pollination.**

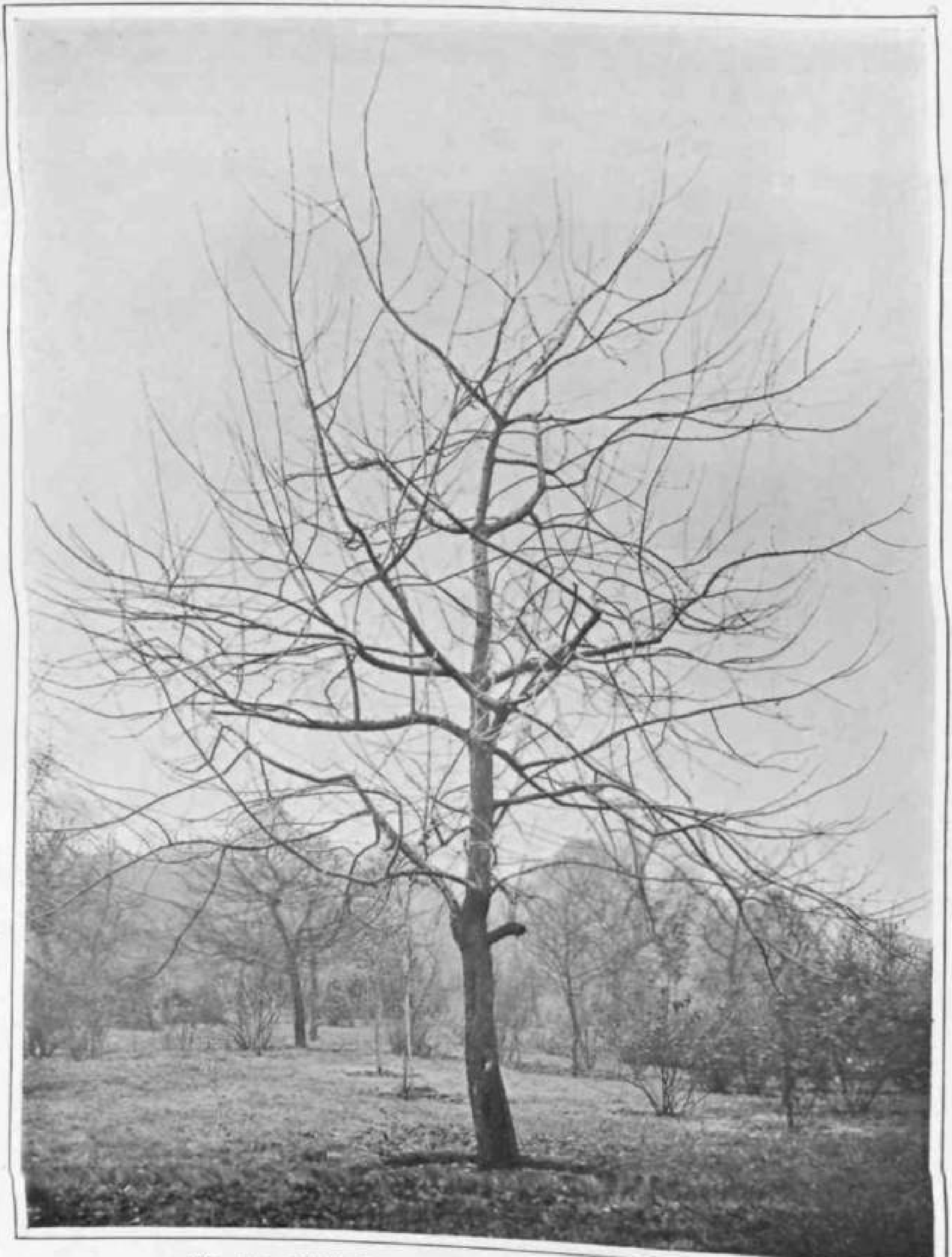


Fig. 447.—WILD PEAR—*PYRUS COMMUNIS*: WINTER.

Fig. ^^8.—WILD PEAR -*PYRUS CQMMUN[S~1N* BLOOM.

Fig. 449.—Flowers of Pear.

by the receptacle, are the inwardly-bent stamens, whose anthers are still closed. From two to four days elapse before the outer stamens unbend, stretch outwards and open their anthers, and are successively followed by the inner stamens, until the fifth, sixth, or seventh day finds even the innermost stamens extended with open anthers. Cross-pollination alone is possible at first, but subsequently self-pollination through the agency of insects would seem feasible ; indeed, the final and spontaneous bending outwards of the styles can bring the stigmas against the pollen-laden anthers and render superfluous any intervention by insects. Yet it is doubtful whether or no self-pollination results in the production of good seed ; for some cultivated sub-varieties of Pear-trees are more or less sterile to their own pollen.

The spotted, sour fruit may be pear-shaped (compare Fig. 450) or rounded, both forms occurring on the same individual tree. Apart from the absence of the concavity at its bottom the fruit differs from an apple in that the five chambers, when cut across, are rounded at their outer margins (not narrowly acute as in the apple) ; also that the fleshy layer is "gritty" when bitten, as minute stone-like bodies are lodged in it at intervals.

There are several varieties of Wild Pear which must not be confused with cultivated varieties that have escaped and are apparently wild. The relationships of the various cultivated varieties of Pear to *Pyrus communis* are not certainly known.

Fig. 450.—Fruits of Pear.

## PYRUS AUCUPARIA {EhrX—ROWAN OR MOUNTAIN ASH {Rosaceæ)

The Mountain Ash owes part of its nnmc to its compound leaves, which resemble those of Ithe Ash, but are alternate and **possess**

l~i£* 45'-— Bark of Rowan.

stipules. From the Ash, as well as from the Apple find Pear trees, the Rowan is distingutshed by its nearly lint-topped inflorescences of many small creamy flowers, and by its red berry-like fruits,

The tree is not a large one, its **height** being from ten to thirty feet. Its **general** form **varies** considerably, **but** the crown is never dense. The bark **remains smooth** for years, showing in its second stage a

Bark.

resemblance to **that** of the Cherry-**tree,** because it is marked with **transverse** lines (lonticels); but eventually

FIK. 452.-ROWAN OR MOUNTAIN *ASti-PYRUS AUCUPARtA:* **WINTER-**

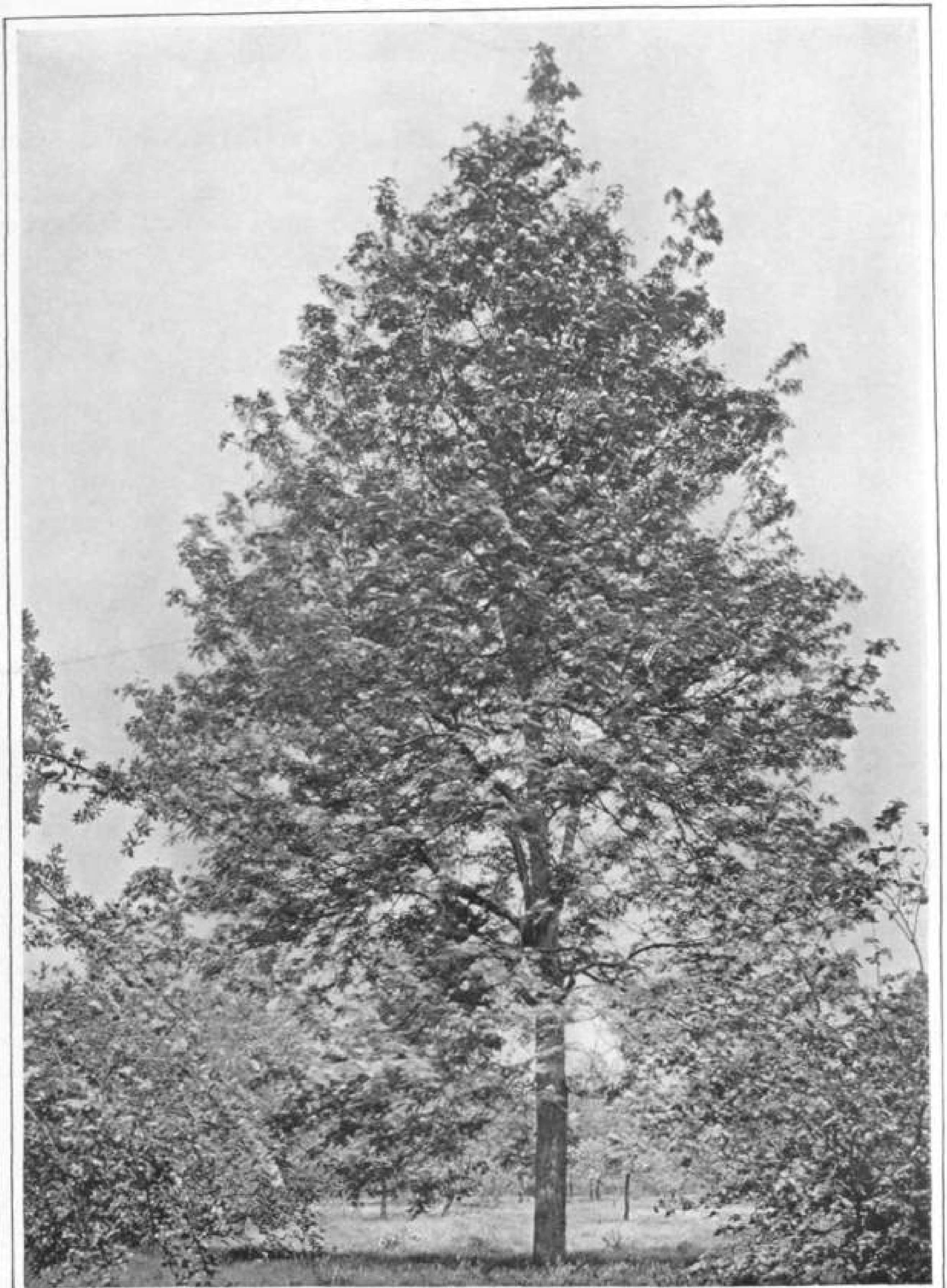


*Fig-* 453—ROWAN OR MOUNTAIN *ASH-PYRUS AUCUPARIA:* SUMMER.


*Fig.* **454.-Leaf of Rowan.**

, ,, • , x J

it becomes thuk, furrowed, and **greyish*** black (Fi

The spirally-arrang^, st^.late leaves show pairs of opjK^ed **leaflets,** and an Leaves, ^ ta-m,nal on, (Fig. 454). The ieaiVt **baa** saw-lik, tocth, und only its pale lower face presets a thin Him of scattered hatrs, especially along the

The long, baiiwMuted resting-bnds, Hke those of the Ash, **have** wry dark-colon red

**Buds.** e lateral buds being pressed close against the side of the stem (Fig. 453). Some buds grow out into long-shoots, but many develop **into slow^rowing dwarf-**shoots, **tffeose** few **crcrwded Jcra,** Vt>:ir nfter year, cause **the ck*** ly set **ring-likt. m.Hdng.** on the s,,,,

l*iie showy **iiiflareiBiccaoes usually** tiTmniate foliaged dwarf-br;uir!i.>. w):i. I' .nv in>,Ti,,d at the tips or on the sides of long-slumts.

Hie inflorescences are repeatedly branched, but **raise &H** the cream-tintod blossoms nearly **Flower*.** to the same IeV(_jl (**Kg,** 456). They appear in May or June.

The regular flower **agrees** in design with that of the Apple-tree, except as regards the **pistil** This consists of from two to four **(often** three) iarpek which at their bases **are** completely united to form a two- to four-<llumbered ovary, but higher up are separate **at** their inner edgt> : the two to four styles are likewise separate, imd have white hairs on their lower parts.

The sti^mtis are receptive **before the anthers** upon. The **aceat** of the flowers is similar to that of fee Hawthorn, and **though attractive** it is none tile less due to a substance (trimctlivlammi also **exhafed** by" &tink- dead fish. Lured by the conspicuous, scented inflorescences, and by the n cta which * is accel sibl^ though imperfectlv concealed under ' thT style-hairs, a • \ horde of short-ton^ unintclli^nt flies d' b te l es, as weUS longer-toiieued in + inckiding bees IS the flowers and effect cross-pollination.

,,:·l(·h ovar·· develops into a small, red, rounded, Ke **fruit (the so - ailed** "berry"), **which** ' has

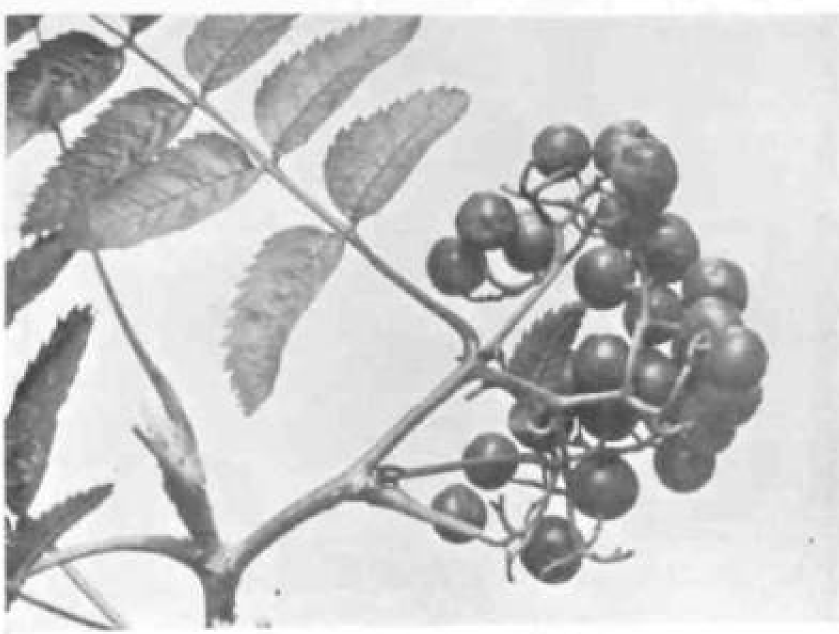
Fig. 455.—Twig of Rowan in Winter.

Fig. 456.—Inflorescence ol Rowan.

from two to four thin-walled stones. The fruits are disi^rsed by birds. The seed is wholly occupied by **the** embryo.

The Rowan, a true British plant, has an extraordinarily wide range of **distribution** "lllc* habitat. **Found** in the far frigid North, with the Birch, it yet **e&tends down** to Gret^. It can ascend to **considerable** altitudes (2,600 feet in Scotland)—hence the **name** Mountain Ash. It can live not only 011 ordinary fresh soil, but also on wet soil in company with the Alder; or, as a little tree, it can eke mit **an existence** on. rocks, **where,'in** place of a long main root, it produces shallow, spreading, lateral ones that force their way into iTevices; and I have seen it growing in the forks of large Oak-trees, on the broad **trunk-heads of** Pollard **Willows, whither** its **seeds were conveyed** by **buds and where accumulations** of leaves, dead wood, and **posses** had provided a scanty *soil.* **This** hardiest of trees can **also** bear **a** fair amount of shade in forest.

Habitat.



Ffg. 457--Fruits of Rowan.

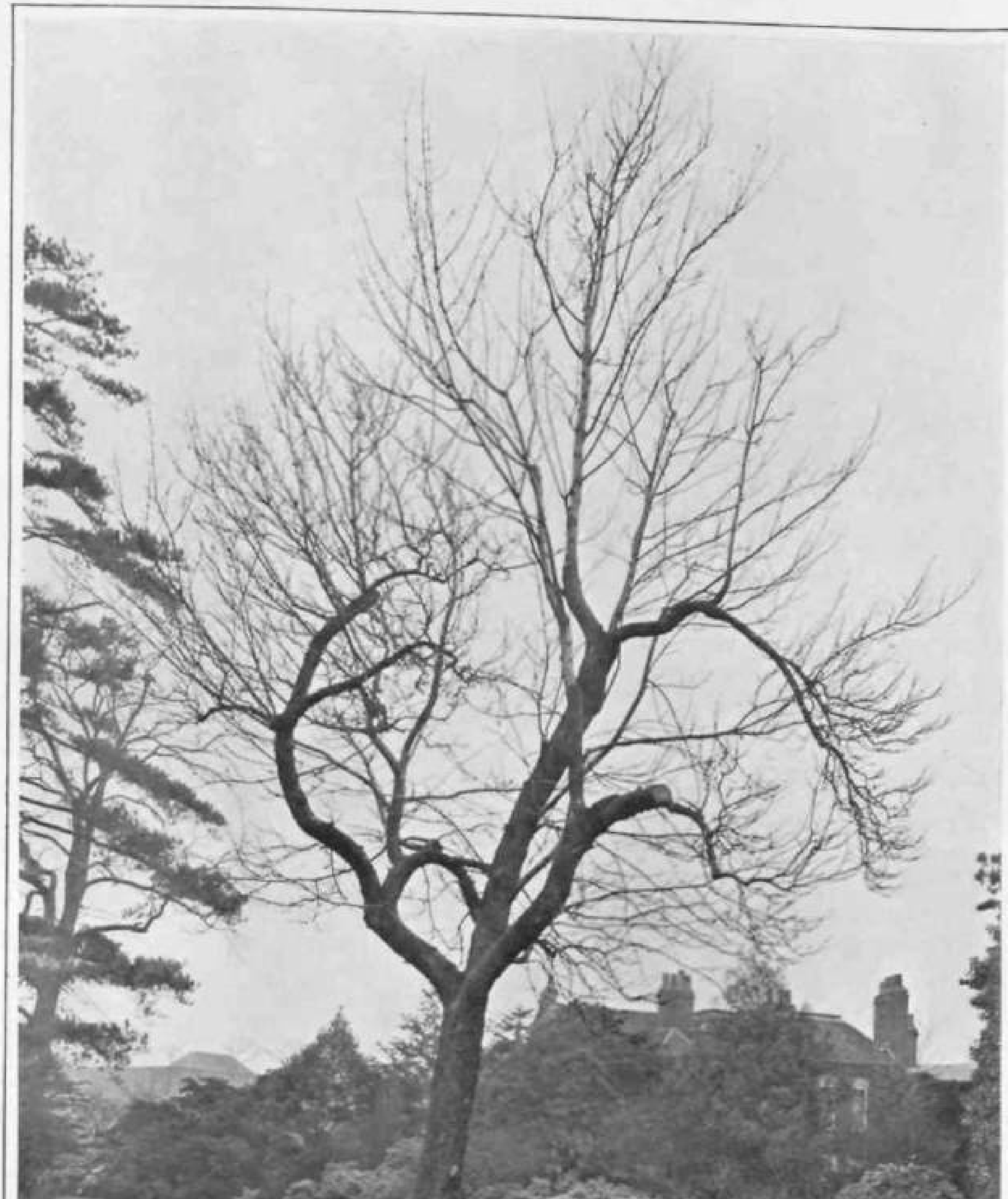


Fig. 458.—SESVICE-TREE-PKfff/S *SORBVS:* WINTUR.

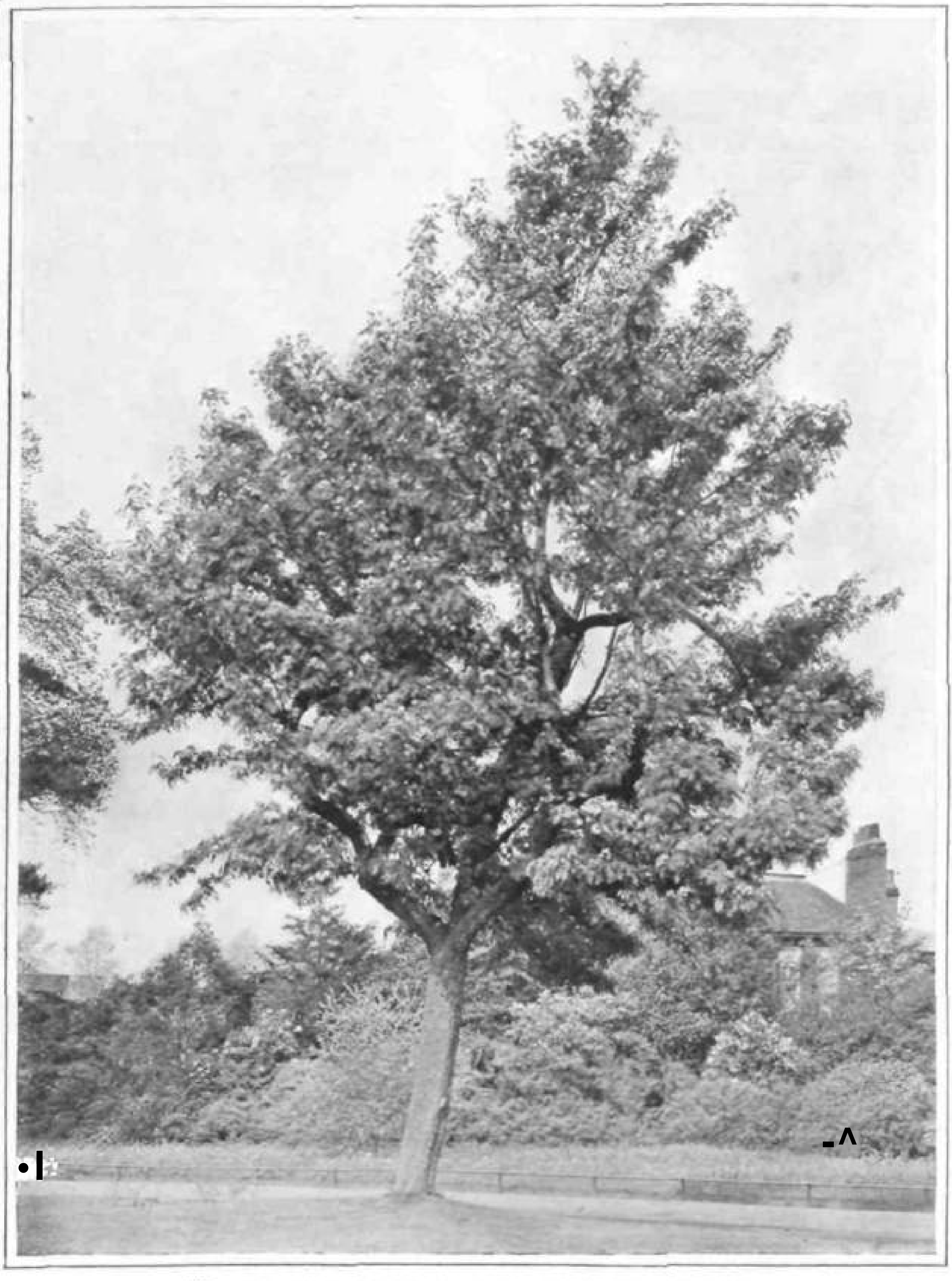


Fig. 45V.—SERVrCE-TREE—*PVRUS SQRBUS*.—SUMMER.

## PYRUS SORBUS (*Gaertn.*).—SERVICE-TREE (*Rosaceæ*)

The Wee-tree is neither common in Great Britain nor us it a native. As it re- .bl^s the Uounta,n Ash ,n habit, foliage,

Fig. 460.—Bark of Service-tree.

and b t o a ^ lie points fa, whi, I, i, diff

The baik becomes rough and scaly early

111 li /0 tF^* 46o!,' 1 i , n T..e compound leaves have leaflets &at

fur th, m,JSt p:u, itn twrth(d , on y near their tips [U. in the Iipper third) ?<FigB xS 56)

The resting^bud L greeni I or g IS red, sticky, and marly hairtes; the lateral ist the stem (Fig. 23)

Th^ la^er white flower (Fig. 461) has Hve woolly styles and five ovary-chambers.

Fig. 46K—Inflorescence of Service-tree.

The larger, **pear-shaped,** or spherical fruits (Fig. 56) are green or yellow with red cheeks, but whim rotting and **edible** may btvome brown.

PYRUS ARIA *(Ehr.).*—WHITE BEAM *(Rosnctw)*

Fig. 46a.-Shoot of White Ueam.

The White Beam is recognised by its **re-peatedly** branched **fiat-topped inflorescences of** white **flowers,** resembling those of the Mountain Ash, its similar collections of orange or scarlet berry-like fruits, **and** by **the** •n"wy under-surfaee of its simple **leaves.**

*Pyrns Aria* **varies** in form from a **shrub to** a tree that **may** bt forty feet in **height.**

**Height and Form.**

As a 1 ret- its shape is so variable M t0 defy Sent<ral d^'i-ij'tiaa ; srniietimes the trunk remains distinct, and **the** branches **ascend oir spread hOlizOBtuHy,** so thai mtr illtistrution of ttie MountLIin Asli would serve to denote this tree ; at other times **all** the brunches ascend steeply as in Figs. 463 and 464. The b;irk remains grey and **smooth** for **many years,** but **eventually** shows shallow **longitudinal** fissures (Fig. 465).

Leaves.

The spirally-armnged leaves have narrow-lit tie stipules **that** become brown and fall very rnrly. Tile toothed blade shows considerable variety of form (Figs. 462 and 468), and may be **feebly**

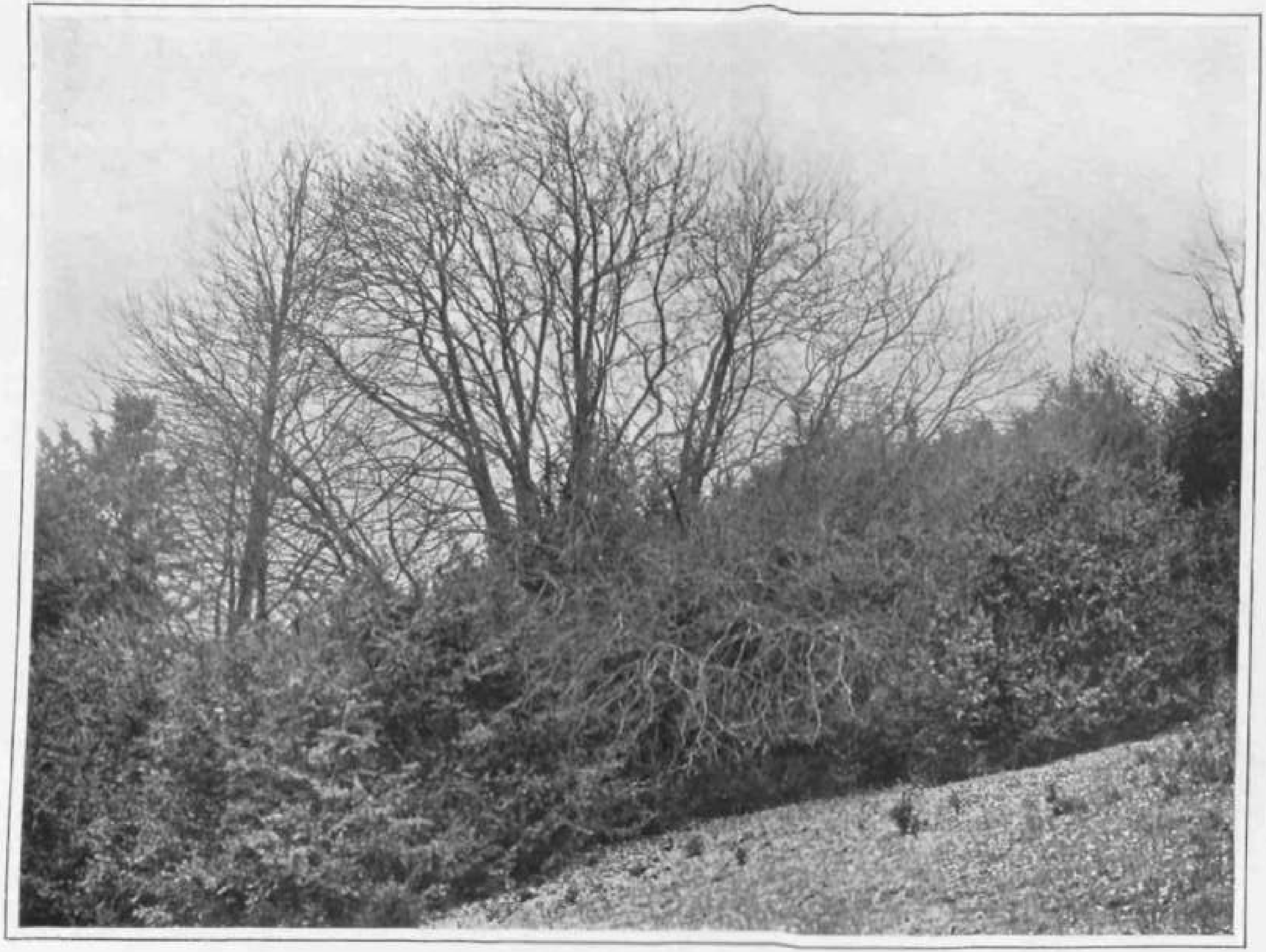


Fig. 463.—WHITE BEAM—P [redacted] WINTER.

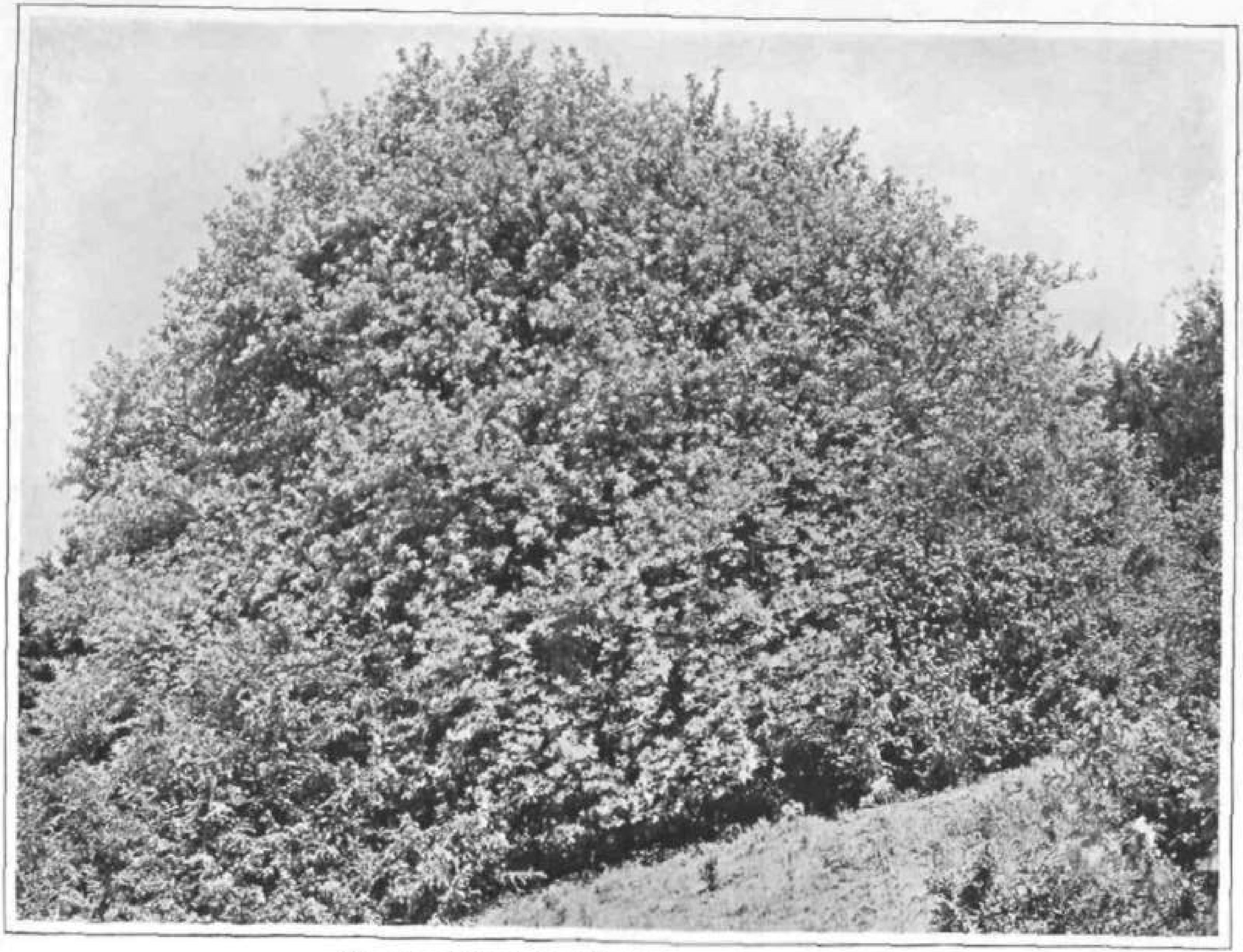


Fig. 464.—WHITE BEAM—*PYRUS ARIA*: SUMMER.

lobed towards its end; but the important future is that its lower to (as well as the leaf-stalk) is coated with a permi_ nent covering of snowy hafaa which render the tree recognisable from a considerable distance. ' oie

dwarf-shoots o3 TM the species described.

blos-

Flow''s. som ^ revealed, The Hat-topped, . . repeatedly branched, in florescences terminate dwarf-shoots (Fig. 466) which axe

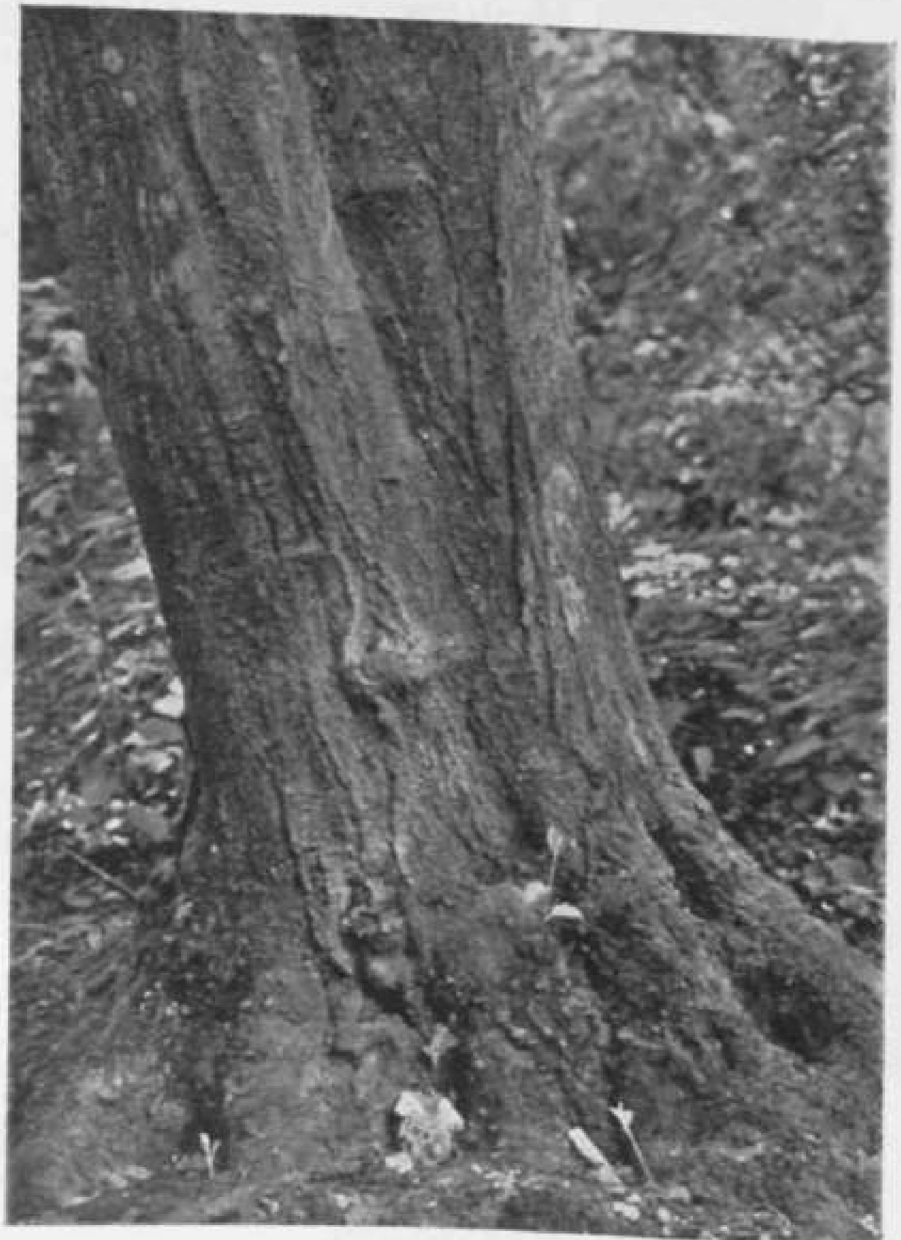


**Fig. 46s.-Bark of White Beam.**

The long, large, pointed resting-btids display a few brown and green scales fringed *m hairs ; the lateral buds are applied to the stem or stand out (Fig- 467).

Buds.

There is the same distinction into long-

at the tips or <m the sid~ of long-shoots. The stems of the infl " * with white wo<% h'lZ^rT™ '^ Coated is very like that «f \\ * Whltct flowe« somewhat larger, aVd tl *'"" **- but pistil is different'. Tt» < ' >tlllct"re of the ne two or three carpels

Fig. 466.—Inflorescences of White Benin.

are more closely united, being fused, not only as far up as the top of the two- or **three-chambered** ovary, but also for some **distance** up the style; yet even where **the** style is single the traces of the three original styles are shown in the form of ridges continued down from the separate style-branches. Eaeh ovary-clmmber contains two ovules.

The fruits (Fig. 468) are ripe in September, when they somewhat resembk little

Frim.

cherries, but their scarlet or orange tints are often flecked with dots, and they arc capped with the remnant of the calyx. The fruit is hardly juiry. for the layer of its wall outside the two or three thin-walled, seed-containing compartments is "Jlowery." Each compartment includes one or two seeds, whose structure agrees with that of an apple-seed.

*The* precise needs of the White Beam have not been closely investigated by foresters, **but**

**Rt-quin.*-** ments.

0 glance at the **Beech-woods** on chalk >nils in Pu< kinghitmshire gives the clue to two characters. Round these woods many White Beams may be seen standing like sentinels, with tli eir snowy leaf- surfaces showing in the breeze. They **are obviously** trees that demand light, and are kept from the inside of the woods **and** even expelled by *the shade*-enduring Beech-trees. White Beams, then, are found in sunny places, often at the edge of a forest, and they thrive especially on soils containing lime (as does the Beedi-tree).

There ft re in Great Britain several species (or sub-species) or hybrids which are closely allied to the White Beam, but differing especially in the form or lob ing of the leaves. One of these, *Pyrus intermedia* (Ehr.), is so intermediate in **character between the White** Beam and the Wild

Fig. 467. Twig of White Beam in Winter.

y

Fiy. «<SS. -Fruits of White Beam,

Service-tree that some botanists regard it as **a** hybrid of these two **species j** while another, *P. pinnatifida* (Ehr.) **[or** *P. semi - phuuttti* (Roth)], has **feavfcs** that show shapes **interme-diate between those of** ***P, Aria*** **and P.** *Aucupuria,* as tin[1] blade is more or less **divided** into lea lifts at its base, but is decreasingly lobed up towards its tip. **This** tree, then, is **probably** a hybrid **of** the two species in quest inn.

## PYRUS TORMINALIS (£jfrr.)._\YiLD SERVICE-TREE (*Rosaceæ*)

Distinctive Features.

This British tree is recognised by its flat-headed, repeatedly branched **inflorescences** of white flowers: its small brown pulpy fruits; its **alter-nate** simple leaves, which have pointed lobes with saw-like teeth, and are **more or less** hairless when mature.

As in **the** arrangement and design of its various parts the Wild Service-tree agrees closely with the Rowan and White Beam, we shall merely mention the points in which it differs from the last-named, which likewise **has** simple leaves.

**The** ovLiKn>wnt:d small **tret,** thirty or forty **fe«t** in height, shows at the base of its trunk a bark that regularly casts **off thin** little scales {Fig. 470).

The simple stipulate leaves vary in form, but their usual shapes are shown in the accompanying illustrations. It will be **noticed** that the lobes of the blade decrease in size from the base upwards, until they insensibly give way to men- teeth near the leaf-tip. The **leaf** contrasts with that of

Fig. -(ftp.—Shoot of Wild Service-tree.

the White Beam, not only in shape, but in that the mature leafstalk and lower face of the blade, though sometimes still showing hairs, are at least devoid of any snowy covering.

ovary, and a single style which divides above into two branches.

The pulpy fruit (Fig. 57) is rounded, oval, or pear-shaped, and as large as a small cherry; its final colour is brown, dotted

Fig. 470.— U:irk (if Wild Service-tree.

The resting-buds *arc* not long, but stumpy find rounded (Fig. 473}.

The inflorescences (Fig. 45) and flowers ar*; wiry like those of the White Beam- *h*\ the flower there are usually two carpels that combine to form an inferior two-chambered

with lighter spots (lenticels); the chambers are surrounded by a fuirly hard stone.

In germination the two oval cotyledons emerge from the soil *;uid* become green.

The tree grows well on light, sandy or even calcareous, soils, avoiding wet or very

Fig. 471.—WILD SERVICE-TREE—PYRUS TORMINALIS: WINTER.

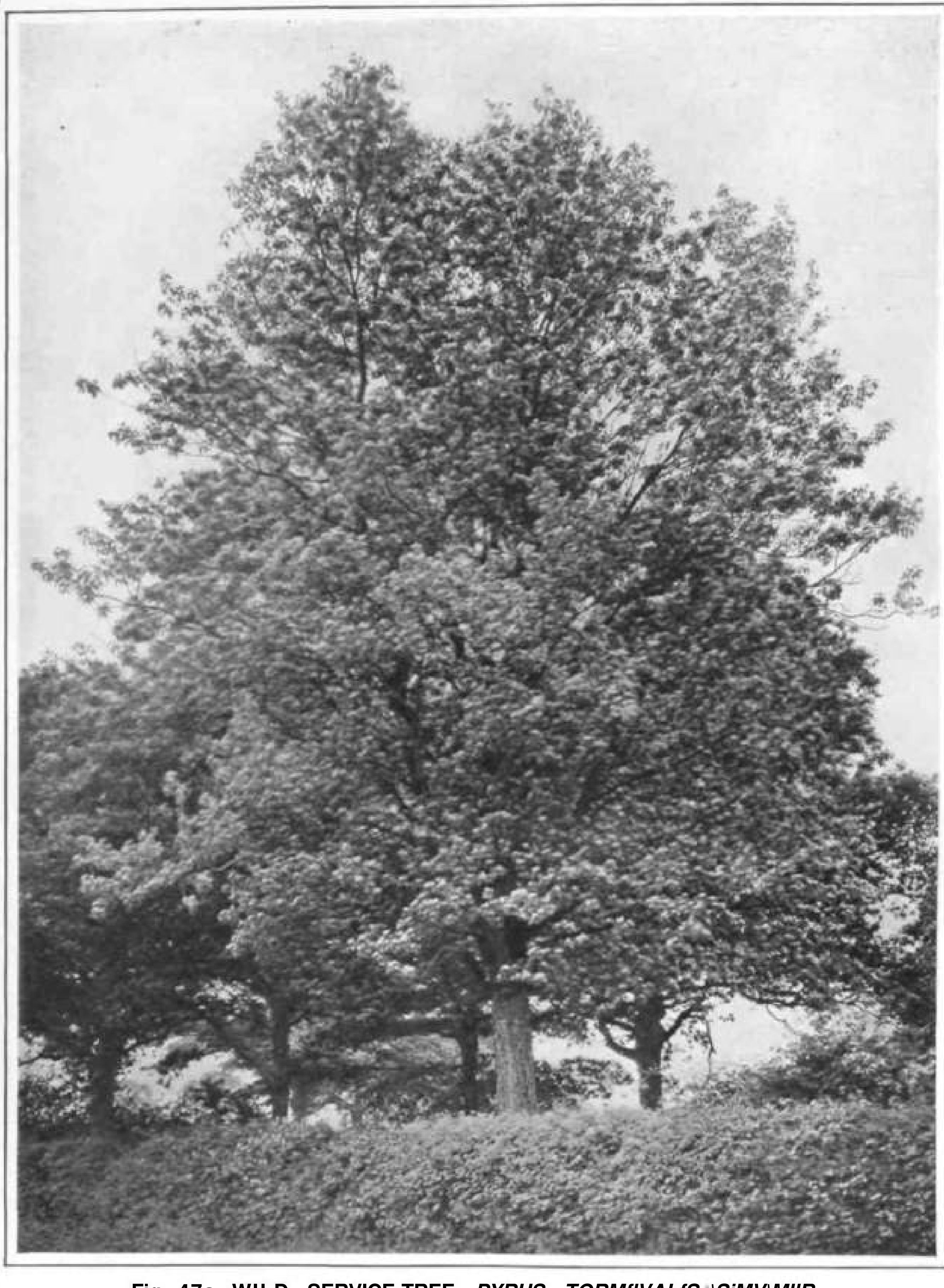


Fig. 47a.-WILD SERVICE-TREE—*PYRUS TORMfIVALfS:¡\SiMV\MIIR.*

dry **places.** **By** dint of spreading out its Jitrml roots the Wild Service-tree can live on shallow soil. Its form gives but little indication of the amount of light that the tree requires. Yet its slow growth during youth (and later life) and the feature **that** large boughs ;uv attached relatively to the trunk, conform with the tree's **capacity** to ensure a fair amount of shade. Thr Wild Service-true Ls therefore often found **in** woods as well as in **hedgerows.**

*Pitrus tortniualis* **and** *P. A ria-* show some analogy to ***Viburnum*** *Oftulut* and *V. l.tintarut* respectively (pages **jgfr-404),** but the leaves of 1 lie lirat two are alternate, those of the last two opposite i in **addition,** in *Viburnum* the petals are united and the **stamens** in each flower number only tivc and IVTC attached, not \o tht receptacle, but to the corolla.

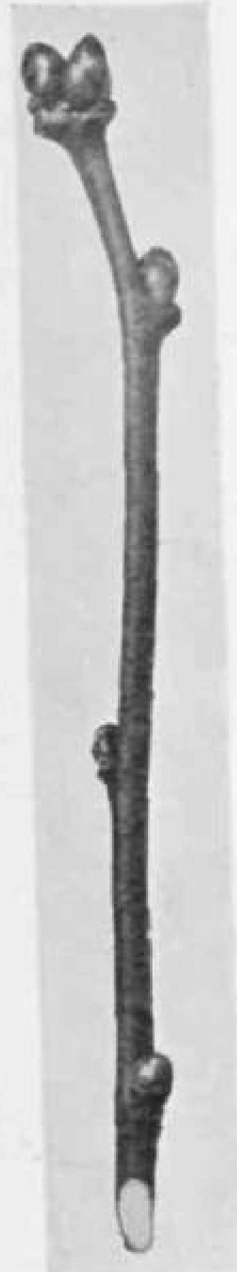


Fig. 473.—Twig ^ Wild Service-tree in Winter.

## CRAT^GUS OXYACANTHA *(Linn.)*

### HAWTHOUN *{Rosaccm)*

Fig. 474- Twig Of **hawthorn** in Vv'inter,

As a shrub or tree the **Hawthorn** or White Thorn is **recog*** nised by its white or pink scented inflorescences (" May-blossom "), red stone - fruits ("haws"), spines, and characteristic lobed leaves, some of which have relatively large green persistent stipules.

**Height and Habit.**

Although usually seen as a closely branched hedge-shrub, the* **Hawthorn may** llttaill to fl **height** ol thirty **feet** or more as a tree, with loosely or densely arranged slender branches, which frequently droop **at** their ends. The trunk often reaches a thukness of mil' fiint. The bark eventually shows numerous, particularly longitudinal, furrows dividing it into mtLiiy small scales (Fitf. 475).

Leaves,

The simple **leaves** are spirally arranged. On the long-sinxitri the stipules arc; large, green, persistent, and indented (Fig. 479); but on **the** tufted **dwarf-shoots** \\w stiputes are small, and short-lived. The stalked leaf-blade is divided into three or five lobes, which are more or less toothed; it is somewhat glossy, and nearly or completely hairless.

**Hints and** Branches.

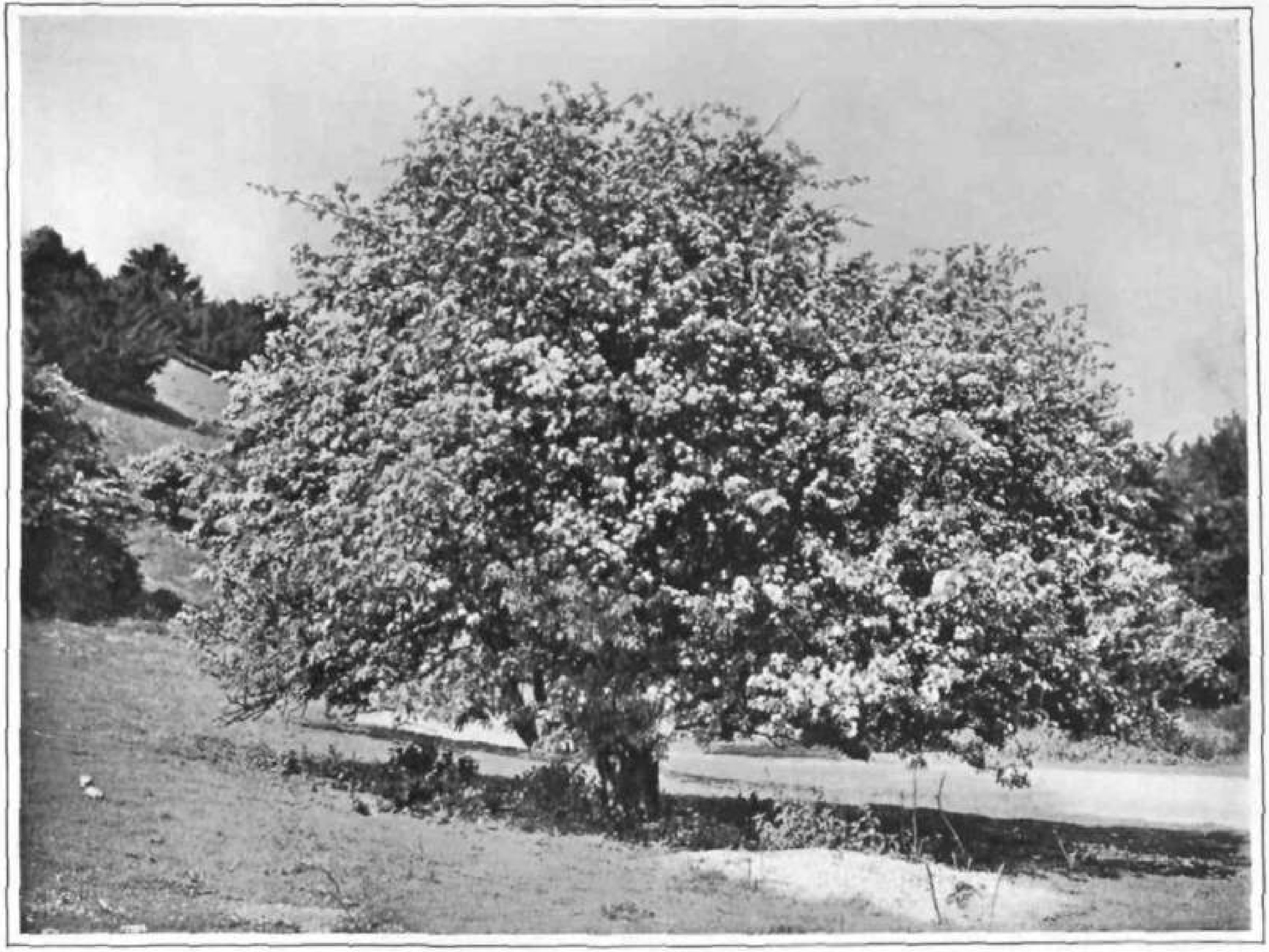
The small rating-buds show a few spirally arranged scales (Fig. 474); but in **wittier** it is the spines that specially aid ttwt identification o£ Hie plant.

The buds may give rise to no less than fivt[1] **kinds** of branches. (1) Some grow out into long-shoots **having** the leaves separ-a t **ed** by distinct in ternodes *{see* Fig. 479), (2) Others develop into foliaged dwarf-shoots with imperceptible interludes, 50 that the lca\. > arc tufted ; and as the stem in this case grows slowly, year after year it **shows** numerous ring-like scars **left by** fallen hud-scales and leaves. (3) Still other bvds grew into shoots like the last-mentioned save that they each terminate in an inflorescence (Fig. 480). (4) Sometimes **a** bud grows out into a shoot with moderately long internodes, as if it were about to produce a long-shoot, but towards its end the leaves gradually dwindle to tiny, narrowr, red scales while the stem tapers to a point; Hie stom stem which hardens and becomes a thorn, and has on its sides only two small basal scales, and a few minute ones separated by distinct intern odes higher up ; this is a *short-thorn (sec* the upper shoot illustrated in

**Fljj. 475.—Bark of Hawthorn.**

hardens find becomes woody to its extreme tip, and thus becomes a thorn ; in later pears this *long-thorn* may emit branches (Fig. 478). (5) Sometimes a bud in the ax3 of a leaf develops precociously, in the year of its birth, into a short red tapering Fig- 479)- Such -*A* short-thorn in later years may omit dwarf-branches from the axils in its basal scales. It will, therefore, be seen that the thorns are arrested branches, and that they represent stunted long-shoots rather than pointed dwarf-shoots.

Fig. 476.— HAWTHORN- *CRATÆGUS OXYACANTHA* : WINTER.



Rff. H77.-HA%VTHORN-t7?4 *T/EQVS QXYACWUiA* —*IS* BLOOM.

The white or rosy flowers open in May or June, and are arranged into BO inflorescence which has a slightly ringed or nearly flat top (Fig. 480\. The **general** design **of** the flower is like that of an Applt'-tree, except as regards the carpels.

**Flowers.**

Each regular flower **has** fere joined sepals; five separate, rounded, white jjetals; about twenty **stamens** with anthers -which urn pink before **they** open-, all th«se arc **attached** at the edge of a little basin. From near the centre of this **there** rises a single stylo (less **frequently two** or throe styles) cupped by a broad **stigma** ; below is the inferior ono-diambored (less often two- or three-chambered) ovary. Each **ovary-chamber** contains IWII ovules, of which one is an **incompletely** developed rudiment incapable of producing a seed.

The plant often covers itself so completely with blossom **that** the leaves, though **present, axe feardly seen.** Moteover, the flowers have a characteristic odour that is pleasing to some human beings, **and to** flies that

Fig* **479.—Shoots of Hawthorn-**

Fig. **478—Spines of Hawthorn,**

**Pollination.**

dTC fond Dl P * * " ^ ing organic matter (the scent is at least partly due to trimethvhinin, which is **also** exha om dead fish). W ies, as well as some beetles and bees* cross - pollinate **the** May - blossom. The stigma is receptive **before** the still pink anthers open; at this stage the OU^T stamens stand erect, and the inner stamens ore bent inwards ;ind downwards beyond reach of the stigma, so that nnly eross-poUimuion is possible. In **fine** weather all the stamens subsequently **Spread** out radially, and reveal at the **base** of th» style the silvery hairs that conceal the nectar. But

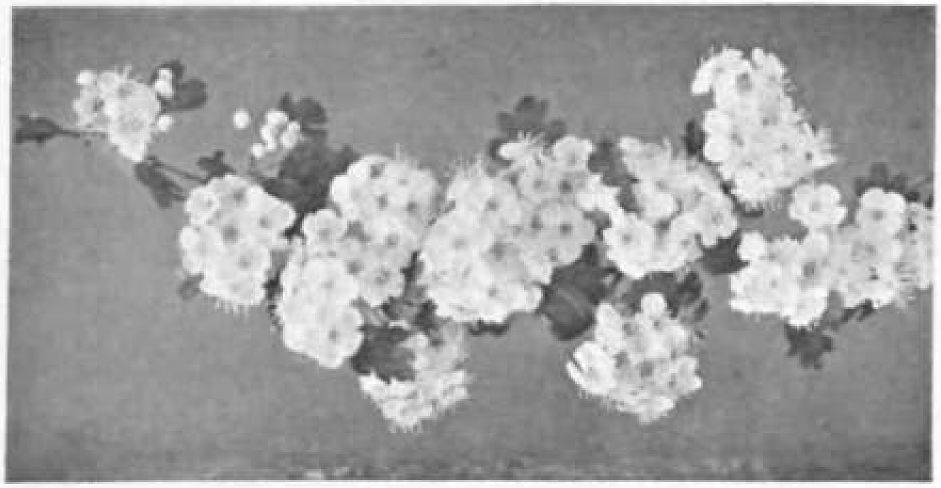


Fig. 48U. ['lowers of Hawthorn.

if the weather be conl and damp, tJio inner **stamens never** relinquish their bent pose, while the outer stamens project above the stigma upon which they shed their pollen, **thus causing** spontaneous self-pollinaUon.

Not until October or **November** lias the **ovary given place** to the ripe, red "haw" (Fig, 481), which is not a berry, but a stone-fruit containing a single, one-seeded, hard stone (less frequently two or three one-seeded stones). The roof of the fruit lying within the persistent ring of sepals has no fleshy layer, so that here tlu-st one is near the surface. It is in the hardness of its stone that *Cra-Imgus* differs from *Pyms.* The fruits ;iro eaten and dispersed by birds.

**Kruit.**

The seed is wholly occupied by the enibiyo. In germination the oval green rotyledons emerge from the soil, and are immediately succeeded by delicate **little** foliage-leaves very simitar to the later ones.

**Seed.**

Of tlit; Hawthorn there are two extreme kinds which art: found growing wild, and are described as distinct species or sub-species. The common one has usually one style, one ovary-chamber, and therefore one store •—**hence** it is known as *C. pwnogyna.* The less **common** form, known **as** *C, «xy<icau-thaidcSf* has **two** or three styles, ovary-**chambers,** and **stones,** and **differs** in other respects. **Between these** two **extremes** there occur **inter-mediate** forms **which** may or may not bo hybrids. In addition to the two species described above, **there** are garden varieties **with** red blossom, also **with** double white or red tfouvrs. But many Hawthorns, trees and shrubs, **Cttlti-vated** in gardens belong to entirely different species.

**Forms.**

,%i **^L-Froltt** of Hawthorn.

## CORNACEÆ

### CORNUS SANGUINEA (*Linn.*).—DOGWOOD (*Cornaceæ*)

The Dogwoo[d] ... creamy-white, terminal, nearly flat-topped inflorescences, its characteristically veined, simple, opposite leaves, its red branchlets and autumn leaves, and above all by th[e]

**Fig. 482.—Shoot of Dogwood.**

structure of its regular flowers. The flower has separate petals, and an inferior two-chambered ovary; it includes four sepals, four petals, [fo]ur stamens, one style, and a knob-like ... a.

The shrub oft[e]n a p ... form, and varies in height from six to fifteen feet. The main branches ... tend to be straight; they are covered with a brown bark which shows many fine cracks running lengthwise and crosswise. The straight slender branchlets, on the other hand, are blood-red in colour, especially at spring-time.

The simple, stalked leaves (Fig. 482) are opposite and ranged in four ranks. They possess no stipules. The leaf-blade is often oval in shape, has an untoothed margin, but terminates in a sharp point. The most characteristic feature of the leaf, however, is the form of the veining; the lateral veins are few (three or four pairs) in number, are prominent and arched, so as to converge finally towards the tip. The leaves become red in autumn.

Leaves.

The downy resting-buds (Fig. 483) are compressed and knee-shaped, the lateral ones being more or less applied to the stem. Each shows from two to four scales. Beneath the obvious lateral bud in the axil of a leaf there stands a smaller "accessory" bud.

Buds.

The creamy-white flowers, which are ranged in terminal, stalked, more or less flat-topped, repeatedly forked inflorescences ... 484), open in June or ...y; but occasionally a second crop of ... into blossom in ... October.

Flowers.

The flower is regular and bisexual. Four tiny ... the sepals. The four ... white ... succeeded by four stamens which alternate

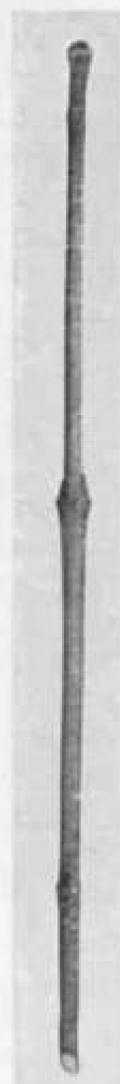


**Fig. 483. Twig of Dogwood in Winter.**

Fig. 484.—Inflorescences of Dojpvood.

with them. In the centre of the flower is a knob-like stigma, **which** terminates a single style, And below nil these parts is the inferior two-chambered ovary containing one ovule in each **chamber.**

The nectar is freely accessible to all kinds of insects, as it is manufactured by the di.sk **surmounting** the ovary. For

**Pa Mi nation.**

111 is reason, also because **the** small flowers are massed together to form **showy** blossom, and exhale the scent of trimethylamin (which is also **exhaled** from dead Jish), the insert visitors include **a** considerable **number** of short-tongued, unintelligent, flies and beetles. These easily lick the **surface** of the exposed disk, as do the few bees and the hover-flies that also come to the (lowers. As the anthers open toward? the centre of the flower at the same time as the stigma is receptive cross-pollination and self-pollination by **the** agency of insects are both possible.

**Frufl.**

The fruit (Fig, 485) ripens in September, **wfcefl** *it is* seen to be a bkek **or bluish-purple, somewhat** dry, spherical stone-fruit, about as large as a pea, and containing a two-chambered stone within its **feeble** fleshy layer. At its summit there stil] remain tlii- lour **teeth** representing the sepals.

***CMrntts*** *.\fits* (Linn.) is *a* shrub or Jff.tJe tree *often.* ~<t in **English** gardens. .(ii]iiiiK',!i it is not .1 British **plant,** its opposite simple leaves arc ii»;irkwl by the siunc **characteristic arched** vein trig as thoseof *C, sttn-gutnta.* But the flowers of C ***Mat*** aJ*e yellow **and** open in **February** or Mfirch **before** t!>e leaves **appear.** At this season the shrub, with its little groups of stalked **yellow [flowers** decking the tips and sides of the Icatlcss twigs, is **therefore** almost itniuistakabJe. The fleshy **traits** arc **r«J.**

**Fig. ^85.—Fruits of Dogwood.**

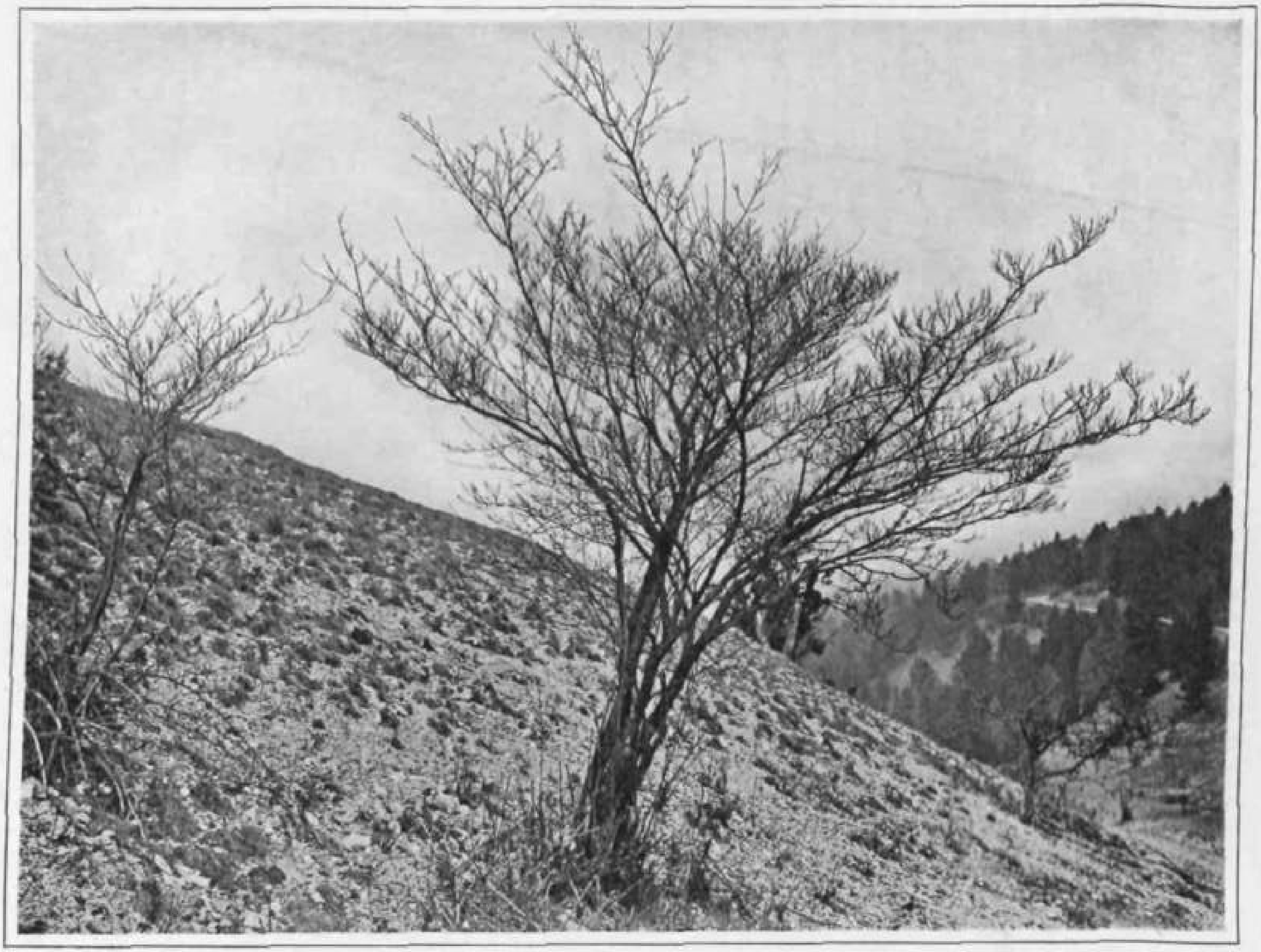


Fig. 6.— SA : WINTER.

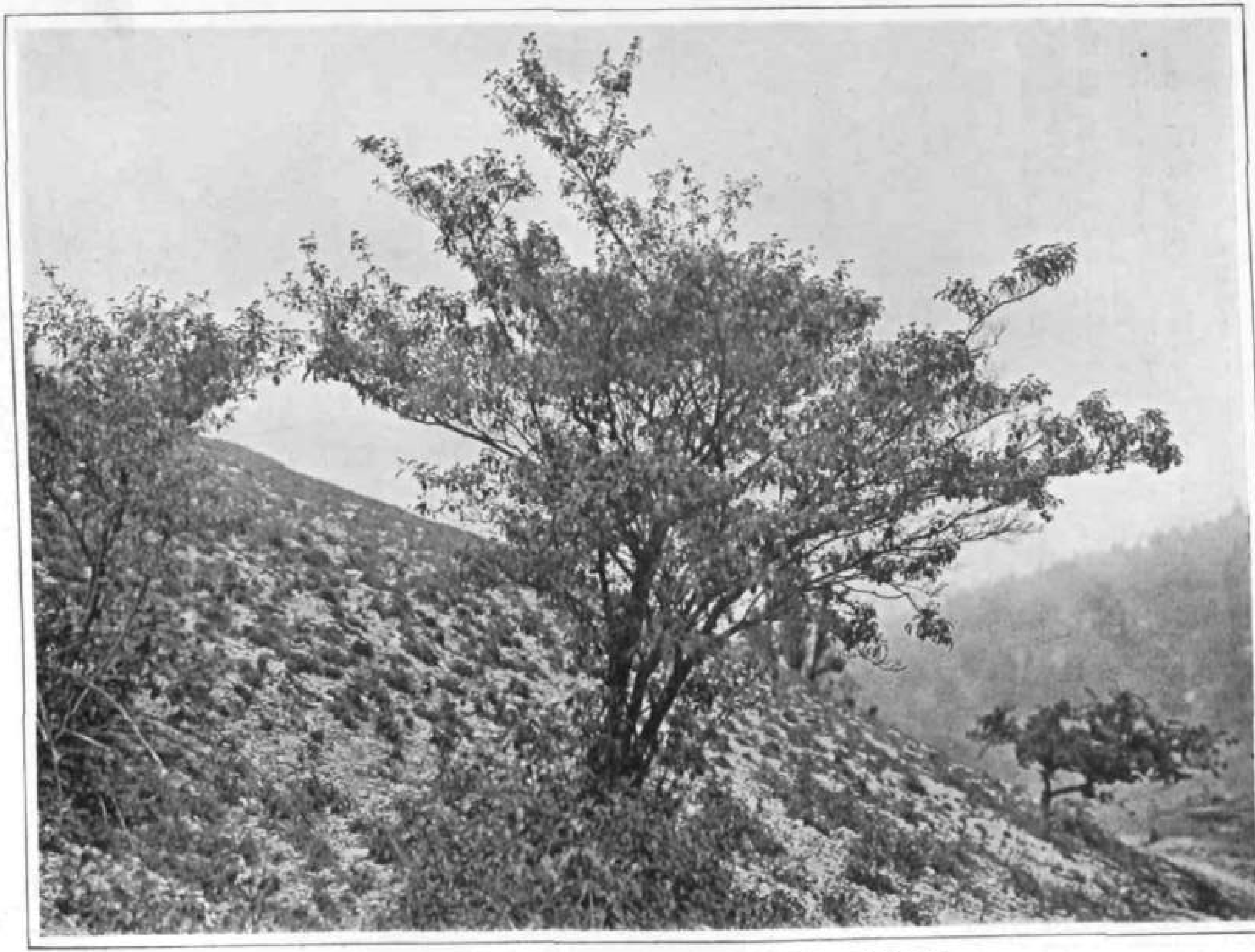


Fig. 487.—DOGWOOD—*CORNUS SANGUINEA*: SUMMER.

## OLEACEÆ. OLIVE FAMILY

Among the familiar members of the Oleaceæ are the Lilac, Privet, and Ash-tree. In this family the leaves are *opposite*, and devoid of stipules. The flower is *regular and hypogynous*, and commonly shows the following parts: *four sepals, four united petals,* only *two stamens,* and a superior *two-chambered ovary* containing only a few (often four) [illegible]. The peculiar feature is the presence of only two stamens.

But, as will be seen hereafter, the Common Ash-tree differs in being a degenerate [illegible] which has lost both sepals and petals.

### FRAXINUS EXCELSIOR (L.)
### COMMON ASH-TREE (Oleaceæ)

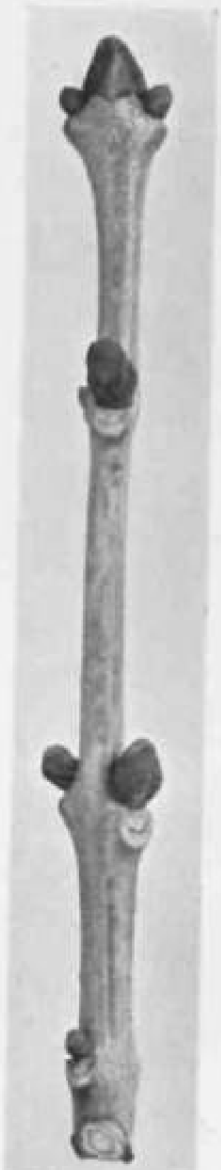


Fig. 488. Long-shoot of Ash in Winter.

This tree [illegible] by its op[illegible] compound leaves, which are mounted on prominent [illegible]; its [illegible] resting-buds and coarse lumpy twigs [illegible] tufts of little flowers which emerge before the leaves; its bunches of hanging strap-like fruits; as well as by the peculiar structure of the flowers.

The deep and large root-system limits well-grown Ash-trees to deep soil.

**Dimensions and Form.** The tree may be 200 feet in height, but the trunk is not pro[illegible] ate[illegible] as it rarely exceeds a yard [illegible]. In the forest the trunk is straight, cylindrical, and branchless up to a height of perhaps [illegible] feet, but in the open the boughs may be [illegible] the ground. The crown is rather loosely branched and the foliage relatively light, so that the tree does not cast deep shade.

The bark remains smooth for thirty or forty years, but finally becomes rough and furrowed (Fig. 490).

The [illegible] four-ranked [illegible] (Fig. 494). Leaves [illegible] stalked, but [illegible] stipules. Each [illegible] four or six pairs [illegible] stalkless opposite leaflets [illegible] as a terminal one; the leaflets are [illegible] and sharp-pointed. The leaves unfold late in the season, not before May, and fall in autumn, often while still green.

**Buds.** The black resting-buds (Figs. 488, 489) are very characteristic of the tree. The terminal bud is considerably larger than the lateral ones. The black colour is mainly due to [illegible] coating of black hairs clothing the outermost pair of scales, which, with

Fig. 489. Dwarf-shoot of Ash in Winter.

or without the co-operation of two others, invest the bud. The twigs are coarse, and are remarkable for the thick nodes., which owe their prominency to the large •opposite loaf-cushions upon which the and that these together with the following leaves display an interesting series of transitional stages between scales and full-sized **elaborate** foliage-leaves. **The** terminal buds develop exclusively into leafy shoots.

Fig. *490.* - **tJnrk of Ash.**

leaf-scars are mounted (Fig. 488); particularly striking for these reasons are the rough leafless dwarf-shoots (Fig. 489), which have the projecting leaf-cushions separated only by very short intemodes. When a foliage-bud opens it is seen that there arc often three pail's of scales enveloping each bud,

z

Flowers.

lu April or May, before the leaves unfold, the branched and tufted inflorescences shoot forth from lateral buds on the twig produced during the preceding year (Fig. 493). The tree commences to flower regularly at an age of from thirty to forty years.

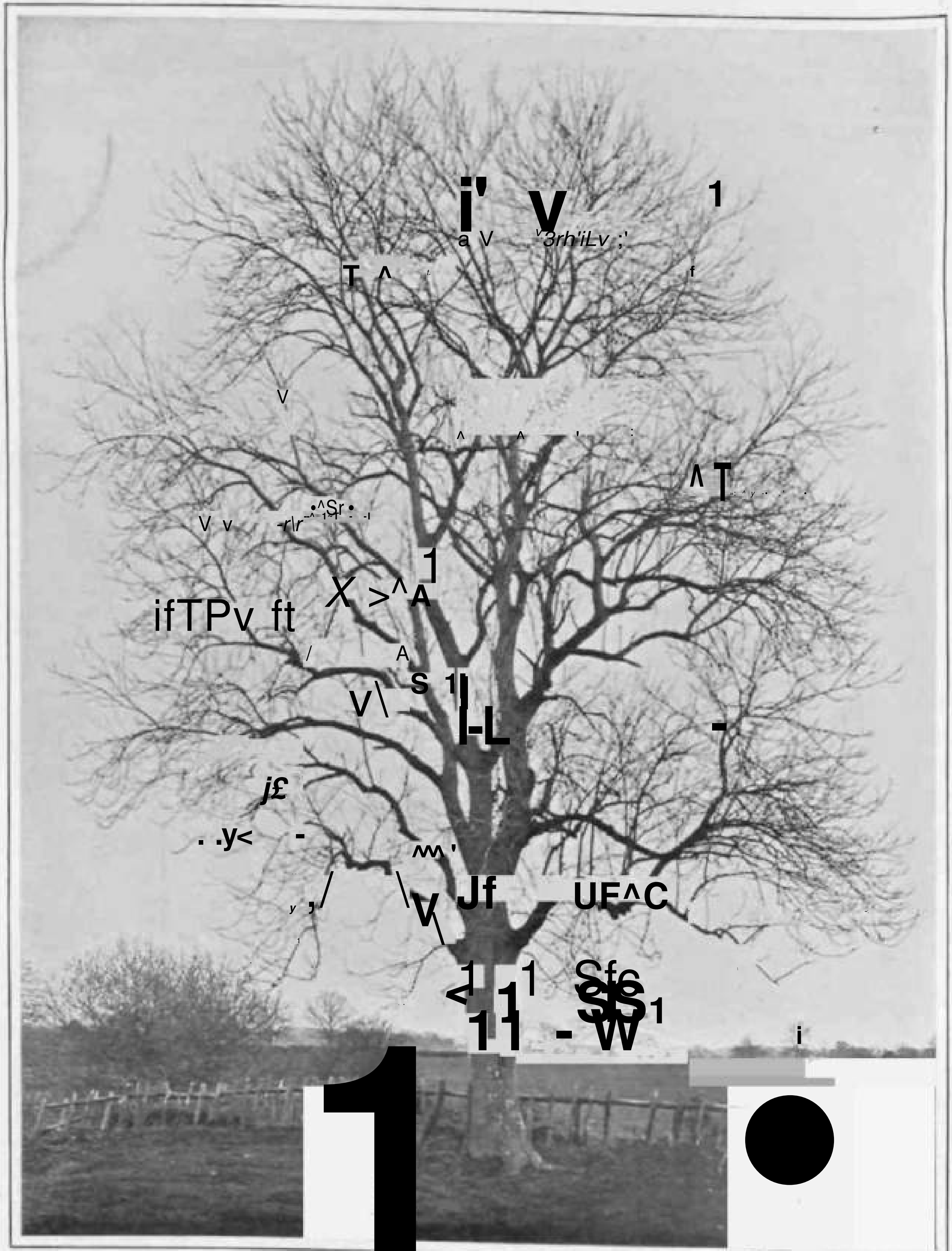


Fig. 49t—ASH-*FRAXINUS EXCELSIOR*: WINTER.

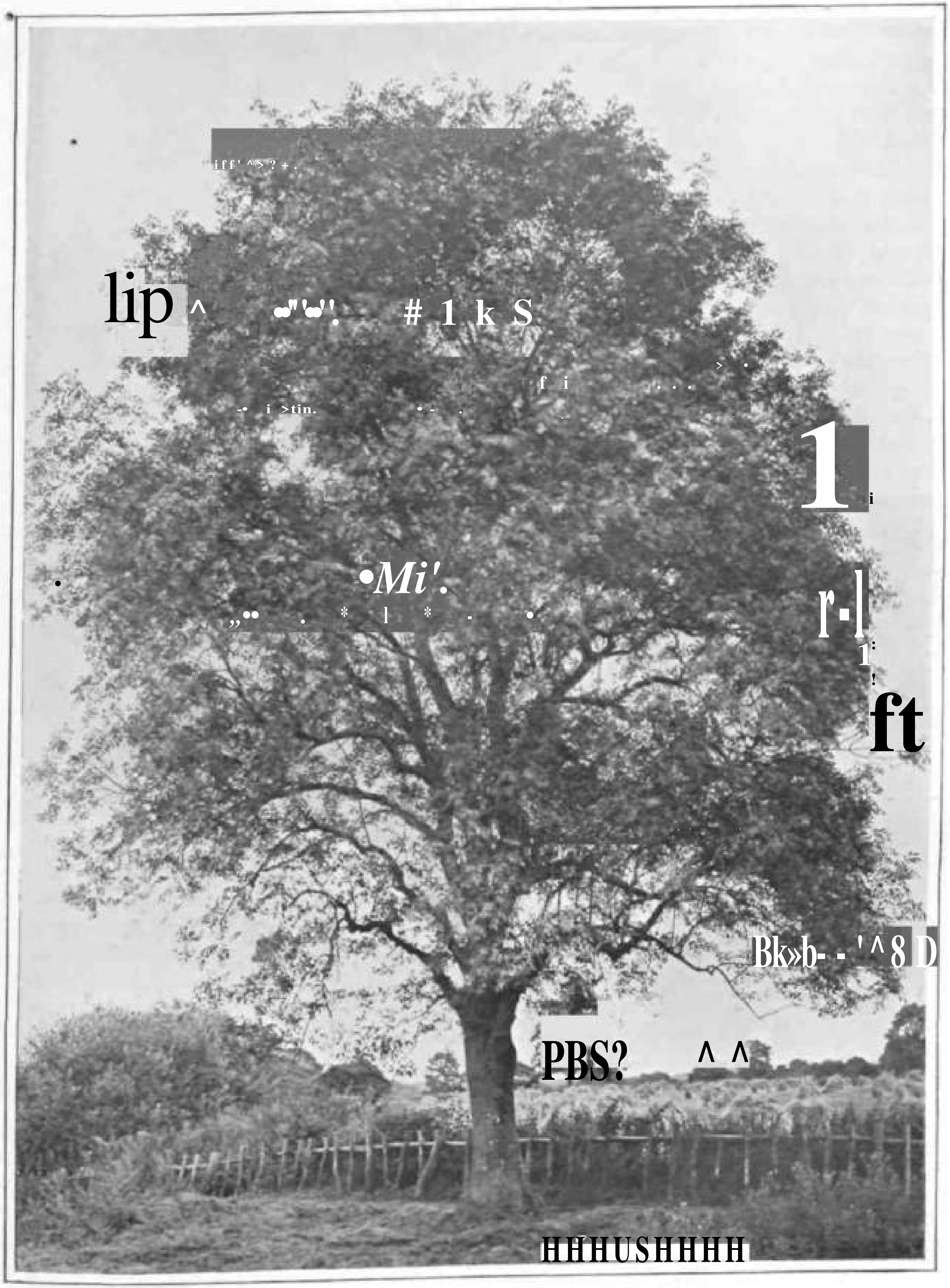
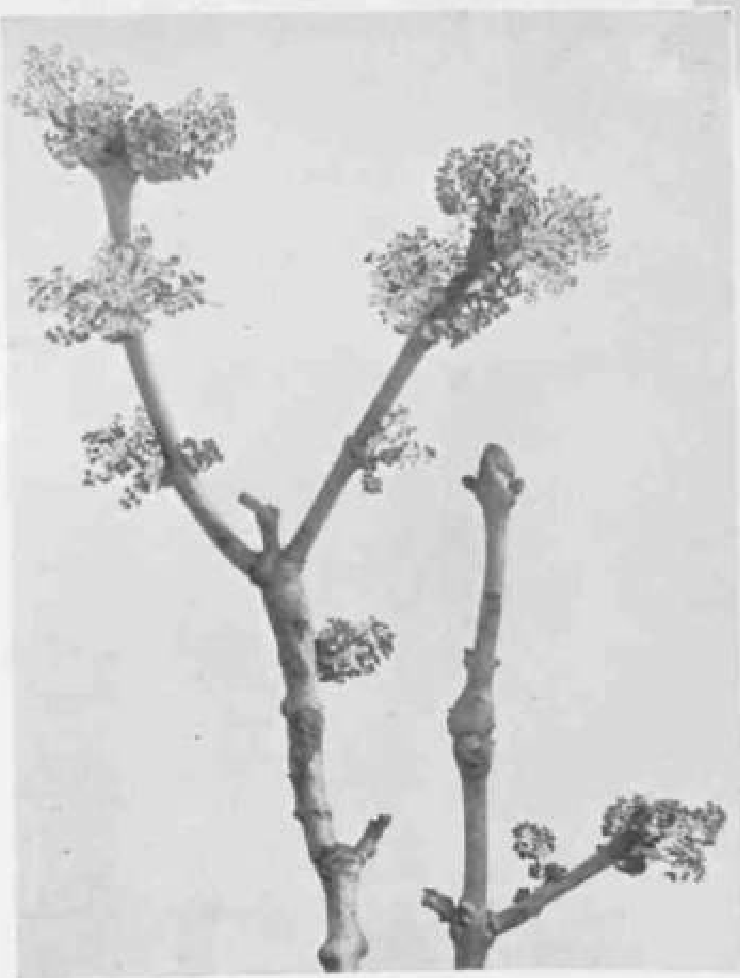


FIG. 493.—ASH—FRAXINUS EXCELSIOR: SUMMER.

The **flowers** are extremely interesting as affording examples of degeneration that has culminated in the production of unisexual flowers devoid of sepals and petals. There are three distinct kinds of flowers—bisexual, male, and female—each staniBag alone in the axil of a narrow, pointed, little bract. None of the **flowera** have sepals nr **petals.** The bisexual flower consists solely of two stamens with purple anthers, and a superior pistil; this latter shows two large fleshy stigmas combining below into a very short style, which caps flu two-chambered, laterally flattened, ovary ; in'each ovary-chamber there are (ultimately) two ovules. The female flower is similar, except that the two stamens soon fall off, **never** open their anthers, nor produce perfect pollen. But the male **flower consists** entirely of two stamens. There are, however, flowers **intermediate** between these three types. Some apparently bi-sexual **flowers** are really male, as the pistil falls off early ; and seemingly other falsely bisexual Jtmvcrs do not produce seed, despite of pollination, and are therefore male flowers. The three distinct kinds of (towers are grouped on the same individual tree or on different trees in various ways; and it is of great interest **that** the same individual tree is not necessarily of the same sex in successive years.

Fig. **494.—** Shoots of **Ash.**



Fig, 493. Inflorescences of AsH.

Comparison with the Manna **Ash** *{Fraximis Omits),* which has sepals, and four narrow long petals to each flower, suggests that the Common Ash has lost these structures us it has became wind-pollinated. Even the Manna Ash sometimes produces

Fig. 49S- — Fruits of Ash.*

flowers without petals ; and the Common Ash, on the contrary, is known to produce four sepals sometimes. It is also evident that the Common Ash has produced male **tod** female flowers through the degeneration of the pistil and stamens respecti\'ely of an originally bisexual flower.

The /towers are wind-pollinated, and pollination is facilitated by *the circumstance* that *blossoming* takes place before the foliage comes out *to* obstruct the free transference of pollen blown to the stigmas.

iruit.

The ovary develops into a strap-like winged fruit, and, as the; fruits remain green for many weeks, and **hang** in large clusters (Fig. 4g5), they are apt to be mistaken for foliage The wing is terminal, 11 ud often is tipped by the remains of the style. At **the** base is the seed-chamber containing one seed. The fruit does not open spontaneously, so **that** **it** is described as a one-winged nut. *But* in addition to these fruits are other smaller strap-like fruits ***which*** *contain* merely the four minute shrivelled ovules ; **fertilisation** has not been *eiiect'ive,* and these fruits, of course, **will** not give rise to new plants. The dry, brownish, fertile fruits usually hang from the tree all through the winter, after which they are dispersed by wind.

Seud.

The seed contains an embryo as **well** as food-material **(endosperm)** outside (his. At germination the seedling[1] lifts **the** fruit bodily above the *soil,* and tin: *cotyledons* remain *for* **a** time inside the **Seed,** sucking up the food-material. The cotyledons subsequently expand as green, nearly oval leaves, and arc succeeded, not by ordinary foliage-leaves, but by three-lob Ľd leaves. For about five years the growth of the little stem is tolerably slow, but thereafter the young tree grows relatively rapidly.

The Ash-tree demands **a** considerable amount **of** light, as might be surmised from the length of its bole in forest, the rapid **growth** of (ho young tree, the loose crown and tfiirt foliage and the comparatively slight shade *cast by it,* and from the rough **bark** of later years,

Among the **cultivated** varieties of **the**

**Fig. 496.— Weeping Ash.**

Common Ash two deserve special mention : *(t)* The Weeping Ash (Fig. 496), which, as Varieties. reSartls Its brancWn& &OWB the mode of growth of an Elder, Weeping Beech, or Laburnum *{see* pages 392, 209, 322-4). (2) The variety which is known as *monophyll** because all the leaflets except the terminal one of the leaf are suppressed, so that the loaf at first sight seems to be simple.

## CAPRIFOLIACEJE. ELDER FAMILY

The Caprifoliiiccsai include the Elder, Guelder Hose, Snowberry, and Honeysuckle. Tlie *frfals* of the flower are *iwited,* and the *ovary* is *inferior* and often three-chambered, Each **flower** includes usually five sepals (represented), five petals, and five stamens, which are attached to the corolk but alternate with the petals. The ***leases*** of the members of this family are *opposite,* and usually devoid of stipules.

### SAMBUCUS NIGRA *(Linn,).*—COMMON ELMER *{Caprifoliacea)*

The Elder is recognised by the flat-topped inflorescences of small cream-coloured flowers, the opposite pinnately compound leaves, the kirge white pith of the vigorous shoots, as well as by the rough bark, **the** general habit, and the structure of **the** flowers.

**Fig. 45>7- *-Twig* of Elder in Winter.**

The Elder-tree varies in stature from **twelve** to thirty feet, and in habit from a shrub to a tree with drooping branches. The bark soon becomes rough and deeply **furrowed** ; event ually it is thick, yellowish - brown, and scaly (Fig. 499).

**Leaves.** The opposite com-**pound** Jeaves (Fig-. 500) are arranged in four ranks. Sumo of the leaves are devoid of stipules, hut **others have** at the base one or two short thread-like stipules, which **seem** to be attached to **the** stem between (he leaf-stalks, rather than to the leaves. The tip of the young stipule is glandular, and is said to excrete sugar, The utility of these nectaries, if they be such, is entirely unknown, as they are also found on stipules far away from the flowers, The stalked, almost hairless, leaflets are arranged in from two to five opposite pairs, but there is also a terminal leaflet which is usually more equal - sided at the base of its blade than are the others ; each leaflet has marginal saw-like teeth, and often is prolonged into a si en de r tip.

Tlic rest-i11g-bud is peculiar in that **though** it lias two, four, or six scales at the base, the **upper** leaves projecting at its tip arc green **folfage-**leaves. The

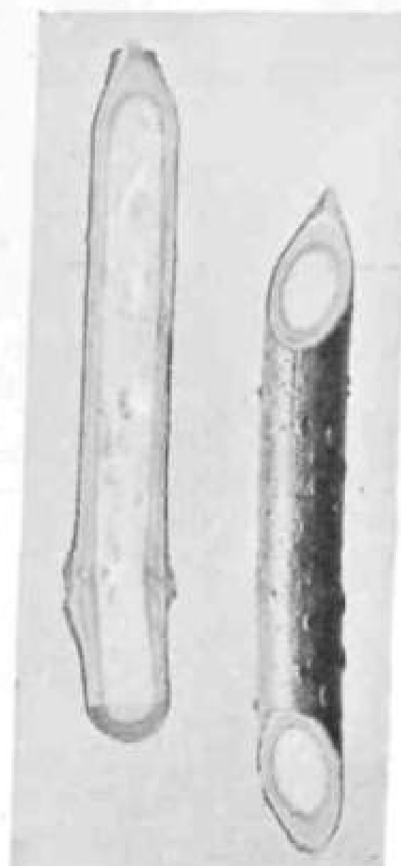


**Fig. 49H. -Stem of Elder, showing Pith.**

bud is therefore partly "naked" (Fig. 497). Another characteristic feature is that in

**Buds,**

the axil of each leaf, directly beneath the main bud, there is a smaller one, or there may be two or three smaller ones. The twigs are noticeable for .

The Elder admirably illustrates the mode of growth of a weeping-tree, and of a shrub.

**Mode of Growth.**

It tends to lose the tree-like form owing to two peculiarities in its behaviour. First, each stem grows only for a limited time, after which

Fig. 499.—Bark of Elder.

(i) the large size of the white pith (Fig. 498); and (2) the distinctness of the lenticels (Figs. 497-8), which are yellow-brown, cork-like little lumps standing out especially clearly from the green twigs of the current year.

+h 1 , J / T ^ Th^ buds that develop ar/Lt ^ ? such a drooping shoot ton of ^ tlp, but are situated near the shoot w ^, h or towards the base of the ng, erect Conse-

Fig. 500. -*Shoot of* **Elder.**

to these vigorous ascending branches there are other shorter branchless that spread *horizontally iind* **exe** *to some extent* **dwarf-shoots.**

**Flowers.** Tlie *small,* cream-tinted flowers opw *in June, and* are arranged in repeated])' bran died and **flat-fopped** inflorescence, which terminate- foliaged shoots of the current ytar (Fig. 501). Tlie regular bisexual Jlowr is **attached** to its stalk by **a** distinct joint. The Jive little green sepals do not touch one another in the bud. The five cream-coloured petals are united **at** the base to form a very short tube, to which **the five** stamens are attached. The inferior, grcm ovary cotit;uns one ovule in each of its three chambers, and is surmounted by a short thick style **With** a three-lobcd **stigma.**

Although the inflorescences are showy and scented, the flowers are visited by but few bisects, and these are mainly flits and beetles, wluch take pollen from the **yellow** anthers—far **there** is no nectar. The anthers open outwardly, yet self-pollination is easily accomplished, because the anthers and stigmas are rips at tin- same time.

quently the apparent trunk of a tree is not a. true one, but is composed of the bases of many branches, and it shows a more or less distinct zig-zag form. Not only the arrested growth of the main **stein** (and branches) causes the slirub-hkc form, but the repeated shooting out of tall, erect, pithy stems from the base of the trunk (*see* Fig. 499) and from the bases of the main boughs also contributes to produce this result. In addition

**Fig. 501.—Flowers of Elder.**

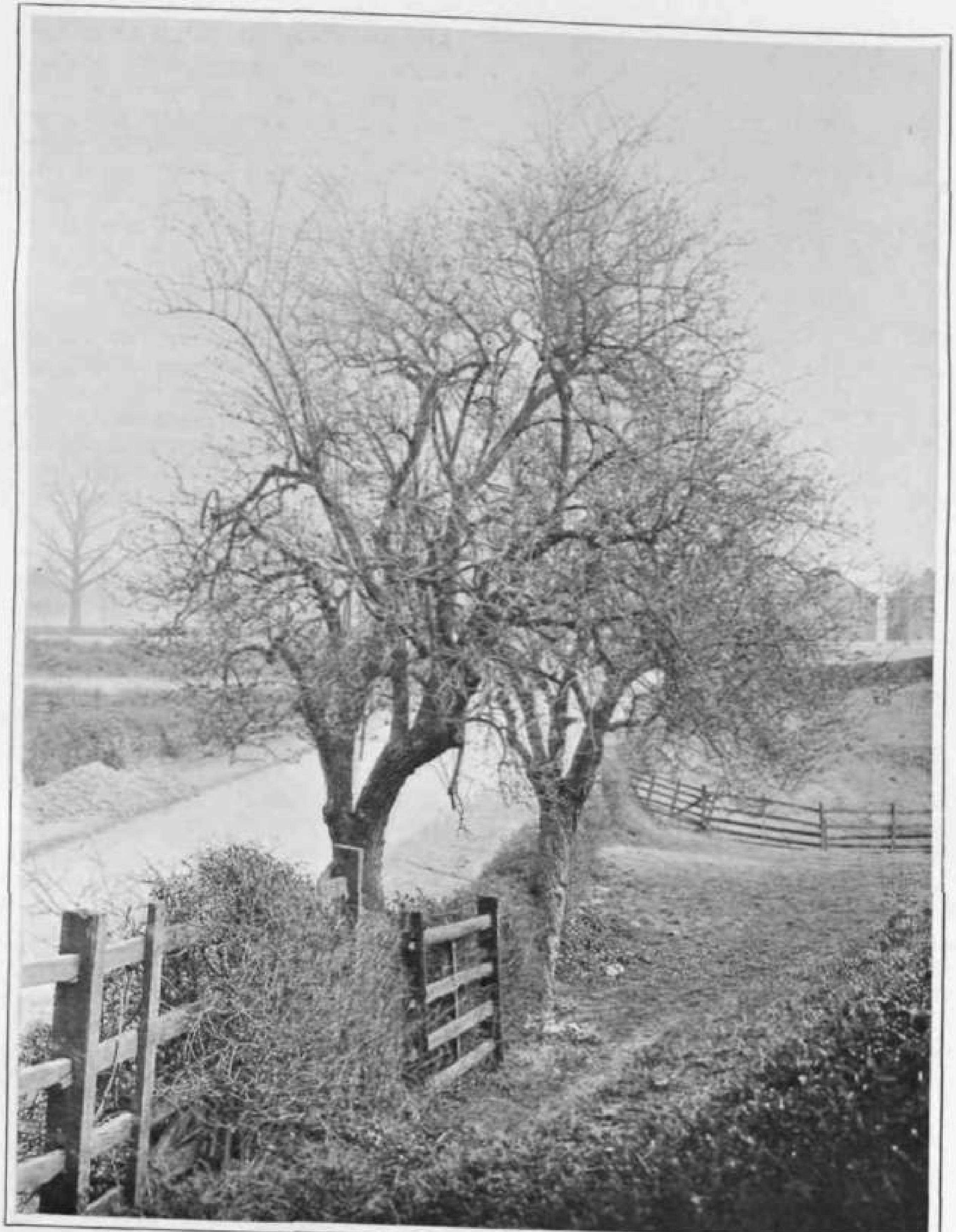


Fig. 50a.—*EUtEft-SAMBUCUS NIGRA :* WINTER

Fig. 503.—ELDER—*SAMBUCUS NIGRA* IN BLOOM.

The ovary develops into a stone-fruit containing three one-seeded stones, ;uid having a. pulpy outer **wall** which is **usually** black, though occasionally green. The fruits arc dispersed **by** birds. The seed contains food-material stored outside the tiny embryo.

FTM'tind Seeds.

Fig. so*.-Fruits of Elder.

**VIBURNUM** LANTANA *{Linn.)*.—WAYFARING-TREE *{CaprifoUacea)*

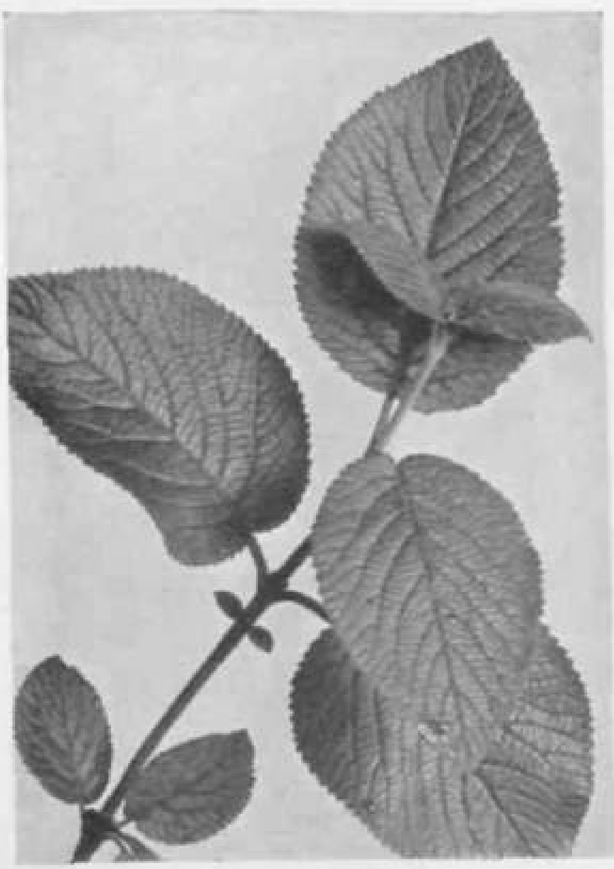


Fig. 505-—Shoot of Wayfaring-tree.

Characteristic of the Wayfaring-tree are the terminal parasol-likt: white inflorescences, the opposite simple **leaves,** the **scurfy** hairs clothing the shoots, the **blade** flashy fruit contain Lig only one stone, and, **finally,** the structure of the little flowers.

Height **and Habit.**

Despite its name the Wayfaring-tree is usually **a** shrub rarely exceeding fifteen feet in height, and often not **half** thjs. From **j**fc base spring many long, ascending,branched shoots, whose growth is so rapid **that** they frequently attain a. length of six feet in their first year. Branched scurfy hairs clothe the .shoot, and remain **attached** for five years ; but the stems eventually become encased in longitudinally fissured **bark.**

Leaves.

The opposite, four-ranked leaves (Fig. 505) ale simple, and stalked, but lack stipules. The leaf-bind^ is toothed at the margin; on its **somewhat wrinkled** upper face **scattered** hairs occur, while on the lower face, and especially along the very prominent

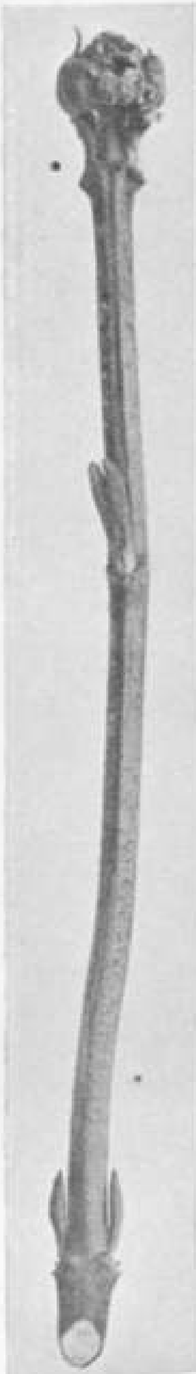


**Fig. 506.—Buds of Wayfaring-tree in Winter.**

veins, are borne numerous branched, scurfy hairs, which are continued along the leaf-stalk.

The resting-buds are of two kinds. A vegetative bud destined to develop into a foliaged branch is narrow and stalked; at first it has two external scales, which soon fall off, but it finally shows only a pair of erect, folded foliage-leaves clothed with hairs —the bud is thus "naked." But a terminal bud that in due time will produce an inflorescence is spherical in shape, and swells observably during the winter (Fig. 506), even though the blossom does not open before May or June.

**Buds.**

The inflorescence (Fig. 507) terminates a shoot, and resembles that of the Elder, though tending to be more umbrella-like in place of being flat-topped. The white flower, which has two bractlets at its base, is designed like that of the Elder except that the disk above the ovary excretes sugar, and that the three stigmas are directly inserted upon the ovary, and, finally, that the ovary has one complete chamber containing one ovule and two rudimentary chambers devoid of ovules.

Flowers.

Cross - pollination and self - pollination through the agency of insects can take place in the Wayfaring-tree and Guelder Rose, as the projecting stamens open their anthers at the same time as the stigma is receptive. Bees visit the flowers in order to collect pollen, while short-tongued flies and beetles sip the freely accessible nectar. As the stamens eventually spread out, spontaneous self-pollination seems to be infrequent, but pollen may fall on to the stiemas of adjacent flowers and thus effect pollination of a kind. [The long-tubed Honeysuckle flowers are pollinated by long-tongued insects (moths and humble-bees).]

The oval stone-fruit (Fig. 510) is somewhat flattened laterally; green at first, it becomes red, and finally black. It differs from the fruit of the Elder in containing a single one-seeded

Fruit.

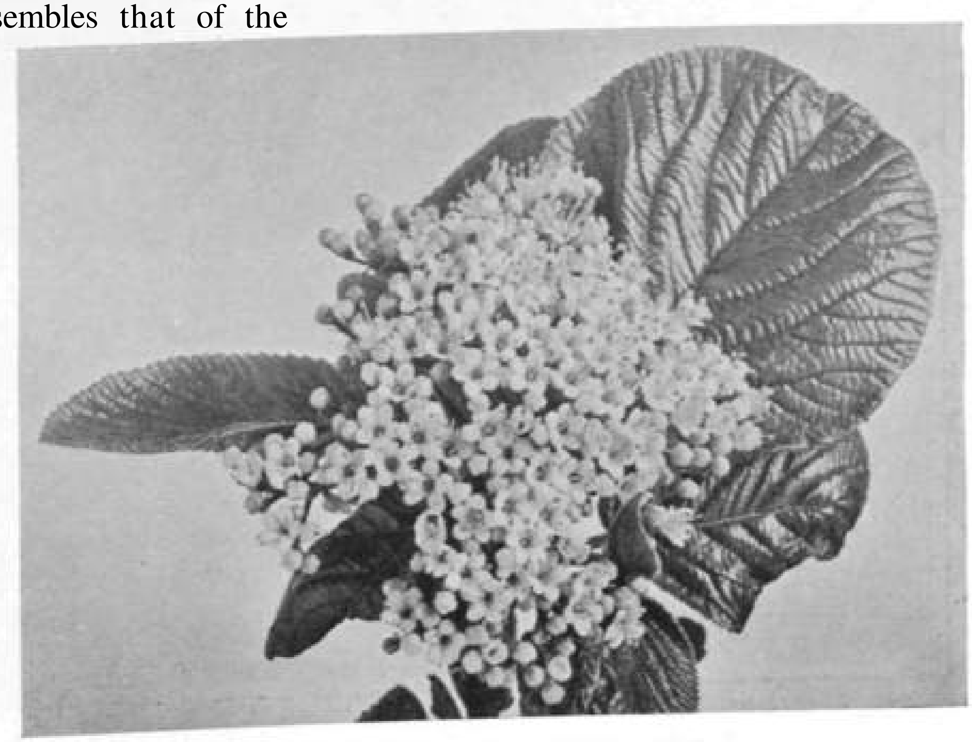


**Fig. 507.—Inflorescence of Wayfaring-tree.**

Fig. JO8._WAYHARINO-TREE-*VIOVUM-M LASTANA:* WINTER.

Fig. 509.—WAYFARING-TREE—*VIBURNUM LANTANA*—IN BLOOM.

stone, as is the natural result of **the** presence of only one ovule in the ovary.

The Way faring-t ree is of interest in displaying a strong preference for **a** soil containing much lime, or, at least, it is usually found on calcareous soil.

*Viburnum Tijius,* a common garden shrub known as •• [aimistinus," i lifters from *V. Lanlana,* in that Us simple leaves are evergreen, ami consequently **thick** and ie;itliery.

Fig. **510**—Fruits of Wai **faring tree.**

## VIBURNUM OPULUS (Z.mn.).~Guia^u ROSE *{Caprifotiauce)*

The Guelder Rose is easily recognised by its characteristic inflorescences, consisting of showy, white, irregular, marginal flowers, and small, regular, central flowers; by its opposite lobed leaves, each n{ which has two pairs of stipules as well as some basin-like glands on the leaf-stalk, (The **only** plant in common **cultivation** likely to be **confused** with this plant is *Hydrangea,* which has similar inflorescences; but the central flowers of. the Guelder Rose are designed on the same plan as those of the Elder, and have five stamens each, whereas those of *Hydrangea* have from eight to ten stamens each.)

*Viburnum OptUus* is a shrub, from nine to fifteen feet in height, which emits from its base many ascending shoots that give off slender hairless branches*

The opposite, four - ranked leaves are simple (Fig. 311). At the base of the leaf on each side are two thread-like stipules. At the tip of the stipub is a gland which is often basin-like;

**Leaves.**

Fig. 511.-Shoot of **Guelder** Rose.

Fig. 512. Twig of Guelder Rose in Winter.

1 u higher up the lo.f-.tnlk ther, stand larger b^Kke &*& supported on very Bfaort .talks, these gten^ g sl;il,a ,.. ...-rete 100* bl tlu,ir utility to the plant is eatfcdy unkno^. Th, leaf-blade has three or five pointed lobes, and th, vei^ tends to be palmate at ... '" \j only on the lower face does the b huU possess hairs, which are s arranged along the

The egg-shaped resting-bud (Fig. 5 ... , 1, y whiHl " enveloped by a divided tetP t«0 n-r often the tip, and probably represents two united scales.

The showy inflorescences (Fig. 513) terminate foliaged shoots of the current year, and are repeatedly branched, more »r fefiB flat-topped, cdlectfcassof Rowers, whiih open in June.

The flowers assume two forms.

The central flowers are small, white, and regular; moreover, each is designed like the flower of *Vikurnum Laiitana.*

The marginal flowed aj<5 conspicuous, V» ,nd\)m, wlmt invgntar; each has ***** &ye greeil sepaia; five some-what ir[•cglIia]-T spreading petals, Flowers· Ued at the base to form a short tube; ~ small sterile stamens shou,nK h ve ver > t denot, the :mthers; ^ ^ve llin s tha g these ^^ ^ timversally do-a ^ ^ ^y s fa ^ ^ ovar>, wMch, is an ovule capped bv iwu or three stigmas ^ pp fiowera ^ (nKuniv cr ?» ^ ^ attract the notice ^d"fe,%t "W of i n ^ but the central ones «J<"in"fttio" prince seed. Bees W & flies arid flo e nectar excreted by b? ;, i,k *Zl* lies above the ovary. Cross- /'; an lf-pillinatinn are both possible, as 1 ". st "d Stigma ripen sLmultaneously.

The ovary becomes a vivid red fruit (Fig. 517) c inin a single

The "lto^Ho- has a cultivated double-variety known as thc iiwh:iiMr ee"

Pl«. 513- Inflorescences of Uuelder Rose.

2 A

Fig. ««*— GUELDER *DSE-VIBURNUM OPULUS.

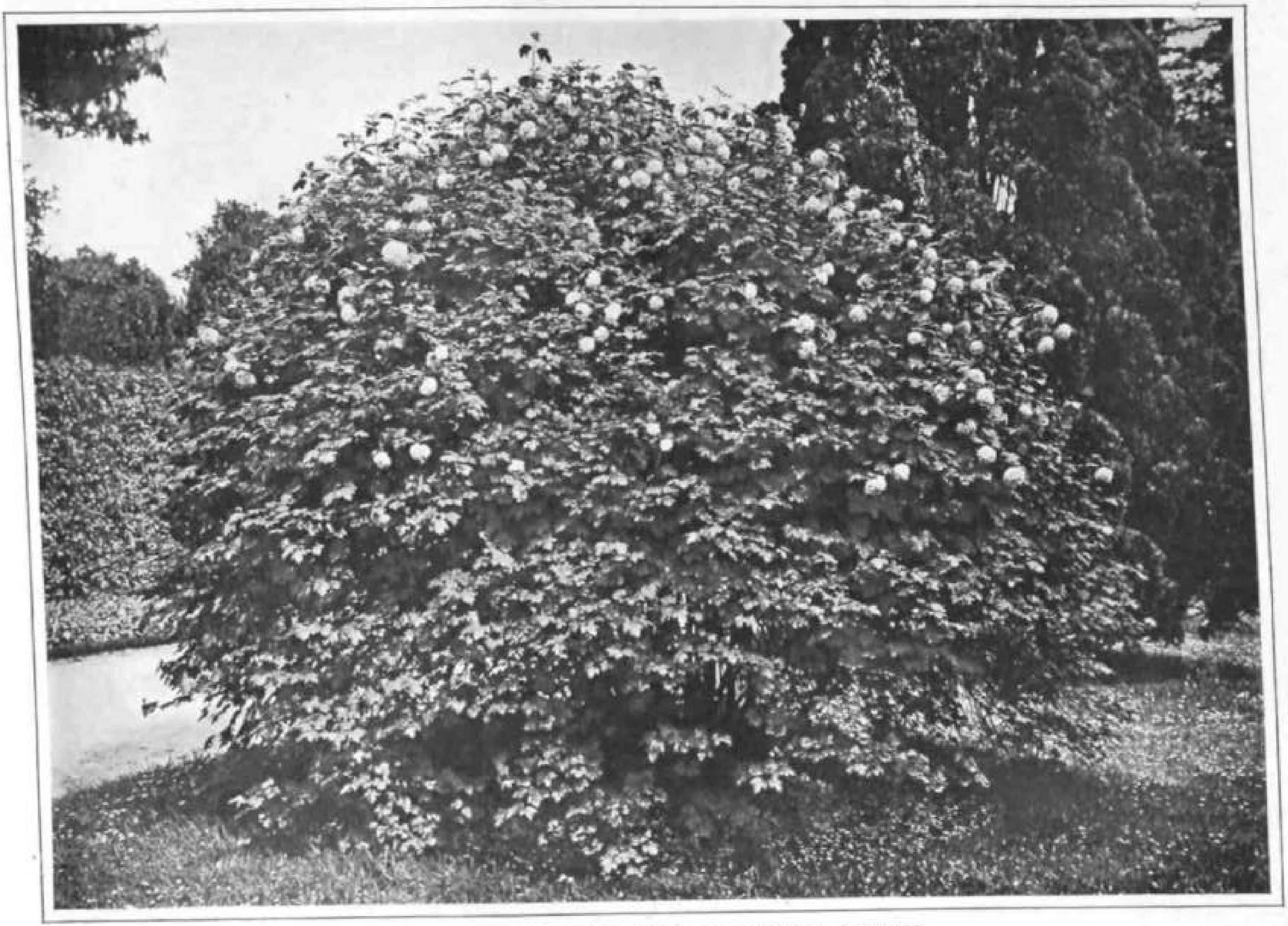


Fig. 515.—SNOWBALL-TREE—*VIBURNUM OPULUS.*

(Figs. 515 and 516). It **Should** *W.* iwted tlmt tliis "doubling*' **is** quite **different** from that in the Cherry. The double **blossom** *oi* the **Cherry** is one **flower** that possesses an abnormal **number of** petals ; **the dtnable-blDsaoH] of** the Snowball-tvee is **an inflorescence** in which all the flowers* arc **changed** into **marginal** (sterile) rlowois. A tree of tliis **latter** kind am **be** propagated only by cuttings.

**f%* s 16.-Inflorescences of Snowball-tree.**

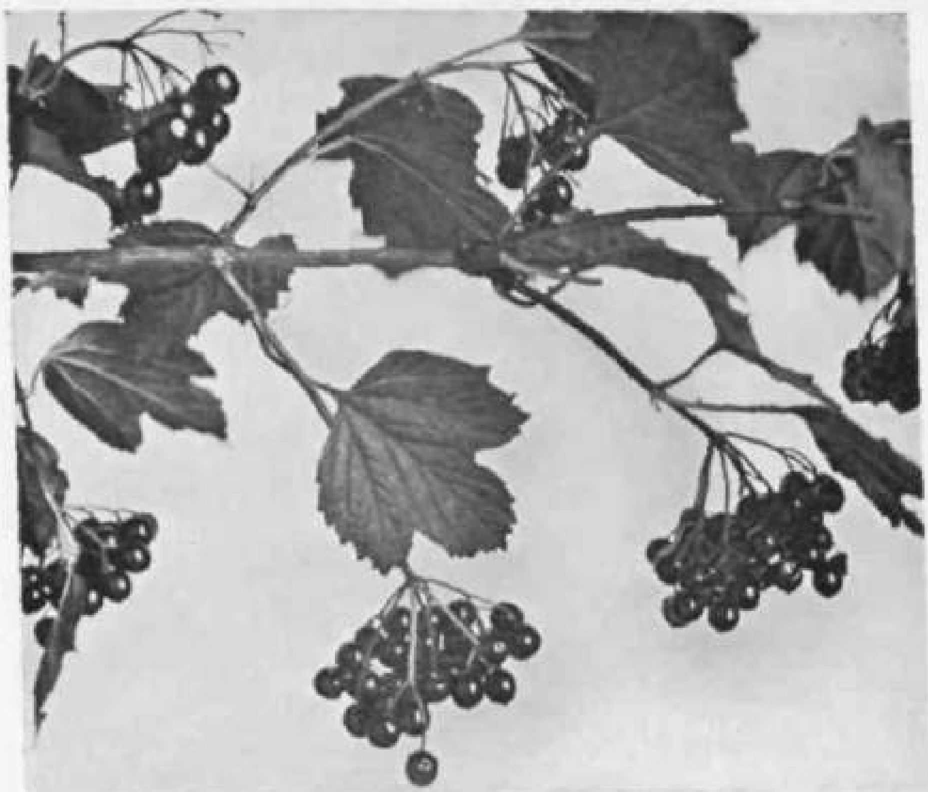


**Fig. 517.—Fruits of Ouelder Rose.**

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