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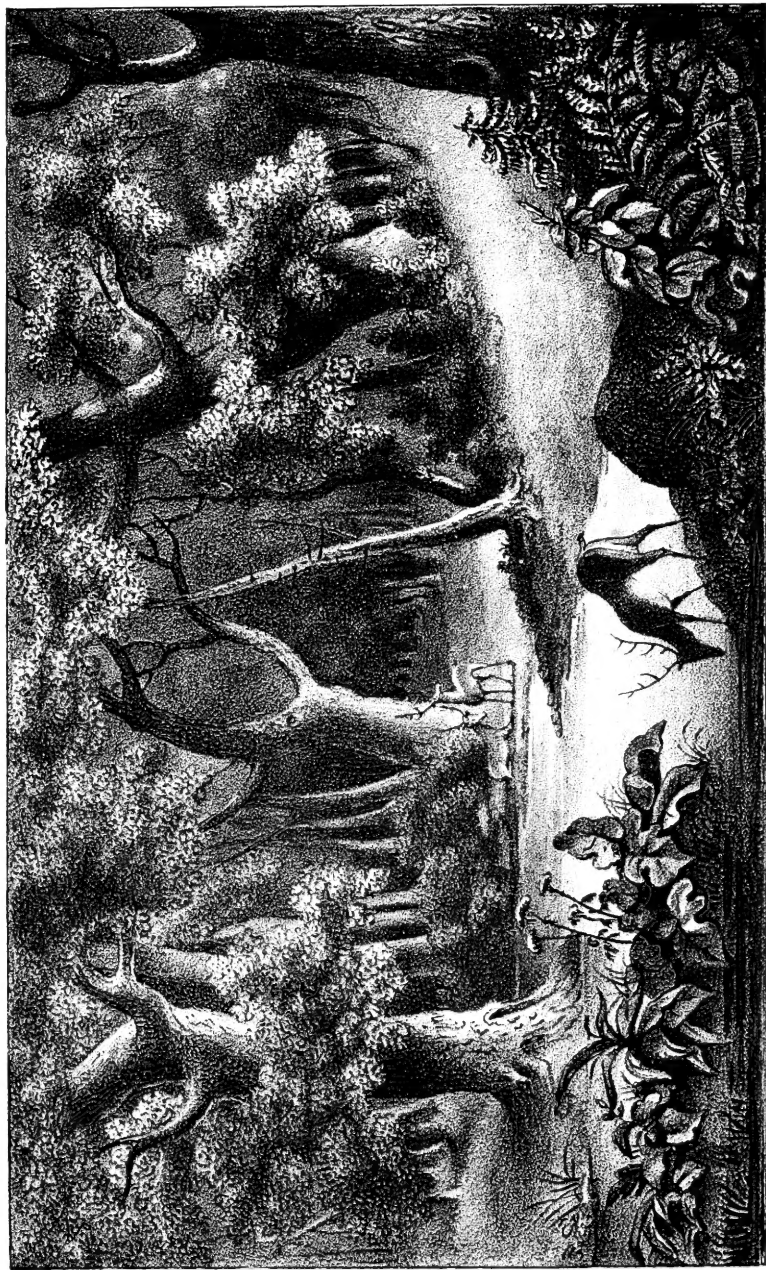
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Drawn by Edwards

FRONTISPIECE.

At the Sign of the Lion

THE
SYLVA AMERICANA;

OR

A DESCRIPTION OF THE FOREST TREES

INDIGENOUS TO THE

UNITED STATES,

PRACTICALLY AND BOTANICALLY CONSIDERED.

ILLUSTRATED BY MORE THAN ONE HUNDRED ENGRAVINGS.

By **D. J. BROWNE.**

.... arbore sulcamus maria, terrasque admovemus
arbore exadificamus lecta.

PLINII SECUNDI: *Nat. Hist.*, lib. xii.

BOSTON:
PUBLISHED BY WILLIAM HYDE & CO.

M DCCC XXXII.

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PRESS OF JAMES LORING.

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TO THE
MASSACHUSETTS HORTICULTURAL SOCIETY,
WHOSE
ZEALOUS AND ENLIGHTENED EFFORTS
HAVE
SO GREATLY CONTRIBUTED TO THE ADVANCEMENT
OF
HORTICULTURE IN THIS COUNTRY,
THIS WORK
IS
MOST RESPECTFULLY INSCRIBED
BY
THE AUTHOR.

MASSACHUSETTS HORTICULTURAL SOCIETY

1890

REPORT AND COLLECTION FOR THE

YEAR

1890

MASSACHUSETTS HORTICULTURAL SOCIETY

1890

MASSACHUSETTS HORTICULTURAL SOCIETY

P R E F A C E.

AMONG the variety of useful and interesting productions abounding in this vast continent, none claim our attention in a more eminent degree than the indigenous trees of our forests. Independent of ornamenting the earth and of furnishing us with timber and fuel, they arrest the progress of impetuous and dangerous winds; maintain the temperature of the air by diminishing extreme cold, and regulating intense heat; oppose the formation of ice, and shelter the earth from the scorching rays of the sun; produce an abundance of water in the streams, and oppose a barrier to washing away or undermining their banks; preserve and enrich the soil on hills and mountains; discharge the electricity of the atmosphere; and serve as laboratories for purifying the air we breathe.

The trees of our country recall the idea of it in the most forcible manner, wherever we meet them; and are often the first objects that attract the attention of those who have been long absent from their native land, and who, on their return, pour out their genuine effusions of joy on beholding them. We are aware that many an American has sighed under the shade of the banana for a sight at the village elm, the well-known oak, or the unchanged pine of New England. We are told of a young Indian, Pontaveri from Otaheite, who, amidst the splendor of Paris, regretting the simple beauty of his native island, sprang forward at the unexpected sight of a banana tree in the Garden of Plants, embraced it, while his eyes were bathed in tears, and exclaiming with a voice of rapture....“ Ah! tree of my native country!” seemed by a delightful illusion of sensibility, to imagine himself, for a moment, transported to the land which gave him birth.

In the United States, there are more than 140 species of forest trees, which exceed 30 feet in height: in France, there are but 30 trees that attain this size, of which 18 enter into the composition of the forests, and 7 only are employed in building. Though vast tracts of our soil are still veiled from the eye of day by primeval forests, the best materials for building are nearly exhausted. And this devastation is now become so universal to supply furnaces, glass houses, factories, steam engines, &c. with fuel, that, unless some auspicious expedient offer itself, and means be seriously and speedily resolved upon, for a future store, one of the most glorious and

considerable bulwarks of this nation will, within a few centuries, be nearly extinct. With all the projected improvements in our internal navigation, whence shall we procure supplies of timber, fifty years hence, for the continuance of our navy? The most urgent motives call imperiously upon our government to provide a seasonable remedy for such an alarming evil: from a government like ours, which is the faithful expression of the public will, and which has no concern but the prosperity and honor of a nation, prospective wisdom is demanded.

From the sensible decay and general havoc made in our forests, we should be reminded, that such as do yet remain entire, may be carefully preserved, and the loss of such as are destroyed, sedulously repaired. There is no part of husbandry which men more commonly neglect than that of planting trees, without which, they can neither expect fruit, ornament or delight from their labors. But they seldom do this till they begin to be wise, that is, till they grow old, and find by experience the prudence and necessity of it. When Ulysses, after a ten years' absence, was returned from Troy, and found his aged father in the field planting trees, he asked him, "Why, being now so far advanced in years, he would put himself to the fatigue and labor of planting that, of which he was never likely to enjoy the fruits? The good old man, taking him for a stranger, gently replied, "I plant against my son Ulysses comes home." The application is obvious, and instructive both to old and young.

It seems hardly possible for any mind to become so debased as to be insensible to the effects of nature, whose vegetable charms become endeared to us as our age and reflection increase. But the more terrible the sight, and the more violent the impression, the more agreeable is it to a greater portion of mankind, who run with avidity after objects of horror, while they pass unnoticed those which produce gentle and agreeable sensations; and it seems to all appearances, that they would rather tremble at the awful thunderbolt of Jupiter, than calmly admire the bounteous horn of plenty; and many who will not cross their thresholds to look at a beautiful scene of nature, will eagerly rush forward to get a sight at a storm or shipwreck in the play house. A more delightful cabinet of natural history can scarcely be found than the forest or plantation affords. It offers matter for contemplation of the most agreeable kind,

Which varies still as seasons still revolve;

and as every tree and shrub has its peculiar inhabitants, we have at the same time a collection of animal and vegetable wonders, sufficient to occupy all the leisure which our economical duties allow us. Every tree we plant adds to the entertainment, which we are preparing for future years, for ourselves, our friends and our country.

Under the foregoing circumstances the author of this work has been induced to compile the *Sylva*, the object of which is to furnish the public with the history of all the important species of forest trees indigenous to

the United States, treating of their uses and application to the arts with the most approved modes of their culture and propagation.

He flatters himself that the course he has pursued in the execution of his task will be found more practically useful than if he had followed a more scientific path. He has been anxious to render his work acceptable to the great body of American agriculturalists, whom he most ardently entreats to turn their attention to the delightful and important pursuit of Arboriculture.

He does not claim or aspire to entire originality, but has consulted the most judicious ancient and modern works on the subject, a list of which is given on the succeeding page.

He is sensible that the task he has chosen is a responsible one; and he confidently ventures before the public with the hope, that a generous allowance will be made for its unavoidable imperfections, when the extent of the undertaking is considered; premising, that any errors into which he may have been inadvertently led, will be cheerfully corrected when apprized of their existence.

It is evident, from the nature of this publication, that little of it belongs to the Author. As a compiler he has endeavored to be faithful; and, in collecting facts, he has selected such as would be deemed the most useful; but whether he has made use of the proper materials must be left for a candid and enlightened public to decide.

THE AUTHOR.

BOSTON, APRIL, 1832.

List of Works which have been consulted.

The names of authors are given in many instances in this work, but in general the quotations are so much altered, or taken from so many sources, that it could not be done with convenience. The principal works consulted, or from which extracts have been made are as follows: Bigelow's Medical Botany, Bigelow's Sequel to the Pharmacopœia of the U. S. Darwin's Phytologia, Decandolle's Philosophy of Plants, Du Hamel, Evelyn's Sylva, Keith's Physiological Botany, Lemprière's Lectures on Natural History, Library of Useful Knowledge, Linnæus' System of Nature, Loudon's Encyclopædia of Agriculture, Loudon's Hortus Britannicus, Michaux' North American Sylva, Miller's Gardener's Dictionary, Mirbel *Traité D' Anatomie et de Physiologie Vegetales*, Nuttall's Introduction to Botany, Philosophical Transactions of the Royal Society of London, Pursh's North American Flora, Smith's Introduction to Physiological and Systematic Botany, Sylva Florifera, Sylvan Sketches, Transactions of the London Horticultural Society, Waterhouse's Botanist.

SYLVA AMERICANA.

PART I.

VEGETABLE PHYSIOLOGY.

By a vegetable, we mean an organized body possessing vitality, power of growth and reproduction, deriving its nourishment directly from the earth, or from substances in which earthy matter is more or less present, but without perceptive powers, or voluntary locomotion; the two latter properties belonging exclusively to animals, and forming the principal line of distinction.

Hence every living substance of the above description, whether it be a tree, a shrub, an herb, a grass, or a flower, is in reality a vegetable; and the whole, taken together, constitutes what is termed the vegetable kingdom. Of these, nearly one hundred thousand species, each possessing its own peculiarities, form and laws, have already been discovered, and the list is annually increasing. The subject, therefore, independently of its practical application, is one of deep interest and importance; and the more it be examined, the greater field we find for inquiry, and an increased reason for admiring the contrivance, wisdom and benevolence, by which this interesting portion of the universe has been regulated.

To describe each particular organ of a vegetable, is denominated *the anatomy*, and to enter upon the functions of those organs with the results, *the physiology* of vegetables. To explain their component or constituent parts, belongs to the province of *vegetable chemistry*. And to treat on the sources by which their growth is promoted, and their productions increased, comes under the head of *chemical agriculture*, or *agricultural chemistry*.

From the great similarity and strong analogy of the laws of the vegetable and animal kingdoms, many modern philosophers have considered the vegetable and animal kingdoms united by one link, and forming a part of the same system; or, in other words, that a vegetable is only an inferior order of animal. But admitting how nearly in many instances the laws of each approximate, and how greatly a knowledge of the one facilitates that of the other; yet the more frequent presence of perceptive powers, and more especially of a choice and capacity of motion in the one kingdom, and a total abstinence of those qualities in the other, present so broad and strong line of distinction, as should make us pause before we admit a doctrine directly at variance with our common observation, and so opposed to the idea we have entertained of the intents and purposes of creation. All that we ought to allow, is that resemblance only in the physical properties and laws of the two kingdoms, by which the vitality peculiar to each is preserved, the different parts are nourished, growth promoted, secretions produced, reproductions effected, and the common principles of decay and dissolution are brought into action. But *here* their analogy ceases.

Vegetables, we know, require a particular temperature, season, soil and aspect, for their growth and maturity, and, in many instances, even for their very existence. In cold climates, they are, in consequence, proportionably limited in the number of their species; and, in the winter, even of temperate regions, many of their functions are suspended; they cease to grow, they part with one of their most essential organs, their leaves, and they require the return of a more congenial season, before their variously animating powers are again roused into action. Animals, on the contrary, so long as the vital principle be

continued, preserve their various functions in full activity and similitude, in whatever temperature, season, soil, or aspect, they may be placed ; and a loss of any of their important organs, or a considerable interruption to the functions of the others, very frequently terminates in their general dissolution.

Vegetables, again, have not a brain and nervous system to endow them with perceptive powers, or, as far as we can judge, with sensation ; nor muscles to promote their locomotion, so necessary to most animals which are to make choice of their food, and whose means of supply are not confined to a narrow circle as in vegetables, in which nature by their peculiar mechanism, has bestowed on them the means of obtaining their nourishment from the soil which first gave them birth. For this purpose the latter are permanently fixed to one spot in the earth, and the vital spark having once been excited, their different movements are rendered dependent upon principles, in which the will has no concern, and where perception cannot be required.

These reflections necessarily lead us to a consideration of the structure and functions of vegetables, in which the analogy of the two kingdoms will be further illustrated, and of the line of distinction, we hope, satisfactorily explained.

To consider vegetable physiology in all its relative bearings, it will be requisite to divide the subject into four distinct heads. First, the structure and functions of those parts of a vegetable which contribute to its nourishment and preservation, including the root, trunk, branches and leaves. Secondly, of those organs which are necessary to its reproduction, and these have reference to the flower, fruit and seed. Thirdly, the process of generation and germination, of the food and agents effecting its growth, and the formation and completion of a new plant. And lastly, the casualties affecting the life of vegetables, consisting of wounds, diseases, natural decay and renovation.

But previously to entering into a particular description of the several organs, it will be proper to observe that vegetables, like animals, are composed of fluids and solids. The fluid parts produce those which are solid ; and the only aliment which

effects and preserves plants, being in a liquid or aereform state, it is wonderfully contrived that there should be an organic vascular system for its distribution, and that it should likewise possess the vital power of assimilation, in order to effect and perpetuate the growth which takes place, and to diversify the products which characterize the innumerable variety of plants which constitute the vegetable kingdom.

GENERAL TEXTURE OF PLANTS.

Much light has been thrown upon the general texture of vegetables, by the microscopic figures of Grew, Malpighi and others, but more especially the observations and highly magnified dissections of M. Mirbel. From preceding writers we have learned the general tubular or vascular structure of the vegetable body, and the existence of some peculiar spirally-coated vessels in many plants. On these slender foundations physiologists have, at their pleasure, constructed various theories, relative to the motion of the sap, respiration and other functions, presumed to be analogous to those of animals. The anatomical observations of Mirbel go further than those of Grew, &c., and it is necessary to give a short account of his discoveries.

He finds, by the help of the highest magnifying powers, that the vegetable body is a continued mass of tubes and cells; the former extend indefinitely, the latter frequently and regularly interrupted by transverse partitions. These partitions being in the corresponding cells, and each cell increasing somewhat in diameter after its first formation, except when restrained by the transverse partition, seems to account for the hexagonal figure.* The membranous sides of all these cells and tubes are very thin, more or less transparent, often porous, variously perforated or torn. Of the tubes, some are without any lateral perforations, at least for a considerable extent; others pierced with holes ranged in a close spiral line; in others several of these holes run together, as it were, into interrupted spiral clefts; and in some,

* For illustrations of this part of the subject, see Plate I.

those clefts are continued, so that the whole tube, more or less, is cut into a spiral line; which, in some young branches and tender leaves, will unroll to a great extent, when they are gently torn asunder. The cellular texture especially is extended to every part of the vegetable body, even into the thin skin, called the epidermis, which covers every external part, and into the fine hairs or down which, in some instances, clothe the cuticle itself.

Before we offer any thing upon the supposed functions of these different organs, we shall take a general view of the vegetable body, beginning with the root, the first organ to be described.

CHAP. I.

ANATOMY OF THE ROOT.

The root, which, though often differing in its bulk and shape, is similar in all its structure and use, (with the exception of the bulb, which, from containing the rudiments of a new individual, may more properly be considered a variety of the seed,) is that part of the vegetable which fixes the plant to the ground, is its organ of nourishment, and the apparatus by which, through its various ramifications, below the surface, it imbibes food from the soil.

In its structure, it is composed of the same parts as the stem and branches, and therefore may only be considered as the stem inverted; the lower portion of the tube dipping into the earth, and forming itself into minute ramifications without leaves; and the upper portion ascending, and producing buds, branches and leaves. This has been illustrated by experiments made upon the plum, cherry and willow, in which, by inverting the stem and root, the former has become a root, sending out ramifications, and the latter a stem producing leaves, flowers and fruit. The structure of the root and stem is therefore one and the same thing, and it is the situation in which each is placed, and the operation of the surrounding medium, that makes the difference; giving to each, a variation in its chemical and medicinal properties though their physical structure continue the same.

The main body of the root, which has been termed *the caudex*, upon its first penetrating the ground, possesses but very limited powers of affording nourishment; and it is not until it has sent forth its ramifications or *radiculae*, and these ramifications have issued still finer filaments of capillary diameter, that an extensive absorption can be effected. These minute tubes, by dipping into the soil in the direction where there is the least opposition, abstract from it, by some undiscovered process, those nutritive parts, which, through the agency of water, become sap, and convey it to the caudex, from whence it rapidly ascends to the stem and branches, and thence to the uttermost extremity of the leaves, there to undergo a new modification to be hereafter explained. The root therefore may be considered as acting the same part towards the vegetable, as the stomach does to the animal; though the apparatus and the fluid prepared, bear but little similarity.

OF THE TRUNK OR STEM.

In cutting the trunk of a tree from the circumference to the centre, the instrument passes through seven distinct parts, in the following order:

1. *The epidermis*, which extends over the surface of every vegetable, as before described. It is also called *cuticle*, *false skin* and *the like*, names which anatomists have given to the external covering of animals. There is a striking analogy between the animal and vegetable cuticle or skin. In the former it varies in thickness from the delicate film which covers the eye, to the hard skin of the hand or foot, the coarser covering of the ox, or the hard shell of the tortoise. In the latter it is exquisitely delicate, as in the covering of a rose leaf, and hard and coarse in the rugged coats of the elm and oak. In the birch, you may see the cuticle peeling off in circular pieces. The vital principle seems wanting in it; this is the only part of a living plant which is dead. In the larger trees and shrubs, the bodies of which, in themselves, are strong and of firm texture, the latter property is not of so much importance; but in the reeds,

the grasses, the canes with hollow stalks, and in the various farrinaceous seeds, where it is most essential that their structure should be protected from the action of insects; nature, to render it more strong and resisting, has given it a glassy rind of network, composed principally of a silicious earth, which Sir H. Davy has ascertained in many instances, is capable of striking fire upon the application of the steel.

2. *The cellular integument*, which lies immediately under the cuticle, and is for the most part of a green color, at least in the leaves and branches. This is in general the seat of color, and in that respect analogous to the *rete mucosum*, or pulpy substance situated under the human cuticle, which is pale in the European, black in the Negro, and red in the American; but we must carry the analogy no further, for these two parts perform no functions in common. Du Hamel supposed this pulp to form the cuticle; but this is improbable, as his experiments show, when that membrane is removed, that the cellular integument exfoliates, at least in trees, or is thrown off in consequence of the injury it has sustained, and a new cuticle, covering a new layer of the same succulent matter, is formed under the old one. Annual stems or branches have not the same power, any more than leaves.

Mirbel remarks that "leaves consist almost entirely of a plate of this substance, covered on each side by the cuticle. The stems and branches of both annual and perennial plants are invested with it; but in woody parts it is dried up and reproduced continually, such parts only having that reproductive power. The old layers remain, are pushed outward by the new ones, and form at length the rugged, dry, dead covering of the old trunks of trees."

The petals of flowers are almost entirely composed of cellular texture, the cells of which are filled with juices fitted to refract and reflect the rays of light, so as to produce the brilliant and delicate tints which constitute so great a portion of their beauty.

3. *The cortex or true bark* of the plant, known to every one by the name of *bark*. It consists of but one layer in plants and branches only one year old, and often not distinguished from

the wood. In the older branches and trunks of trees, it consists of as many layers as they are years old.

The bark contains a great number of woody fibres, running for the most part longitudinally, which give it tenacity, and in which it differs very essentially from the other parts. These woody fibres when separated by maceration, exhibit in general a kind of net-work, and in many instances great regularity and beauty of structure.

In the bark the peculiar virtues or qualities of particular plants chiefly reside, and more especially in several of its internal layers nearest to the wood. Here we find in appropriate vessels the resin of the fir and juniper, the astringent principle of the oak and willow, on which their tanning property depends, the fine and valuable bitter of the Peruvian bark, and the exquisitely aromatic oil of the cinnamon. The same secretions do indeed, more or less, pervade the wood and other parts of these plants, but usually in a less concentrated form.

4. *The liber*, which is the inner layer of the cortex or bark. It consists of *laminæ* or plates, bound together by a cellular matter, which, when dissolved by maceration in water, detaches these plates or coatings from each other; when they resemble the leaves of the books of the ancients; whence arose the name of *liber*. The liber is softer and more juicy than the cortex.

It is in this layer only that the essential vital functions are carried on; after a while it is pushed outward with the cellular integument, by the successive formation of new layers, and with the cellular integument finally becomes a lifeless crust. Grew, Malpighi, Du Hamel and others, supposed that the liber annually changes, by hardening, into the *alburnum* or young wood, an opinion also maintained by Mirbel, and some of the ablest philologists, but which is founded upon mistaken principles. It is through the liber, however, that the matter in which the new wood is formed, which annually augments the diameter of the trunk and branches, is secreted; and hence the importance of this portion of the bark.

As the net work formed by the dividing threads of the meshes is not readily dissolved in water, while the cellular matter which

fills them up is remarkably soluble, the liber of some plants, as the Lace tree, (*Daphne Lagetto*), when soaked in water and afterwards beaten, forms a very beautiful vegetable gauze; which may be used as an article of dress. A coarse specimen of this gauze, or lace, is seen in the bark of many of our indigenous trees, particularly the oak, when it has been long exposed to the weather, after being separated from the trunk. The natives of Otaheite manufacture garments from the liber of the mulberry. The liber of flax is by a more refined process converted into linen. This regular arrangement, however, of the longitudinal texture of the liber is not found in every instance; for on the fir and some other trees, the longitudinal threads are seen lying nearly parallel to one another, without any meshes or intervening cellular matter.

This part of the bark is important to the life of vegetables; the outer bark may be peeled off without injury to them, but the destruction of the liber is generally fatal. The operation of *girdling* trees, which is often practised in new countries, consists, in making with an axe, one or more complete circles through the outer bark and the liber of the trunk. Trees seldom survive this operation, especially if it has been performed early in the spring, before the first flow of the sap from the root towards the extremities.

5. *The alburnum, or sap wood*, which may be considered the grand vascular organ of the plant, which is made up of cells and tubular vessels; the cells being constantly filled with the rising sap, which, after undergoing some changes, is taken up by the tubes and conveyed to the leaves to their utmost extremity; and having from them received a new modification, the sap is returned by the cortical vessels back to the trunk, and thence to the minutest filaments of the roots.

The alburnum is at first soft and vascular; but it afterwards becomes hard, and in some trees, is of a density almost equal to iron. While in the soft state, it is endowed with nearly as much irritability as the liber, and performs functions of great importance in the vegetable system; but when hardened, these functions

cease, and in time it loses even its vitality ; not unfrequently decaying in the centre of the trunks of trees ; which, often, still flourish, and put out new shoots as if no such decay existed. To carry on, therefore, the functions of the wood, a new circle of it is annually formed over the old ; and thus, also, the diameter of the trunk and branches present, by the number of these annual zones, a pretty correct register of their age, each zone marking one year in the life of the part. The hardness of these zones of wood increases with the age of the tree, being most dense in the centre, and less and less hard as they approach the circumference.

Various opinions have been entertained respecting the origin of the alburnum. Mr. Knight, however, by various experiments, has satisfactorily proved that it is formed from the secretion deposited by the vessels of the liber, but that it is not, as had been supposed by Du Hamel, Dr. Hope and Mirbel, a transmutation of the liber itself.

Mr. Knight is of opinion, that the bark deposits the alburnous matter ; but that the leaves are the organs in which this matter is elaborated from the sap ; or, that the alburnum is generated from the *cambium* of Grew, which is part of the proper juice of the plant, formed by the exposure of the sap to the light and air in the leaf, and returned from it by the vessels that pass down from the leaf into the interior bark, by which it is deposited, and we may add, elaborated by the action of the vital principle inherent in this part of the plant. To determine this point, he removed narrow circles of bark from roots of apple trees, "leaving a leaf between the places where the bark was taken off ; and on examining them frequently during the autumn," he found that the diameter of the shoot between the insertion of the leaf stalk and the lower incision, was as much increased as in any other part of the tree ; but when no leaf was left "on similar portions of insulated bark, on other branches of the same age, no apparent increase in the size of the wood was discoverable."

These experiments explain the reason why trees and shrubs having their leaves destroyed by caterpillars form scarcely any new wood in that season ; and, indeed, every one who has

pruned a tree, or shortened a growing twig, must have observed that the part above the last leaf always shrivels and dies, while all below it continues to live and increase in diameter.

6. *The lignum, or heart wood*, which, when present, is seated below the alburnum, seems principally intended, (like the bones of animals,) to give solidity, form and support to the more solid parts of the plant, and is mostly observable in old trees.

Substantial as is the wood or ligneous part of a tree, it is nevertheless so far from being an essential part, that many plants are without it. The arundaceous plants, as the reeds and the grasses, and, indeed, all the gramina, are naturally hollow.

7. *The medulla, or pith*, which is a soft and spongy, but often succulent substance, occupying the centre of the root, stem and branches, and extending in the direction of their longitudinal axes, in which it is inclosed as in a tube. In its structure it is exactly similar to that of the cellular tissue of the bark; being composed of an assemblage of cells, containing a watery and colorless fluid. Its form is regulated by that of the cavity it fills, which in the majority of instances is nearly circular; but to this there are many exceptions. Thus in the horizontal section of a young stem of the elder (*Sambucus*) and the plane (*Platanus*), we find it circular, but furrowed by the bundles of the spiral vessels of the part that surrounds it. In the ivy and ash it is oval; irregularly oval and furrowed in the plane; triangular in the oleander (*Nerium Oleander*); pentangular in the European oak (*Quercus Robur*); four-sided, with the angles obtuse, or tetragonal, in the common lilac, and yellow-flowering horse chesnut (*Æsculus Flava*); and pentagonal in the walnut (*Juglans regia*). But besides the diversities of form which the pith presents, it varies in diameter in other respects. In the young tree, of a few inches in height, it is smallest at the basis of the stem, largest in the middle, and smaller again at the summit; and in the growth of each future year, nearly the same variations in its diameter are observable. In trees more advanced, pressed and acted upon by the heart wood, it begins to diminish; and in very old trees it disappears altogether.

Linnaeus attributes great importance to the pith, and erroneously

asserts, after Bradley, that it gives birth to the buds. Some botanists of the first rank believe, that the pith is, in a plant, what the brain and spinal marrow are in the inferior order of animals. "The pith," says Darwin, "appears to be the first or most essential rudiments of the new plant, like the brain, spinal marrow, and *medulla oblongata*, which is the first visible part of the figure of every animal fœtus from the tadpole to mankind." It seems, however, that the pith is not essential, or absolutely necessary to vegetation, as we often observe trees to live and thrive without it. The guaiacum or lignum vitæ, it is said has no pith. Most naturalists, however, consider the pith only of secondary importance; though they allow its use in making good the nutritive exhaustion which the rapid growth of young shoots never fails to produce.

OF THE BUDS.

No part of the vegetable structure has been examined with more accuracy than that of buds, (*Gemmæ*), from the time of the faithful and diligent Grew, to that of the discriminating and candid Knight, and yet it is very singular that little was known of their physiology until the experiments and observations of the last gentleman were made public. To him, therefore, we are indebted for some of our most valuable knowledge on this subject.

A bud is that part which contains the rudiments of a plant, or of a part of a plant, for a while in a latent state, till the time of the year, and other circumstances, favor their evolution. From buds, then, an entire plant may be produced, if placed in favorable circumstances, or only a branch, or leaves, or flowers. We can, however, reckon no more than two kinds, those that produce leaves, and those that produce flowers. There is the closest analogy between these organs and bulbs; so close, indeed, that Mirbel, and some others, arrange them together. Practical cultivators mark distinct characters peculiar to each kind of bud. Those that produce leaves are small, long and pointed; the flower buds, again, are thick, short and round. It appears probable that some unknown agents influence the

formation either of flower buds or of leaf buds, or rather that some circumstances will cause the evolution of either of them from the same bud. A fact recorded in the Linnæan Transactions in some measure favors this opinion. The *Solandra grandiflora*, a native of Jamaica, had been long cultivated in the English stoves, and propagated by means of cuttings; but none of the plants ever displayed any signs of fructification. They had been always well supplied with water. One plant, by accident, was left without being watered in the dry stove at Kew: the consequence was, that the branches were much stunted in their growth, and flowers were produced. The experiment has been frequently repeated with success. It appears, that whatever checks the luxuriance of the leaves, tends to the formation of flowers and seeds.

For the purpose of converting leaf buds into flower buds, various expedients may be used with advantage: such as scoring the bark to the wood very deeply with a knife, twisting a wire tightly round the stem, or by cutting off a cylinder of the bark, and replacing it with a bandage.

It is said that there is an intermediate species of bud, which retains some of the characters of each. A striking difference has been noted between the leaf and the flower buds; the first may be removed with impunity from its original situation, and placed in the earth, where it will vegetate with luxuriance; but the last uniformly dies. Both may be removed to another stock with success. This operation is called budding, or inoculation, and is well known to gardeners. Each bud may be considered a distinct being, containing parts precisely similar to those of the parent tree, which, when favorably situated, will develop themselves, and form a plant retaining all the peculiarities of the parent. If those qualities are such as will constitute a variety, they will also be perpetuated; and of this, we have many familiar examples in the various fruit trees commonly cultivated in our gardens, on many of which, budding is the only means of procuring good fruit. The branch formed by the inoculated bud alone yields proper fruit; nor is the stock, on which the budding has been performed, in the least degree

altered. The crab, on which the finest apple has been budded, still remains a crab: thus proving, that it serves merely as a source from which the young bud derives its nourishing matter; although it is highly probable, from the difference of the results, that, that matter undergoes some peculiar elaboration, after leaving the vessels of the original stock. On this principle, five or six different species of fruit have been known to be budded on the same tree, and which, in full fruit, exhibited a singular and beautiful spectacle. It is impossible to say how a bud torn from one tree, and put in the place of another bud in another tree, should become a perfect branch, producing flowers and fruit in the highest perfection; but attempts have been made to trace the various steps of nature in effecting her operations. Accordingly it is said, that after the fresh bud has been inserted into the wound, formed by the extraction of another bud, that the *cambium* unites the two parts, forms a connecting medium for the vessels of the bud and the tree, and thus enables the vegetative process to go on whenever nature requires it. Mr. Knight has noticed some facts worthy of record; and he states that "a line of confused organization marks the place where the inserted bud first comes into contact with the wood of the stock, between which line and the bark of the inserted bud, new wood, regularly organized, is generated. This wood possesses all the characteristics of that from which the bud is taken, without any apparent mixture with the character of the stock in which it is inserted. The substance which is called the *medullary process*, is clearly seen to spring from the bark, and to terminate at the line of its first union with the stock."

The usual position of buds is in the axil of the leaves, except in the genera *Mimosa*, *Gleditschia* and a few others. The buds are opposite to each other when the branches or leaves are opposite, alternate when the latter are alternate, and terminal when the leaves are terminal. In those plants that have both opposite and alternate leaves or branches, the buds are commonly solitary.

Various forms are assumed by different buds, according to those of the contained leaves; an admirable adaptation of

convenience to beauty and regularity being always preserved. Nature has given different coverings to different vegetable productions, according to the peculiarities of their respective climates. In northern regions, the buds are almost universally clothed with scales, or with a downy substance; sometimes these are conjoined, besides being coated with a resinous matter. The horse chesnut and some of our walnuts are good illustrations of large and well-formed buds. By means of these coverings, the young bud is enabled to brave the vicissitudes of the seasons, and to be ready to burst forth on the first approach of spring. This singular power of retaining its vitality, has been considered by some physiologists as the distinctive character of true buds. The most external of the scales are dry and hard, while those that are more protected from the influences of the weather, are soft and succulent. Take a bud, for instance, of the horse chesnut, and close the part which has been just separated from the stock with wax, plunge it into water, and it will remain there without undergoing any alteration for a number of years.

In mild, or even in warm countries, buds have no scales, as they do not require them. Those trees that form an exception to this observation, can thrive indifferently in any climate; so that the rule holds in all distinct cases. The scales are considered by many as imperfect leaves.

The internal structure of buds is said not to differ, in any respect from that of the plumule, previously to its being detached from the seed. Some have fancied, that they have seen the rudiments of every part of the tree concealed in the bud. We are much inclined to question the accuracy of such very minute observers, and, of course, are more willing to impute any errors to optical deception, than any wish to mislead.

The bark and the pith have generally been considered the source of the buds; but the ingenious experiments of Mr. Knight have set aside both of the hypotheses, and have established, as far as the present state of the science will permit, the doctrine, that they derive their origin from the alburnous portion of the tree. This gentleman first showed, that they do not originate in the pith or bark; and also, that Du Hamel's opinion of pre-

existing germs being their source, is at least improbable. He then proves that the "alburnous vessels at their termination upwards, invariably join the central vessels, and that these vessels, which appear to derive their origin from the alburnous tubes, convey nutriment, and probably give existence to new buds and leaves. It is also evident, from the facility with which the rising sap is transferred from one side of a wounded tree to the other, that the alburnous tubes possess lateral, as well as terminal orifices : and it does not appear improbable, that the lateral as well as the terminal orifices of the alburnous tubes, may possess the power to generate central vessels, which vessels evidently feed, if they do not give existence to the reproduced buds and leaves. And therefore, as the preceding experiments appear to prove, that the buds neither spring from the medulla nor the bark, *I am much inclined to believe that they are generated by central vessels, which spring from the lateral orifices of the alburnous tubes.*" By interrupting the circulation in the alburnum, buds may be artificially produced ; and nature has provided means for their reproduction, in those cases where they may have been accidentally destroyed. Several curious facts on this subject may be obtained by an examination of the potato, which like other tuberous roots, are studded with them.

Buds of all kinds are formed about mid-summer ; after which it has been stated, "that there seems to be a kind of pause in vegetation for about a fortnight." Darwin imagined that a store of nourishing matter is collected during that period, which produces that apparent pause. The season of developement is most usually that of the spring, when nature seems to delight in new products : it is then that the buds are evolved, and enter upon the important functions they are destined to perform. Nothing, however, is known of these functions beyond the general result. Branches, leaves and flowers are produced by buds ; but what are the particular operations by which these effects are produced ? The answer is easy but unsatisfactory. Buds transpire, and in all likelihood produce the same chemical change on the atmosphere with the other parts of the plant.

OF THE BRANCHES.

Branches are the subdivisions of a stem or trunk, which are found on many herbaceous plants, but are chiefly noticed on shrubs and trees. The primary branches spring immediately from the trunk; the secondary ones from the primary; and so on in a regular subordination, till they terminate in slender twigs. They consist of precisely the same anatomical parts as the trunk, and with the exception of a root, are in fact little trees, which, if separated from their parent stock, and planted in the earth under favorable circumstances, would throw out roots, and become independent plants. They proceed from buds formed within the surface of the trunk, which interrupt the parallelism of its fibres, and form knots in the wood. These knots afford a point of support and centre of motion to the growing branches, and are sunk more deeply in the wood in proportion to their age. Branches are supposed to originate from a convolution of vessels; so long as the vascular bundles proceed in an uninterrupted straight line, so long will the stem remain straight; but whenever they form a knot, nature appears to make new efforts, and a branch is produced.

The lower branches are often nearly parallel to the horizon at right angles with the trunk: those above them make angles more and more acute, as they are placed nearer the summit; but these angles differ in different species, and in every individual tree are subject to numerous varieties, from the influence of external causes. Some branches produce only leaf and new branch buds: others produce only flower buds. The former are smooth in their surface, pliable and tough, with close straight fibres, easily separated from each other: the latter are wrinkled at their base, have their fibres less compact, and break short when struck. There are also branches which pierce the bark without a bud, and form what is commonly called false wood. These, as they are often luxuriant in their growth, and rob the more useful branches of their due nourishment, are carefully

pruned away by the skilful planter and horticulturist. They have a rough bark, and produce only a few blackish buds.

OF THORNS.

Thorns are stunted branches; their imperfect form may be owing to the buds being partially evolved, from want of proper nutrition. Indeed, that it is, in a great degree, owing to such a cause, is proved by the conversion of thorns into branches on removal into richer soil. This fact is well known to gardeners, as many fruit trees, which are thorny when wild, become smooth when cultivated. Some times the foot-stalks of pinnate leaves that have fallen off become thorns, as in the case in the *Astragalus tragacantha*, or goat's thorn milk vetch.

OF PRICKLES.

Prickles may be taken off with the bark, and is therefore a mere elongation of that organ, which is chiefly composed of cellular substance, and of cortical vessels. There is this remarkable distinction between the prickle and the thorn, that no cultivation whatever can convert the former into a shoot, as is the case with the latter; for the vessels become very rapidly hard, separate from the stem, and at last is merely retained by the exterior covering. The stipules of some plants are converted into prickles, as in *Berberis vulgaris*, or common berberry.

OF THE FLOWER STALK AND FOOT STALK.

The flower stalk and foot stalk are also composed of cellular texture, of central and cortical vessels, which convey the vegetable juices to and from the leaf.

OF THE TENDRILS.

Tendrils have the same structure as the preceding, and are in fact elongated foot stalks, without the leafy expansion, which

adds to their length; and being unable to support their own weight in a straight line, they assume the spiral form. Willdenow ascribes a considerable influence to the current of air in determining the direction of the tendril.

OF THE SAP VESSELS AND SAP.

Much contrariety of opinion has existed among physiologists concerning the vascular system of plants, and the nature of the propulsion of the sap through their stems and branches. Indeed it is a subject upon which very erroneous ideas have prevailed.

That the whole vegetable body is an assemblage of tubes and vessels is evident to the most careless observer; and those who are conversant with the microscope, and books relating to it, have frequent opportunities of observing how curiously these vessels are arranged, and how different species of plants, especially trees, differ from each other in the structure and disposition of them. Such observations, however, if pursued no further, lead but a little way towards a knowledge of the wonderful physiology of vegetables.

That plants contain various substances, as sugar, gum, acids, odoriferous fluids and others, to which their various flavors and qualities are owing, is familiar to every one; and a little reflection will satisfy that such substances must each be lodged in proper cells or vessels to be kept distinct from each other. They are extracted, or secreted from the common juice of the plant, and called its peculiar or secreted fluids. Various experiments and observations prove also that air exists in the vegetable body, and must likewise be contained in appropriate vessels. Besides these, we know that plants are nourished and invigorated by the agency of water, which they readily absorb, and which is quickly conveyed through their stalks and leaves, no doubt by tubes or vessels on purpose. Finally, it is observable that all plants, as far as any experiment has been made, contain a common fluid, which at certain seasons of the year is to be obtained in great quantity, as from the vine branches by wounding them in the spring before the leaves appear, and this is properly

called the sap, by which the whole body of the plant is nourished, and from which the peculiar secretions are made.

In a young branch of a tree or shrub, or in the stem of an herbaceous plant, are found, ranged round the centre or pith, a number of longitudinal tubes or vessels, called by Mr. Knight central vessels, of a much more firm texture than the adjacent parts, and when examined minutely, these vessels often appear to be constructed with a spiral coat. This may be seen in the young twigs and leaf stalks of the elder, lilac and many other shrubs, as well as in numerous herbaceous plants, as the peony, and more especially many of the lily tribe. If a branch or stalk of any of these plants be partly cut through or gently broken, and its divided portions slowly drawn asunder, the spiral coats of their vessels will unroll, exhibiting a curious spectacle even to the naked eye. In other cases, though the spiral structure exists, its convolutions are scarcely separable at all, or so intermediate as to be only marked by an interrupted line of perforations or slits, as shown by M. Mirbel. Indeed, the very same branches which exhibit these spiral vessels when young, show no signs of them at a more advanced period of growth, when their parts are become more woody, firm and rigid. No such spiral-coated vessels have been detected in the bark at any period of its growth.

Besides the central vessels, Mr. Knight has described another set that traverse the alburnum, whence they are distinguished by the name of alburnous tubes. Through them the sap also ascends; for the destruction of a circle of bark does not prevent the formation of buds and leaves; "but," says Mr. Knight, "the alburnous vessels appear to be also capable of an inverted action, when it becomes necessary to preserve the existence of the plant." The cortical vessels of Mr. Knight, which can hardly be considered the same with the *vasa reducentia* of Willdenow, (although they are said to perform the same function) exist in the bark, and serve to reconvey the circulating sap to the root. It is suspected, that there may be two sets of these vessels, one which nourishes the bark, and another that secretes

particular fluids in the bark. Lymphatic vessels have also been described ; but we have met with no satisfactory account of them.

The functions of the vessels of plants have been as variously described as the organs themselves. Malpighi supposed them to be air vessels ; Grew declares, that they sometimes contained moisture ; and Du Hamel suspected that they contained " highly rarified sap." The experiments of Darwin and Knight, have, to a certain degree, determined their uses. The former placed twigs of the common fig tree into a decoction of madder, and on taking them out after some hours' emersion and cutting them across, the colored fluid was found to have ascended into each branch, and the cut ends of the vessels formed a circle of red dots around the pith, and these vessels again were surrounded by other vessels containing the milky juice, so very remarkable in the fig tree. The latter (Mr. Knight) made similar experiments with cuttings of the horse chesnut and of the apple tree, with an infusion in water of very black grapes. The result corresponded with those of Darwin. He, however, pursued the investigation still further, and traced the fluid into the leaves ; and during the whole course it did not give the slightest tinge to the bark, nor to the sap between it and the wood. The pith was very slightly, if at all affected. The radicles are probably elongations of these vessels which absorb the proper fluids from the earth, and convey it into the body of the root, where it becomes sap by some process which we cannot develop ; it is then conveyed to the stem and leaves, where certain other changes take place, that are to be hereafter noticed. The functions of the alburnous vessels appear to be two fold, according to the views of Mr. Knight. At one period, they convey sap to the leaves in common with the central vessels : and during the winter, they serve as reservoirs of the juices of the plant, which, after having undergone certain changes in the leaves, are there deposited until the approach of spring, when they contribute to the formation of those new parts which are necessary for the vital action of the vegetable.

The cortical vessels seem to carry the sap back to the roots through the bark, and, in its course, it possibly forms alburnum,

or at least furnishes the materials. All this, however, is a mere probability, as we know very little with certainty connected with it.

The ascent of the sap varies according to the season of the year, and the state and temperature of the atmosphere; being suspended during the winter, and most active in the spring, when vegetation recommences, and previously to the full expansion of the leaf; that at the vernal season, Dr. Hales has ascertained by experiments on the vine, in the heat of the day it will rise in glass tubes adjusted for the purpose, at the rate of an inch in three minutes, and attain in these tubes the height of more than twenty feet; and that, by its force upwards, it will sustain a column of mercury, of thirty-eight inches, equivalent to the pressure of a column of water of more than forty-three feet; which force, he says is, "five times greater than that of the blood in the crural artery of a horse, seven times greater than that of a dog, and eight times greater than the blood's force of the same artery in a fallow deer."

It is difficult to determine by what means the sap is propelled through the vessels: the agitation of the winds, the form of the vessels, the action of the heat, the pressure of certain plates, called silver grain, in the oak, are all supposed to contribute to this end; and very possibly they do this to a certain extent. We confess, however, that they do not appear to our minds adequate causes. It is a matter of some moment to ascertain how the function is performed; but our knowledge of facts is so very imperfect, that it is impossible to frame any reasonable hypothesis on the subject. In this, as in every other department of physics, men are too prone to step beyond the limits within which their actual knowledge should confine them.

OF THE LEAVES.

This part of the plant which contributes so much to its beauty, (though infinitely diversified in its forms), is in all cases similar in its organization as well as its functions. It consists of a thin and flat substance usually of a green color, issuing generally

from the extremity of the branches, though sometimes from the stem; and is to be distinguished by the sight or touch, into an upper and under surface, a base, a midriff or central line of division, and into lateral lines, or, as they have been improperly termed, lateral nerves.

In its structure, the leaf is made up of a continuation of the cellular tissue, which forms its principal bulk, of a distribution of the alburnum or-sap wood, of a small portion of the lignum or heart wood, and of the upper extremities only of the cortical vessels: all of a peculiarly minute and fine texture, forming a delicate net work; the whole being covered by the epidermis, the size of the leaf varying, from the smallest proportion that can be distinguished by the naked eye, to a magnitude that almost exceeds belief, namely, to several feet in diameter.

The functions of this very interesting organ may be considered the most important of any which are connected with the preservation of the plant. To illustrate these, it is to be recollected that the nutritive ingredients, when first absorbed, are only in the simple state, held in solution by a considerable proportion of a watery fluid; and require the aid of a further process before they possess the consistency and the chemical properties requisite to produce the various secretions which are to contribute to the nourishment and preservation of the plant. The agent, to effect these important changes, are the leaves; and the process, by which those changes are accomplished, is, in the first place, by evaporating a considerable proportion of the watery part of the simple sap as it is conducted from the roots, by which its fluidity is diminished; and, in the next, by absorbing, or taking up from the atmosphere, a certain proportion of its oxygen, caloric, light, and of various nutritive materials, held in solution in that element; by which, through chemical agency, new principles are communicated to the fluid, now denominated, *the proper juice or true sap*, previously to its descent, to supply the different parts of the plant with renovating secretions.

To promote this object, the surface of the leaf is rendered broad and extensive, the tubes and cells exquisitely fine and

delicate, their texture throughout, porous and transparent, and the orifices of the epidermis (so essential to the process) numerous beyond calculation, and so extremely minute, as to require very powerfully magnifying glasses to detect them ; their diameter being only adapted to the absorption and extrication of vapory fluids in the highest degree of tenuity.

The processes of transpiration and absorption, as peculiar to the functions of the leaves, are indeed of a most highly interesting character, and require a far more able pen than mine to do justice to their illustration. Upon the new or ascending sap reaching the leaves from the roots, the operation of transpiring a portion of its watery particles commences from the smooth or upper surface of the leaf, as soon as the sun rises, and continues until the approach of night ; by which the sap acquires more consistency, and is thus rendered fit to receive those materials, which are to be imparted to it through the agency of absorption. This evaporation is so considerable, that Dr. Hales, whose experimental accuracy has never been questioned, has ascertained, that a cabbage transmitted daily more than half its weight, and that a sunflower, three feet high, transmitted in twenty-four hours, a watery fluid equal to twenty ounces.

While this watery evaporation is going on, an absorption by the same surface of the leaf of the carbonic acid gas of the atmosphere, and a decomposition of some of the water left in the sap, are taking place ; by which, in the former instance, the carbon is separated and fixed in the sap, and the oxygen gas is set at liberty ; while in the latter, the hydrogen is communicated to the sap, and its oxygen gas also becomes free ; by which operations, the sap has acquired two of the leading principles necessary to vegetables, the carbon and the hydrogen ; while a double supply of oxygen, or the vivifying principle, is restored to the atmosphere, by which its purity is preserved against the deterioration to which it is uniformly exposed by animal respiration, combustion and mineral absorption.

During the night the under surface of the leaf absorbs moisture from the air, or from the evening dew, to make up in some degree the deficiency of the previous day's evaporation, and takes

up oxygen from the atmosphere, by decomposing it and setting part of the nitrogen at liberty : a portion of the oxygen thus absorbed, is fixed in the sap, and the other part, uniting with the superfluous carbon in the plant, forms carbonic acid gas, which escapes from the leaf and mixes with the atmosphere. This will serve to explain, why the night air is less salubrious than that of the day ; and the necessity of a large proportion of oxygen being set at liberty during the day, to obviate the injury which the atmosphere sustains by the operations of the night.

Thus we perceive the leaves of plants perform very different operations at different times ; since during the day, they are giving out moisture, absorbing carbonic acid gas, and emitting oxygen gas ; during the night, they are absorbing moisture, giving out carbonic acid and nitrogen gases, and taking up oxygen gas. By these operations assisted by the agency of light, (which, independently of its imparting color to the leaf, contributes essentially to its chemical changes,) the sap receives all the primary principles which constitute the plant—namely, oxygen, hydrogen, carbon and nitrogen ; by the various combinations of which, nourishment to the plant is not only produced, but also through the agency of secretion, those other substances are elaborated which we know can be extracted from vegetables ; and which, taken from one description of vegetable or another, amount to no less than thirty-one, exclusively of those which, belonging to the mineral kingdom, have been denominated extraneous ; while, by a very beautiful process, the purity of the atmosphere is so balanced within the twenty-four hours, as to be fitted for all the purposes of animal and vegetable economy. Thus by a wonderful piece of mechanism that cannot be too much admired and investigated, and in the construction of which there is still a wide field for discovery, the sap in its simple state is absorbed from the earth by the roots, and conveyed through the cells and the tubes of the wood into the leaves ; where by the processes of evaporation and absorption (as just explained) it acquires new principles and becomes the true sap. It is then taken up by the extreme vessels of the bark, and by them conveyed back to the branches, stem and root ; depositing in its

passages through the cortical vessels into the cavities of the cellular tissue for elaboration, such portions of it as are to be applied to the purposes of nutrition, or to those secretions that are necessary for the preservation of the plant.

The functions of the leaves have been compared to the respiration of animals, by which the blood parts with its superfluous water, and acquires new principles from the atmosphere; and hence the leaves have been denominated the lungs of the plant. But in this, as in every other instance, a strong line of distinction may be drawn. The change in the leaf is simply effected by exudation and absorption, both of which are varied according to the existing temperature and the time of the day. *That* in the lungs is accomplished by muscular action, and is uniformly the same at all periods, and under every atmospherical change. Animal respiration destroys the purity of the atmosphere. Vegetation restores it; the deterioration of the night being amply balanced by the renovating operations of the day. In the winter, when foliation is suspended, the absence of vegetation is supplied by the agitating storms of the season, bringing with them purifying breezes from the ocean; or rendering less stationary the deleterious exhalations of the land.

Thus in the natural as in the moral world, occurrences, which individually appear to be very striking evils, collectively are productive of the greatest degree of good; and the functions of organic substances, which from their primary effects carry with them strong features of similarity, when more closely investigated, are found to be productive of very opposite consequences.

Color of Leaves. The coloration of plants presents one of the most interesting, and, at the same time, obscure branches of physiological research. Humboldt attributes the green color of leaves to the agency of hydrogen, because he had observed some plants retain their green color in mines. Saussure, however, could not increase the green of plants by means of hydrogen. Humboldt also ascribes the white color to oxygen, which seems to be erroneous, as this oxygen existed in a state of combination previous to its being made apparent, and cannot therefore be proved to produce this white color. Senebier's phlogistic

hypothesis is unworthy of detailed notice. His subsequent opinions respecting the operation of carbon, do not seem to be better founded. This philosopher, as well as Berthollet, determined many important facts. There is a very evident connexion between the decomposition of carbonic acid gas and the green color of leaves, as is shown by the following results. Green leaves only yield oxygen gas; the parenchymatous substance of the leaf is the seat of decomposition of the gas, and of the green color; the coloration will take place in leaves separated from the stem, so that there can be no living action in them; consequently the coloration is independent of the life of the plant.

It appears from the various experiments of Berthollet, Senebier and others, that solutions of the colorable parts of leaves are rendered red or green according to the predominance of acid or alkaline matter; but similar effects will be also induced on entire leaves. Etiolated leaves, and those reddened by age, pass into green in alkaline fluids; those that are yellow from decomposition, become brown in the same circumstances. Ellis observed, that if the green color had been previously affected by the action of water, that alkalis did not restore it. On these facts this physiologist ventures to presume, "that these same agents (acids and alkalis) if present, will exert a similar action on leaves during their growth."

He first establishes the existence of a large quantity of alkaline matter in the leaves, and shows that the separation of the carbonic acid, and its subsequent decomposition, render the alkali predominant, and consequently better fitted to exert its specific influence "on the colorable juices of the plant," which produces the color of the leaf. So that according to Mr. Ellis's views, the decomposition of the carbonic acid answers two purposes, the production of oxygen gas and the formation of the green color.

If the green color depend on the predominancy of alkali, it may be reasonably supposed that the white color depends on a deficiency of it. Senebier's experiments support this supposition, and his results have been confirmed by Davy and others. This whiteness of color will continue so long as the acid abounds;

and accordingly we find that plants growing in the shade are *etiolated*, or devoid of the green hue, until they are placed in the full sunshine. The various shades of color exhibited by different leaves immediately before their fall are effected by similar causes, and consequently are explicable on the same principles. In the same way, too, the variegation of different leaves may be resolved, or at least the agents that produced them may be pointed out. The mode in which these effects are induced, Mr. Ellis does not attempt to detail, being satisfied with the general fact. It would open a field of interesting inquiry, to examine, with care, the gradual changes from green to white, with all the intermediate and collateral varieties of color; and, it is probable, that in the course of such researches, many valuable facts would develop themselves, and thus tend more clearly to elucidate this branch of vegetable physiology.

CHAP. II.

OF THE ORGANS OF REPRODUCTION.

The organs of reproduction, as we have before stated, consist of the flower, fruit and seed.

It is well understood, that upon the early advance of vegetation, there are to be seen sometimes upon the stem, frequently upon the bulbous roots, and always upon the branches, very small prominences denominated the gem or bud, containing the rudiments of future formations; some expanding into leaves and new branches, some into flowers, and others into flowers and leaves conjointly.

The flower gem, to which our attention now must be exclusively directed, by the progress of vegetation, gradually expands and enlarges until the outline of the flower becomes observable; when supported by the stalk or peduncle, all the several parts

are progressively developed, until the flower itself bursts forth in full maturity and beauty.

In no part of the vegetable creation has so much taste and variety been displayed as in the flower; the brilliancy, shape, and fragrancy of whose blossoms cannot fail to attract the attention of the most indifferent observer; while the whole face of nature is adorned and enlivened by the diversity of their species, and the endless variety of their tints and hues. But it is not the taste displayed in the color, form and distribution of the flower, (however fit objects for admiration) that confers the greatest interest upon these organs of vegetables. It is their internal structure and the object they have to answer, which entitle them to philosophical consideration.

The flower is composed of the calyx or cup, of the corolla or blossom with its petals, of the receptacle or base, and of the nectarium, *as auxiliary*; and of the stamens with their anthera, and the pistil with its stigma, style and ovary or germ, as *primary or essential organs* of fructification.

The calyx, which is to be found immediately surrounding the lowest portion of the corolla or blossom, is a green membraneous sac, most frequently formed in the shape of a cup, and is intended to defend, support and nourish the more perfect parts within. It is consequently made of stronger materials, that it may thus perform its functions uninterruptedly.

The corolla or blossom, in which all the beauty of the flower is investigated, is supposed to be an extension of the inner or vascular part of the bark; and consists either of a single piece, or most frequently of many pieces that have been denominated *petal* or *petals*; and these are found to contain an infinite variety of small tubes of the porous kind, intended (as it is conjectured) for the absorption from the atmosphere and from the rays of light, of those renovating materials which are to contribute to the support and fertility of the more essential parts of the flower; while the corolla generally, defends and protects those parts from external injury. The mechanism of the petals therefore is of a very delicate and minute character; and the corolla, by

encircling the internal parts with its foliage, is well calculated to answer the defensive purposes to which we have alluded.

The receptacle is the base of the flower close to the stalk upon which all the other parts rest, as may be seen in the artichoke, when the leaves are removed; and which, no doubt, though we may not comprehend it, serves some other useful purpose in the economy of vegetation, independently of the support it affords to the flower.

The *nectarium*, or *nectary*, consists of a small sac or bag, situated most frequently (though not uniformly) at the base of each petal, from which the honey is secreted that is supposed to be the source of nourishment to the internal parts of the flower. When the nectarium is wanting, nature has given greater activity to the other nutritive organs; and when in the place of honey, a strong poisonous fluid is secreted, (as is sometimes the case) it is intended to keep off and destroy insects in those flowers which are particularly liable to their attacks.

Having described the contributive, secondary, or auxiliary parts of fructification, we come now to the essential; and these are the stamens and pistils.

The stamens, which are formed of the woody part of the plant, are slender, thread-like substances, varying in number in different flowers, and placed within the corolla, and on the outside of the pistil which they surround. On the top, or upper extremity, is situated the anther; a small prominent bag, or *viscus*, which contains in cells, or rather in globules, the pollen, farina, or dust, (most frequently of a white, though sometimes of a yellow, orange, or of a violet color,) that forms the great principle of fertilization. From the anther descends a fine line of communication called the filament, which attaches the stamen to the receptacle, though sometimes to another part of the flower, according to the varying circumstances of each individual.

The pistil, which is supposed to be formed of the pith of the plant, is a small and column-shaped substance, occupying almost invariably the centre of the flower, where it is encompassed immediately by the stamens. The pistils vary in number, being sometimes one, as in the cherry, and at others more than one,

as in the apple and pear. It consists of at least two, but more generally of three distinct parts; the ovary—the style—and the stigma, or summit.

The ovary is situated at its lower extremity or base, supporting the style and stigma, and from containing the rudiments of a new plant, has been denominated by Linnæus, the germ, or germen. In its figure and shape, it varies in different plants; consisting in some of only one cell, and in others of more, according to the peculiarity of each individual flower.

The style, which is the middle portion of the pistil, is a prolongation of the substance of the ovary, being terminated at its upper extremity by the summit or stigma, thus forming a line of communication between the two extreme parts.

The stigma is a small glandular-looking substance, sometimes of a triangular, at other times, of a circular shape, placed at the top of the style, and from which it is also denominated, the summit of the pistil; as the style may be termed the centre, and the ovary or germ, the base.

It is upon the arrangement of the stamens and pistils, that Linnæus has principally formed his system of classification; the particulars of which may be found in most of our elementary works on botany. Suffice it here to say that the pistil (at its base) is the organ which contains the rudiments of the fruit and future seed; but which seldom acquires a reproductive property, without the influence of the dust contained in the anther of the stamen; and which being dropped, by the bursting of the globules, on the stigma, invests the ovary with the requisite fertilizing principle.

The contents of the ovary being thus called into action, it gradually expands and enlarges, until by its own natural supplies, it is rendered independent of the other parts of the flower; and these being no longer required, they decay and drop off, and the fruit or pericarp by a progressive increase, is ultimately formed into all its magnitude and perfection. Thus we see the ovary, which in the early stage of growth, exhibited only the appearance of a homogeneous mass of pulpy substance, as it advances in size, displays the rude outline of separate organs, until it reaches

its full magnitude ; when the embryo of a future plant may be discovered in the centre of its own supplies. By this process the pericarp, in a diversity of shapes and forms, is rendered perfect in all its several parts ; and as the seed, which it contains, is one of nature's greatest resources in the vegetable world, it is defended above all other parts of the plants against the accidents to which it may be liable. Thus in the one instance, it is imbedded in the soft pulpy substance of the esculent fruits ; in another, it is protected by thick membranes, and inclosed in a pod, as in leguminous vegetables ; while in a third it is surrounded by a hard shell or a thick cuticle, (as in the various species of corn), which requires a very strong force to rend it asunder. It is thus fitted for the purpose of future germination, which will be hereafter considered.

OF THE SEEDS.

The seeds are the sole end and aim of all the organs of fructification. Every other part is in some manner subservient to the forming, perfecting, or dispersing of these. A seed consists of several parts, some of which are more essential than others, and of these we shall give a particular description.

The embryo, or *germ* is the most essential of all, to which the rest are wholly subservient, and without which no seed is perfect, or capable of vegetation, however complete in external appearance. It is sometimes called *corculum*, or little heart, *punctum vitæ*, or speck of life, and it is in the point whence the life and organization of the future plant originate. In some seeds it is much more conspicuous than in others. The walnut, the bean, pea, lupine, &c. show the embryo in perfection. Its internal structure, before it begins to vegetate, is observed by Gærtner to be remarkably simple, consisting of an uniform medullary substance, inclosed in its appropriate bark or skin. Vessels are formed as soon as the vital principle is excited to action, and parts are then developed which seemed not previously to exist.

The cotyledons, or seed lobes, are immediately attached to the embryo, of which they form, properly speaking, a part. They

are commonly two in number, but sometimes four, and in others only one. When the seed has sufficiently established its root, these generally rise out of the ground, and become a kind of leaves. Such is the true idea of the organs in question, but the same name is commonly given to the body of the seed in the grass and corn tribe, the palms, and several other plants, thence denominated *monocotyledons*, because the supposed cotyledon is single. It neither rises out of ground, nor performs the proper functions of a cotyledon, for, what these plants produce is, from the first, a real leaf; or, if the plant has no leaves, the rudiment of a stem.

The albumen, or white, is a farinaceous, fleshy, or horny substance, which constitutes the chief bulk of some seeds, as grasses, corn, palms, lilies, never rising out of the ground nor forming the office of leaves, being destined solely to nourish the germinating embryo, till its roots can perform their office. In the datepalm, this part is nearly as hard as stone; in the *Mirabilis jalapa* or four o'clock, it is like wheat flour. It is wanting in several tribes of plant, as those with compound, or cruciform flowers, and the cucumber and gourd kind, according to Gærtner. Some few leguminous plants have it, and a great number of others, which, like them, have cotyledons besides. We are not however to suppose that so important an organ is altogether wanting, even in the above mentioned plants. The farinaceous matter, destined to nourish their embryos, is unquestionably lodged in their cotyledons, whose sweet taste as they begin to germinate, often evinces its presence, and that it has undergone the same chemical change as in barley. The albumen of the nutmeg is remarkable for its eroded variegated appearance, and aromatic quality; the cotyledons of this seed are very small.

The vitellus, or yolk, first named and fully illustrated by Gærtner, is less general than any of the parts already mentioned. He describes it as very firmly and inseparably connected with the embryo, yet never rising out of the integuments of the seed in germination, but absorbed, like the albumen, for the nourishment of the embryo. If the albumen be present, the vitellus is

always situated between it and the embryo, and yet is constantly distinct from the former. In the natural order of grasses the part under consideration forms a scale between the embryo and the albumen.

The true use of the vitellus is supposed to be to perform the functions of a cotyledon with regard to air, if not to light, till a real leaf can be sent forth, and the subterraneous cotyledons of Gærtner in the horse chesnut and garden nasturtium are rather of the nature of a vitellus. It does not appear that any plant with genuine ascending cotyledons is likewise furnished with this organ ; on the other hand, it commonly belongs to such as have the most copious albumen, and therefore should seem to answer some other end than mere nutriment, which is supplied by the latter.

We learn from the above inquiries, that the old distinction between plants with one cotyledon and those with several may still be relied on, though in the former the part which has commonly been so denominated is the albumen, as in corn, the real cotyledon of which is the scale or vitellus, which last organ however seems wanting in palms, lilies, &c., such having really no cotyledon at all, nor any thing that can perform its office, except the stalk of the embryo. In the horse chesnut, oak and walnut possibly, whose seed lobes do not ascend, the functions of a real cotyledon, as far as air is concerned, and those of the albumen may be united in these lobes, as is the case with most leguminous plants ; which is rendered more probable, as several of the latter have the corresponding parts likewise remaining under ground.

The testa, or skin, contains all the parts of a seed above described, giving them their due shape ; for the skin is perfectly formed, while they are but a homogeneous liquid. This coat differs in thickness and texture in different plants. It is sometimes single, but more frequently lined with a finer and a very delicate film called by Gærtner *membrana*, as may be seen in a walnut, and the kernel of a peach, almond, or plum. In the jasmine a quantity of pulp is lodged between the *membrana* and the *testa*, constituting a pulpy seed, *semen baccatum*, which is

distinct from the *acinus*, or grain of a compound berry in the raspberry, the seed of the latter having its proper double covering within the pulp. The testa bursts irregularly, and only from the swelling of its contents in germination.

The *hilum*, or scar, is the point by which the seed is attached to its seed vessel or receptacle, and through which alone life and nourishment are conveyed for the perfecting its internal parts. Consequently all those parts must be intimately connected with the inner surface of the scar, and they are all found to meet there, and to divide or divaricate from that point, more or less immediately. In describing the form or various external portions of any seed, the hilum is always to be considered as the base. When the seed is quite ripe, the communication through this channel is interrupted; it separates from the parent plant without injury, a scar being formed on each. Yet the hilum is so far capable of resuming its former nature, that the juices of the earth are imbibed through it previous to germination.

CHAP. III.

GENERATION OF PLANTS.

It is well known that the ancients supposed two sorts of generation, namely, equivocal and univocal. This latter, they said, took place when any thing was produced from its proper egg or matrix; the equivocal, when any living thing was generated fortuitously, or by chance, from the confused mixture of particles. Thus, for example, they believed that fleas were generated from urine and sawdust; that myriads of little insects, like atoms, came up out of slimy water, and maggots out of cheese in the summer, that several sorts of herbs quickly sprang up out of mould taken from a considerable depth below the surface of the earth; and lastly, that worms were produced from putrid carcasses. Others thought that the Creator, at the beginning, mixed seeds

and eggs with the earth everywhere ; so that when such earth was dug up, and the sun by his heat, had hatched the seeds, they imagined that herbs, plants and animals sprung up, which were concealed therein from the creation. But all the ingenious men of this enlightened age, who have imbibed the sound principles of natural philosophy and natural history, have long ago rejected this ridiculous opinion. The Almighty at the first gave to every living thing its own proper seed, and to each a tendency or propensity to propagate its species ; and established this first and great law to remain unalterable, "Increase and multiply." If from putrefaction, and the heat of the sun, living creatures and plants could be produced, it would have been needless, and consequently highly unworthy of the Supreme Being, to have created so many and so amazingly curious vessels for the preparation of the seed ; for in that case, putrefaction would be equivalent to creation. And if very minute insects and other animals could be produced from putrefaction, and hatched by the heat of the sun, why might not horses, elephants, and other large animals, be produced in the same way ? For in large bodies the mechanism is easier, as the matter is more manageable ; but in such minute insects, and, as we may say, such nothings, what wisdom, what power, what inexplicable perfection is displayed, since Nature is never more complete, than in her most minute works ! He must be void of understanding who does not perceive the absurdity of equivocal generation, when he sees a body made with such wonderful art, and adorned with so many thousand pipes and canals, that no mechanic, even the most perfect of mortals, can find out all the contrivance, much less imitate this wonderful fabric ; yet he believes all those things were made by a fortuitous and confused concourse of atoms. For it would follow from hence, that a new species both of animals and plants would always occur, neither of which we observe, or have any account. In this case too, there could be no arguing from the genera to the species. In a word, there would be no such thing as certainty, but all confusion. Redi, having a mind to examine equivocal generation, put recent flesh into a glass vessel, covered with a very thin linen cloth, and exposed it to the sun ; after a

little time, he found that flies laid their eggs upon the linen cloth ; but no maggots were produced in the flesh. We must not conclude that insects are produced by equivocal generation, because we see many thousands of them about pools and ditches, where the putrefying filth of those places furnishes plentiful nourishment for them, which is the reason that their eggs are there deposited. The *Stapelia hirsuta* produces a flower that smells like carrion, for which reason the flesh flies, deceived by the smell, fill the whole flower with their eggs, taking it for putrid flesh. We have no reason to believe, what some have asserted, that wheat degenerates into barley, and barley into oats, and oats into broom grass ; for every species produces its own like ; nor was it ever known that the fierce eagle produced a timorous dove. Having confuted equivocal generation, it will follow that every living thing is produced by univocal generation, or from an egg. Now vegetables we have already proved, are endued with life, therefore they all proceed from eggs. And indeed the great Harvey long ago maintained this doctrine, that every living thing derives its origin from an egg. But some of the moderns have strenuously endeavored to overthrow this opinion, their cause being chiefly supported by such arguments as the following. If, say they, we take a part from the root, and set it in the ground, it strikes root, and a new plant springs up ; again, if a polypus be cut into several parts, from each of these parts an entire and complete polypus is formed, according to Trumbull and others. But do we not as frequently see that a plant produces from the same root several shoots or stems ? For a stem is nothing but a root above ground ; for which reason, if we turn a tree, as for example, the cherrytree, upside down, the stem will become the root, and the root be changed into branches. Besides, what we have said is farther confirmed by the branches, all of which spring from the stem or root ; but the stem or root from whence this branch or shoot was taken, arose from a seed or egg. The same thing may be said of the polypus among the animals ; and therefore a polypus lives a vegetable life, or a vegetable lives the life of a polypus ; and this manner of propagation, through every race in the animal creation, is extremely common in the vegetable king-

dom. No one ought to wonder that new leaves are produced every year from the root or branches ; for in the same manner do we daily see the feathers of birds produced. A feather ; which is a most curious piece of workmanship, consists of a concave base, filled with a vessel like a lymphatic, so that the nutriment can pass upward but not downward ; next there is the midrib and the lateral branches, both partial and proper, so that a feather may be compared to a fern twice compounded. Now daily experience informs us that feathers, though adorned with such curious mechanism falls off every year, and that others, springing from the body of the bird, succeed in their stead. Moreover, it is evident that feathers grow only out of the body of the bird, that this body is their root, and that this root owes its origin at first to a seed or egg. The same also holds in plants ; therefore polypi, and plants of every kind, have undoubtedly seeds or eggs, by which they are multiplied, without being cut or propagated by shoots, layers, branches, or suckers. Add to this, the celebrated Jussieu discovered eggs or seeds in the polypi as may be seen in the Transactions of the Stockholm Society for 1746.

Here we are to observe that all viviparous animals have their eggs, out of which comes their offspring, though these eggs are contained in their proper matrix, and excluded in due time, in the same manner as an egg in the nest cherished by the incubation of the bird, whose uterus is the nest. Nor can we deny, but the smallest vegetables have seeds, although not often discoverable by the naked eye. Valisnerius has discovered the seeds in duck's meat ; and Michelius has done the same in the mucor and byssus ; Bobart in the ferns ; Linnæus in the mosses ; and Reaumur in the fungi. The ancients thought that the mistletoe was produced without seed, having seen it often grow from the underside of branches ; for how the seeds of mistletoe could be conveyed from one tree to another, and there adhere to the underside of the branches, was very difficult for them to conceive. But time has discovered, that the thrush, swallowing the berries on account of the pulp, afterwards voids the seeds entire, which adhere with the excrements to the branches. These viscid seeds are washed by the rains, so that some of them are

often protruded to the lower side of the branches, where they grow. Some people are persuaded, that the sessile and flat fungi on trees, are morbid excrecencies; but it is obvious they are true species of those agarics which are furnished with caps and stems, and grow on the ground, whose seeds falling on a moist tree, produce, as it were, half cups without stems.

That seeds are the eggs of plants, appears from hence, that as every egg produces an offspring similar to the parent, so do the seeds of vegetables, and consequently they also are eggs. The containing parts of a hen's egg are, the shell, the external film or membrane, the internal membrane lying immediately under the former, the *chalazæ*, or membrane inclosing the yolk, twisted at the extremities. The parts contained are, the air within the membranes at the obtuse end of the egg, the *albumen*, or white, the *vitellus*, or yolk, in the centre the *punctum vitæ*, or point of life. When a perfect egg is placed under a hen, after two days' incubation, the speck of life becomes red, sends out its blood vessels through the yolk, and at last we find the whole chick is formed out of the speck of life. The yolk becomes the secondines; the white contributes to the nourishment of the chick; and the two membranes become the *amnion* and *chorion*. Every seed of a vegetable, as we have before shown, is in structure essentially the same as the egg of a bird, endowed with vessels, and contains under several membranes, the plant in miniature. When a seed is exposed to a due portion of moisture, and a just degree of heat, it begins to swell, and on its out side, there is seen a vesicle, which is the amnion of Malpighi, furnished with an umbilical cord, which is produced through the chorion to the opposite side of the egg. While with the egg the amnion increases, on its top is observed another small body, which likewise augments continually, till it has filled the whole chorion of the egg; and the amnion and chorion are turned into the external shell or coat of the seed. That most plants have seminal leaves or lobes is very well known. Now these seminal leaves once constituted the whole seed, except the hilum, or little heart, in which is the point of life; and these lobes prepare the nourishment for the tender plant, until it be able to strike root in

the earth, in the same manner as the yolk in an egg, becoming the *placenta*, prepares the nourishment, and sends it by the umbilical cord to the chick.

From the foregoing observations, it is evident that the seeds of all vegetables may be considered as eggs, from which the respective species are produced. Now, daily experience teaches us, that no egg can produce an animal, till it be impregnated or fecundated by the male; a hen, indeed, will lay eggs, but they will prove abortive, unless they are impregnated or fertilized by the male. That generation precedes the birth, appears throughout universal nature. In quadrupeds it does without doubt: but in fishes, it is supposed by some that generation follows or comes after the birth or exclusion of the eggs, and that the male sperm is emitted upon the eggs after they are excluded from the matrix of the female. This is demonstrable in the salmon during the spawning season.

Physiologists have entertained a variety of opinions respecting generation. After rejecting the effervescences, precipitations, and other ridiculous notions of the ancients, they now seem to acquiesce in two opinions. The first is that of the great Hervey, who supported that the speck of life, or cicatricula, the entire rudiments of the future fœtus were present, perfect in all its members, and that it was only requisite that the male sperm should add or excite the first spirit, motion and life. His followers contend, that so curious and wonderful a machine as an animal body, could never be formed and perfected by another machine; and that therefore in the ovaria of the first female there must needs have been her offspring, or ova, and in them others of the same kind; and so on in an infinite series through all the subsequent descending generations. In a word, that in the ovaria of Eve, the whole race of mankind were contained, whether, past, present or future. Now allowing the infinite divisibility of matter, yet it exceeds all belief, that so many myriads should be contained in one egg. The second hypothesis is that of Leuwenhoek. He supposed that the *semen masculinum* contained millions of animalcules, and that each of the ova, in the female ovaria, had a small perforation, no bigger than to admit a single animalcule. Through this small aperture an animalcule is supposed to enter;

soon after which the ovum becomes detached, and, in a wonderful manner, descends the Fallopian tube into the uterus, together with the animalcule, which in time becomes a perfect fœtus. But this theory is more plausible than just : for by the conjunction of two animals of different kinds, a species is produced, which we call hybrid, mongrel, or mule, being of a mixed nature between the male and female parent. And it must be allowed that an animal thus formed could not be produced, were the rudiments of the fœtus to derive their origin wholly from the male, agreeably to this hypothesis. All we certainly know of the mysterious work of generation, is, that all animals require the concurrence of a male and female to produce their kind ; and that these, distinctly and invariably, are found to beget animals of their own species. We know but little of those peculiar characters in the parts that go to make up animated nature, which mark one animal to creep in the dust, and another to glitter upon the throne ! Something more certain may be discovered regarding the origin of vegetable life, to which we shall return.

That we may make a full inquiry into this subject of the reproduction of plants, it will be proper to investigate the situation of their organs of fructification. Now we have proved that the seeds are the eggs of plants ; and it appears wherever the fecundated eggs are, there are we to seek for the organs of generation ; and we shall find the fructifying organs of plants where the seeds are produced. But the seeds are produced where the flower and fruit are ; therefore the flower and fruit are the organs of generation. Some have asserted that certain vegetables wanted flowers, and others both flowers and fruit. Tournefort maintained that the algæ and mosses had seeds, but no flower ; and that the fungi, and some others, had neither flower nor fruit. Hence some of the moderns have argued against the fructification. But for one to deny flowers and fruit to the most minute vegetables, which he finds in all the larger species that fall under his inspection, is not the part of a fair and rational inquirer. For it is the same as if we should conclude concerning some minute species of insects, that they had neither feet, eyes nor mouth, because we cannot discover them with the

naked eye. Bobart sowed the seeds of ferns, which grew very well. Plumier discovered the flowers in some of the fern kind. Linnæus discovered the seeds of mosses. In the prickly club-moss, he observed, that one part of the fructification contained the fertilizing dust, and the other the seeds ; which were evident signs that the plant had both flower and fruit. Micheliüs has frequently numbered the stamens of the fungi, and has sown their seeds which flourished well. From which we may conclude, that these lowest tribes of vegetables are all furnished with flowers and fruit, although, by reason of their exceeding minuteness, they have not hitherto been distinctly known to botanists. In short, there never was a clear and evident example produced of any plant which wanted flowers and fruit ; and therefore we may justly say, that in their fructification consists the essence of plants.

Universal experience attests, that the existence of the flower always precedes that of the fruit, in the same manner as generation the birth in animals ; so that not one example of the contrary can be produced in any individual. Since in animals all generation precedes the birth, and in vegetables every flower precedes the fruit, we must necessarily ascribe fecundation to the flower, and the birth or exclusion of the seed to the ripe fruit.

Hence we may define a flower to be the genital organ of a plant serving for fecundation, and the fruit to be the genital organs serving for the birth or maturation of the seed. All flowers, whatever, except the mosses, are furnished with anthers and stigmas, or both together ; and as this holds universally in every species of plant, (the mosses only excepted,) those parts must necessarily constitute the essence of a flower. If we find a flower with anthers, but no stigmas, we may also assuredly find another flower either on the same, or on a different plant of the same species, which has stigmas with the anthers or without them. Pontedera contends, that there are some plants which have no anthers, as for example, the sago palm tree (*Cycas Circinialis*) the *Celtis*, or nettle tree, with some others ; but in this he is mistaken ; for even the number of the anthers in those plants he mentions is at present very well known to botanists.

For the act of fecundation two things are requisite, namely, the genital organs of both sexes ; because, as we have before stated, one of the sexes alone cannot propagate the species. Now the act of fecundation is performed in the flower ; therefore it follows, that the genital organs of both sexes must be present in the flower. We are here, however, to observe, that those organs are not always present in one and the same flower. It is sufficient that those of the male be in one flower, and those of the female in another. Since every plant bears seeds by which its offspring can be propagated, and no egg can be hatched before fecundation, it will follow, that fecundation is as necessary as the seeds themselves. Hence it appears, that the organs of both sexes, which serve for fecundation, are altogether necessary, if the flower is perfect, and that they are the essential parts. But we find no parts of a flower that are essential but the anthers and stigmas, therefore these parts are the genital organs of both sexes, serving for fecundation. Now we maintain that the anthers are the *testes*, and that the pollen performs the office of the *semen masculinum*. The truth of this we shall deduce by the following arguments.

1. *Preceding the fruit.* The anthers and their dust always come before their fruit. When the fruit sheds its seeds, it comes to maturation. This is the case with the anthers ; for when they shed their dust, they are come to maturation, and have done their office ; yet their dust is always shed when the flower is in full vigor, and then the anthers drop, and are useless.

2. *Situation.* The anthers are always so situated in the flower, that their dust which is the male sperm, may reach the pistil or female organ ; for the stamens either surround the pistil, as in most flowers ; or, if the pistil incline to the upper side of the flower, the stamens do the same ; or, if the pistil nods, the stamens ascend.

3. *Time.* The anthers and stigmas are in full vigor at the self-same time, and this not only when both are in one and the same flower, but also when they are in distinct or separate ones ; so that the long catkins of the hazel, birch and alder, never discharge the dust of their anthers before the stigmas below them

are come out. The male hemp never sheds its dust before the pistils of the female plant appear.

4. *Cells.* If we cut asunder the anthers before they shed their dust, we find their structure altogether as wonderful and curious as the seed vessels themselves. For, within they consist either of one cell, as the mercury; or, two, as the hellebore; or three, as the orchis, &c.

5. *Castration.* If we cut off the anthers of any plant which bear but one flower, taking care at the same time that no other plant of the same species is near it, the fruit proves abortive, or at least produces seeds which will not vegetate. This is a certain truth, which any one will find upon trial.

6. *Figure.* The figure of the fertilizing dust, will clearly convince any one, that this fine powder is not accumulated by chance, or from the dryness of the anthers. Malpighi, Grew and others, who had viewed the figure of these particles with good microscopes, found all the particles exactly equal to one another, but in different genera, as great a difference in shape and figure, as the seeds themselves. As for example, in the sunflower, the particles are globular and prickly; in the mallows they appear like wheels with teeth; in the ricinus, or palma Christi, they are shaped like a grain of wheat, flat and smooth; in the borage like a thin leaf rolled up; in the narcissus, kidney-shaped; in the comfrey, like double globules. The powder of the anthers, in regard to fecundation, answers to Leuwenhoek's animalcules in the male sperm; and the stigma, which receives this dust, is always moist, that the dust may instantly adhere to it. The observation of the famous Jussieu, concerning the maple, deserves our notice. "Those gentlemen," says he, "who have examined the fertilizing dust of the maple by microscopes, have drawn the particles in the form of a cross." From which observation we may infer, that those particles are hollow globules, containing some subtle matter within, that as soon as the hollow globules touch the moisture, they burst, and discharge their exceedingly fine contents. This last observation throws some light on the generation of animals, from its analogy to the seminal animalcules. Upon the whole, it abundantly appears, that the

anthers are the male organs of generation, and their dust the genuine male sperm. Since in every flower the anthers and stigmas are the genital organs serving for fecundation, and the anthers the male organs, it is obvious to every one, that the stigmas, the other essential part of the flower, is the female organ of generation, which we shall more fully prove by the following arguments.

1. *Situation.* For we are to consider that the stigma is always so situated, that the anthers, or their impregnating dust, can reach it, as we have shown above. Besides, it is remarkable, that in most plants, the number of the stigmas exactly corresponds with the cells of the pericarp.

2. *Time.* The stigmas are always in full vigor at the same time with the anthers.

3. *Falling off.* The stigmas, in most plants, when they have discharged their office, drop off in the same manner as the anthers do; which is a most evident sign that the stigmas contribute nothing to the ripening of the fruit, but serves only for the purpose of generation.

4. *Being cut off.* If the stigmas be cut off before they have received the impregnating dust of the anthers, the plant is castrated as to the female organs, and the fruit perishes; a sufficient demonstration that the stigma is that part of the female organ of generation destined for conception. The stigma of a flower, has, besides, two other singular properties; namely, that it is always divested of the cuticle or film, nor has it any bark as the other parts, and then it is always bedewed with moisture.

The generation of plants, then, is brought about by the anthers shedding their dust on the stigmas. It is not sufficiently clear in what way the generation of animals is accomplished; but thus far we are certain, that the male sperm must come in contact with the female organ, if there be any impregnation. In the vegetable kingdom the fertilizing dust is carried by the air to the moist stigmas, where the particles burst and discharge their exceedingly fine or subtle contents, which impregnate the ovary. That this is the case, will be shown by the following arguments.

1. *Sight.* When a plant is in flower, and the dust of the

anthers is flying about, part of this dust lights upon, and is seen to cling to the stigma.

2. *Proportion.* For the most part the stamens and pistils are of the same height, that the male dust may more easily come at the stigma ; but in some plants it is not so, and then a singular process of fecundation may be observed. As for example, some of the pinks have pistils longer than the stamens : the flowers do not nod, but the pistils are reflected or bent back like rams' horns towards the anthers.

3. *Place.* The stamens for the most part surround the pistil, so that some of the dust is always blown by the wind on the stigma.

4. *Time.* Here we are to observe, that the stamens and pistils come at the same time, and that not only in one and the same flower, but also where some are male and others female, on the same plant, with a very few exceptions. One thing which merits our observation in regard to time is, that when the male and female flowers are in distinct cups on the same plant, or on different plants of the same species, and where the male flowers are not erected perpendicularly over the females, there it is necessary that the flowering be over before the leaves come out, lest the fecundation should be hindered by the intervention of the leaves, as for example, in the mulberry, alder, birch, hornbeam, beech, oak hazel, and also in the willow, poplar and ash.

5. *Rains.* In almost all sorts of flowers we see how they expand or open by the heat of the sun ; but in the evening, and in a moist state of the air, they close or contract, lest the moisture getting to the dust of the anthers should coagulate the same, and render it incapable of being blown on the stigmas ; but when once the fecundation is over, the flowers neither contract in the evening, nor yet against rain. Flowers with covered anthers never close in the night. The anthers of the rye hang out beyond the flower, and if rain falls while it is in flower, the dust is clotted ; hence the husbandman truly predicts a bad crop ; for the grains are not so numerous, because many of the florets prove abortive. But the anthers of the barley lie so close within the husk, that the rain cannot get in. If rain falls upon the blossom

of the apple, pear, or cherry, the gardener immediately dreads the blossom falling off or proving abortive; and experience confirms the truth of this, for the powder of the anthers is spoiled; yet this accident oftener happens in the cherry than the apple or pear; for all the anthers of the cherry flowers discharge their dust at once: but the case is not so in the others. Smoke is also injurious, by drying up the moisture of the stigmas.

6. *Culture of Palm trees.* That the cultivation of palm trees were in use to pull off the spadices from the males, and suspend them over the spathæ of the females, is attested by Theophrastus, Pliny, Prosper, Alpinus, Kemper and many others. If this operation happened to be neglected, the dates were sour and destitute of nuts. Kemper adds this singular circumstance, that the male spadix, after being thoroughly dried and kept till next season, still retained its impregnating virtue.

7. *Nodding flowers.* Since the male dust is generally of a greater specific gravity than the air, in most plants that have the pistil longer than the stamens, the all-wise Creator has made the flowers nodding, that the powder may more easily reach the stigma; as may be seen in the common snow drop and violet. Now it cannot be said that this happens merely from the weight of the flower, for sometimes the fruit in the same plants, which is ten times heavier than the flower, grows erect, as in the crown imperial, fritillary and others.

8. *Sunk flowers.* The stems of many plants grow under water; but a little before they blow, the flowers emerge or rise above the surface of the water, when they blow, and swim till they receive their impregnation and then sink again.

9. *Consideration of all sorts of flowers.* Here a number of particulars may be produced, but we shall confine ourselves to those that are the most striking and applicable to the subject. When the flowers of the male hemp are pulled off before those of the female are fully expanded, the females do not produce fertile seeds. But as a male flower is sometimes found upon a female plant, this may be the reason why fertile seeds are sometimes produced even after this precaution has been observed. The tulip affords another experiment of the same purpose. Cut

off all the anthers of a red tulip before the pollen is emitted ; then take the ripe anthers of a white tulip, and throw the pollen of the white one upon the stigma of the red ; the seeds of the red tulip being thus impregnated by one of a different complexion, will next season produce some red, some white, but mostly variegated flowers. The hops are of two sorts ; the one male, and the other female ; and that which is commonly called the fruit, is only the calyx expanded and lengthened ; hence the female plants, though not impregnated, can bear cones. This it was that deceived Tournefort, so that he would not acknowledge the sexes of plants, because a female plant of the hop, in the garden at Paris, throve well, and bore fruit in plenty every year, when no male plants were within several miles of it. The same thing happens in the mulberry and blite, the berries of which are only succulent calyxes, but not seed vessels or ovaria. — One Richard Baal, a gardener, at Brentford, sold a quantity of cauliflower seed, (*Brassica florida*) which he raised in his own garden, to several gardeners in the suburbs of London, who carefully sowed the seeds in good ground, but they produced nothing but the common long-leaved cabbage, (*Brassica longifolia*) for which reason they complained that they were imposed upon, and commenced a suit against Baal in Westminster Hall. The judge's opinion was, that Baal should return the gardeners their money, and also make good their loss of time and crops. This, however, ought not to be considered as a fraud, on the part of the poor gardener, but ought to be ascribed to the impregnation of his good plants by the common cabbage. Wherefore, if we have an excellent sort of cabbage, we ought not to let it flower in the neighborhood of an inferior kind, lest the good sort be impregnated by the dust of the other, whereby the seeds will produce a degenerate race. It is needless to mention more examples, though we could easily deduce some singular experiments from many more plants, to corroborate this doctrine of the generation of plants. We shall next mention the utility of insects in the fecundation of plants. In a great many flowers there is a honey juice separated by the flower, which Pontedera thinks is that balsam which the seeds imbibe, to make them keep and

preserve their vegetative quality longer; and as long as the balsam is not dried up or spoiled, so long the seeds are fit to germinate. Several insects, as bees, flies, and butterflies, live on the honey juice only. Quintilian, the Roman orator, has a very singular case in one of his orations. "A poor man and a rich man," says he, "had two small adjoining gardens. The rich man had many fine flowers in his garden, and the poor man had bees in his. The rich man complained that his flowers were spoiled by the poor man's bees, which he warned him to remove. The poor man not complying, the other scattered poison on his flowers; on which the poor man's bees all died; and Dives is guilty of this great injury. The poor man pleads that the bees did no hurt at all to the rich man's flowers; that neither the Creator, nor any human laws, had ever restrained bees within any certain limits; and therefore the rich man might hinder the bees from settling on his flowers if he could." But the other might have objected, that the bees were so far hurtful to his flowers, that they sucked the honey juice, and carried off the fertilizing dust. After all, it is probable that the bees are more useful than hurtful to flowers, since, by their unwearied labors, they spread the fertilizing dust, so that it may reach the pistil; for it is not clear what use the honey juice is of in the economy of flowers. From what has been said it appears, that the generation of plants is performed by the fertilizing dust of the anthers falling on the moist stigma, or female organ; which dust, by the help of the moisture, adheres and bursts, discharging its contents, the subtle particles of which are absorbed by the style, into the ovarium, germ, or seed bud. Upon the whole, we think that the flowering of plants may be truly called their generation.

From what has been said it follows, that a flower which is furnished with anthers, but wants the stigmas, is a male flower; that a flower which has stigmas, but no anthers, is a female; and one that has both is a hermaphrodite flower. Nor need we wonder, that in the vegetable kingdom many plants are hermaphrodites, though in the animal kingdom there are a very few of this kind; for there one sex can easily move to the other; whereas plants are fixed to one spot, and cannot remove from it.

We call a plant which has only male flowers, a male plant ; that which has only female flowers, a female plant ; and that which has only hermaphrodite flowers, a hermaphrodite plant. A fourth sort, having on one and the same stem both male and female flowers distinct, is called an androgynous plant. There is also a fifth sort, namely, when on one and the same plant there are not only hermaphrodite flowers, but also male or female flowers ; and this is called a polygamous plant. When male flowers are added to the hermaphrodite, they serve to impregnate those which have not been impregnated by their own males ; or, if female flowers are added, they are impregnated by the farina of the hermaphrodite flowers.

From the foregoing remarks the reader may perceive how similar nature is to herself, and how exact in following her own laws in all her works. Who would ever believe so many truths were discoverable concerning plants ? Though, without doubt, there are many more that remain still undiscovered. To conclude, our Creator has thought proper to discover to our senses much of his providence ; and to encourage our researches, he has endowed us with a most ardent desire to trace im along the path that he has made.

GERMINATION AND GROWTH OF PLANTS.

Before we describe the process of the germination of plants, as connected with the subject, it will be useful to know the means adopted by nature for the distribution of the various seeds, so as to afford that diversity of vegetable productions which we see adorn and cover the face of the earth.

If seeds were to fall into the ground merely by dropping down from the plant, from thus being collected in a mass, either the fermentative process would take place and decomposition and decay be the consequence, or such a partial vegetation would be produced, as would render a large surface of the globe destitute of verdure and of the supplies so essential to animal life ; while the atmosphere, from numerous decompositions on the one hand, and from a deficiency of the renovating principle on the other,

would lose its purity, and be no longer fit for the purposes for which it was created. But Providence has wisely ordered it otherwise. For in the first place of this partial distribution, it is so arranged that this, like every other part of the creation, shall be subordinate to the rest ; and that each shall take its respective share in contributing to the benefit of the whole. Thus the vegetable world where each portion of it, from its construction, is rendered helpless and incapable of extending itself beyond the spot which first gave it existence ; the sources of propagation, by a very curious mechanism in some instances, and through a variety of mediums in others, are made to distribute themselves in all those directions which can render their perpetuation useful or necessary. Thus in some, the seed vessel is made to burst its integuments with an elastic jerk, by which its seed is thrown with violence to a considerable distance. Others again are covered with a spiral awn or spring, blended with a number of minute hairs which serve as so many fulcra, by which they cling to whatever objects come in their way ; and the seed, thus attached, is kept in continual motion until it falls and germinates, or dies in the ground. Thus cattle, to which it frequently fixes itself, by moving from place to place, and depositing the seeds over a large space of ground, are often the instruments of this kind of distribution. In other instances, a dispersion takes place from birds and other animals feeding upon the fruits of plants, and dropping the seeds after they have devoured the pulp. Some carry them away to a particular spot to make a hoard of them ; and such as are not consumed, germinate and become plants. Others swallow the seeds, and afterwards deposit them in the soil without being injured. Our own species, we know, not only distribute the seed peculiar to our native climate, but also bring from the most distant regions the productions of foreign countries, and naturalize them in our own. The winds, also, are another very powerful agent in the distribution of those seeds which are purposely constructed to be acted upon by their influence ; as the lichens and other seeds which float invisibly in the air, and vegetate wherever they happen to meet with a suitable soil. Some are furnished with a light down, others by a membraneous

wing, and a third again are in themselves so light, that each of them float in the air and are carried in its current which way soever the wind may blow. A last means adopted by nature for the dispersion of seeds, is the action of streams, rivers and the currents of the ocean. The mountain stream or torrent washes down the valley the seeds which may accidentally fall in it, or which may happen to be forced from its banks when it suddenly overflows them. The broad and majestic rivers, winding along the extensive plains and traversing the continents of the world, convey to the distance of many hundred miles, the seeds that may have vegetated at their sources; while by the currents of the ocean, fruits and seeds, indigenous to America, have been deposited upon the western shores of Europe.

Thus nature, by means the most comprehensive, yet upon principles the most simple and intelligible, provides for the completion of all her works; and the more we examine her attributes, the greater proofs we obtain of the usefulness and ends for which her powers have been called into action.

Germination is that act or operation of the vegetative principle by which the embryo is extricated from the envelopes, and converted into a plant. This is universally the first part of the process of vegetation. For we have already proved, that all plants spring originally from seed; the doctrine of equivocal generation being now most completely exploded, and an additional proof adduced of the uniformity of the operations of nature. But seeds will not germinate at random, and in all circumstances whatever. They will germinate only under certain conditions, and till such conditions take place the vital principle lies dormant in the substance of the seed. But when a seed is placed in the soil, or in circumstances otherwise favorable to vegetation, the vital principle is immediately stimulated into action, producing a variety of combinations, and effecting a gradual change in the parts of the seed. The radicle is converted into a root; the plumelet into a trunk or stem with its leaves and branches; and a new plant is formed capable of extracting from the soil or atmosphere the food necessary to its growth and development.

The conditions necessary to germination relate either to the

internal state of the seed itself, or to the circumstances in which it is placed, with regard to surrounding circumstances.

1. *Maturity of the seed.* The first condition necessary to germination is, that the seed must have reached maturity. Unripe seeds seldom germinate, because their parts are not yet prepared to form the chemical combinations on which germination depends. There are some seeds, however, whose germination is said to commence in the very seed vessel, even before the fruit is ripe, and while it is yet attached to its parent plant, as for example, the garden radish, the lemon and the pea. But these are examples of rare occurrence; though it is sometimes necessary to sow or plant the seed almost as soon as it is fully ripe, as in the case of the coffee bean; which will not germinate unless it be sown within five or six weeks after it has been gathered. But most seeds if guarded from external injury will retain their germinating faculty for a period of many years.

2. *Exclusion of light.* The second condition is that the seed sown must be secluded from the action of the rays of light. This has no doubt been long known to be a necessary condition of germination, if we regard the practice of harrowing or raking in of the grains or seeds sown by the farmer or gardener as being founded upon it. But it does not seem to have engaged the notice of the scientific, or to have been proved by direct and intentional experiment till lately. Ingenhoutz and Senebier ascertained by experiment that seeds germinate faster in the shade than in the sun, and hence concluded that light is prejudicial to germination. But it remained to be determined whether the prejudicial effect was to be attributed merely to the light, or partly to the heat accompanying it. From the experiments of Ingenhoutz and Senebier, the injury appeared to be occasioned by the light only, because the comparative experiments in the shade and in the sun, were made at equal temperature, as indicated by the thermometer. With this conclusion, however, though apparently legitimate, M. Saussure professes to be dissatisfied, because the thermometer placed even under the recipient is, in his opinion, incapable of indicating the actual degree of the heat of the solar rays impinging on the surface of

the seeds, which he believes to be carried to a very great height, though still escaping our instruments of observation. But this mode of reasoning is, to say the least of it, still more inconsequential than the former; because it is setting by a mere probability from which nothing can be inferred, in opposition to a direct fact, from which something surely should be inferred. It may, indeed, be true, that the degree of heat impinging on the surface of the seed is so great as to impede its germination; but as no direct proof can be adduced in support of the opinion, we must just rest satisfied with the indications of our instruments, till such time as other instruments shall be invented capable of detecting their errors; and with the previous conclusion, till such time as some positive fact shall be opposed to the experiments from which it is deduced.

3. *Action of Heat.* A third condition necessary to germination is the access of heat. No seed has ever been known to germinate at or below the freezing point. Hence seeds do not germinate in winter, even though lodged in their proper soil. But the vital principle is not necessarily destroyed in consequence of this exposure; for the seed will germinate still, on the return of spring, when the ground has been again thawed, and the temperature raised to a proper degree. But this degree varies considerably in different species of seeds, as is obvious from observing the times of their germination, whether in the same or in different climates. For if seeds which naturally sow themselves, germinate, in different climates, at the same period; or in the same climate at different periods; the temperature necessary to their germination must of consequence be different. Now these cases are constantly occurring and presenting themselves to our notice; and have also been made the subject of particular observation. Adanson found that seeds which will germinate in the space of twelve hours in an ordinary degree of heat, may be made to germinate in the space of three hours, by exposing them to a greater degree of heat; and that seeds transported from the climate of Paris to that of Senegal, have their periods of germination accelerated from one to three days. Upon the same principle, seeds transported from a warmer to a colder climate,

have their period of germination protracted till the temperature of the latter is raised to that of the former. This is well exemplified in the case of our green house and hot house plants, from which it is also obvious that the temperature must not be raised beyond a certain degree, otherwise the vital principle is totally destroyed.

4. *Access of Moisture.* A fourth condition necessary to germination is the access of moisture. Seeds will not germinate if they are kept perfectly dry. Water, therefore, or some liquid equivalent to it, is essential to germination. Hence rain is always acceptable to the farmer or gardener, immediately after he has sown his seeds; and if no rain falls, recourse must be had, if possible, to irrigation. But the quantity of water applied is not a matter of indifference. There may be too little, or there may be too much. If there is too little, the seed dies for want of moisture; if there is too much, it then rots. The case is not the same, however, in all seeds. Some can bear but little moisture, though others will germinate even when partially immersed, and indeed there are some that will germinate when wholly submersed.

5. *Access of Atmospheric Air.* A fifth condition necessary to germination, is the access of atmospheric air. Seeds will not germinate if placed in a *vacuum*. Ray introduced some grains of lettuce seed into the receiver of an air pump, which he then exhausted. The seeds did not germinate. But they germinated upon the readmission of the air, which is thus proved by consequence to be necessary to their germination.

The discovery of the several gasses, and of their various chemical properties, has contributed more than all other circumstances put together, to explain and elucidate the phenomena of vegetation. The first experiments on this obscure but interesting subject are those of Scheele; who discovered soon after the introduction of pneumatic chemistry, that beans did not germinate in any kind of gas indifferently; but that oxygen gas is necessary to the process. Achard afterwards proved that no seed will germinate in nitrogen gas, or carbonic acid gas, or hydrogen gas, except when mixed with a certain proportion of oxygen gas; and hence concluded that oxygen gas is necessary to the germination of all seeds, and the only constituent part of the atmospheric air which is absolutely necessary. The experiments of M.

Achard, were afterwards repeated and confirmed by a number of other modern chemists, who found that seeds will not germinate in nitrogen gas, but will die if put into it even after germination, at least if the radicle only is developed. Senebier found that seeds will not germinate in an artificial atmosphere that does not contain at least one eighth part of its bulk of oxygen; but that the most favorable proportion is when it contains one fourth part. It has been ascertained, however, that seeds will germinate even in an atmosphere of pure oxygen, though not so readily as when presented in a state of mixture or combination with other gasses. It cannot indeed be necessary that the oxygen consumed in germination should be presented to the seed in an uncombined state; as is obvious from the natural agency of the atmospheric air, as well as from direct experiment. Humboldt found that the process of germination is accelerated by means of previously steeping the seed in water impregnated with oxymuriatic acid. In all cases of germination the presence of oxygen is necessary. For even of those seeds that germinate in water, the germination takes place only in consequence of the oxygen which the water contains in an uncombined state. The period necessary to complete the process of germination is not the same in all seeds, even when all the necessary conditions have been furnished. Some species require a shorter, and others a longer period. The grasses are among the number of those plants whose seeds are of the most rapid germination; then perhaps cruciform plants; then leguminous plants; then labiate plants; then umbelliferous plants; and in the last order rosaceous plants, whose seeds germinate the slowest. The following table indicates the periods of the germination of a considerable variety of seeds as observed by Adanson.

	DAYS.		DAYS.
Wheat, millet seed, . . .	1	Purslain,	9
Spinage, beans, mustard, . . .	3	Cabbage,	10
Lettuce, anise seed, . . .	4	Hyssop,	30
Melon, cucumber, cress seed, . . .	5	Parsley,	40 or 50
Radish, beet root, . . .	6	Almond, chesnut, peach, . . .	1 year.
Barley,	7	Rose, hawthorn, filbert, . . .	2 years.
Orach,	8		

When a seed is committed to the soil under the conditions that have been just specified, it begins, for the most part, soon after to inhale or imbibe air and moisture, and to expand and augment in volume. This is uniformly the first symptom of incipient germination, though not always an infallible symptom; because the seed may swell with moisture merely by being soaked in water, though the vital principle should be totally extinct. But the first infallible symptom of germination is to be deduced from the prolongation of the radicle beyond the extent to which it would attain merely in consequence of soaking. In the latter case the augmentation of the radicle is limited by the extent and capacity of its envelopes, or by the quantity of moisture necessary to its saturation; or by causes inducing incipient putrefaction. But in the former case its augmentation is circumscribed by no such limits: for it not only assumes a swollen and distended appearance in consequence of the absorption of moisture; but acquires an additional and progressive increase in the actual assimilation of nutriment, bursting through its proper integuments, and directing its extremity downwards into the soil.

The next step in the process of germination is the evolution of the cotyledon or cotyledons, unless the seed is altogether a cotyledonous.

The next step, in the case of seeds furnished with cotyledons, is that of the extrication of the plumelet, or first real leaf, from within or from between the cotyledon or cotyledons, and its expansion in the open air.

The last and concluding step is the developement of the rudiments of a stem, if the species is furnished with a stem, and the plant is complete.

Such are the phenomena observable in the germination of seed; air and moisture are absorbed from the soil or atmosphere by the hilum or envelopes. Their agency is immediately exerted on the farina of the albumen or cotyledons; and a food is thus prepared for the nourishment of the tender embryo, to which it passes through the medium of the vessels of the cotyledons, or, as they have been also denominated, the seminal root. The radicle gives the first indications of life, expanding

and bursting its integuments, and at length fixing itself in the soil : the plumelet next unfolds its parts, developing the rudiments of the leaf, branch and trunk ; and finally the seminal leaves decay and drop off ; and the embryo has been converted into a plant capable of abstracting immediately from the soil or atmosphere the nourishment necessary to its future growth.

FOOD OF PLANTS.

It is of the utmost consequence to determine what is the food of plants. Upon that question philosophers have widely differed. From a variety of experiments, accurately conducted, we are led to believe that all vegetables, from the hyssop upon the wall, to the cedar of Lebanon, receive their principal nourishment from oily particles incorporated with water, by means of gasses, vegetable extracts, salts, earths and manures. Until oil is made miscible, it is unable to enter the radical vessels of vegetables ; and on that account Providence has bountifully supplied all natural soils with chalky or other absorbent particles. We say natural soils, for those which have been assisted by art are full of materials for that purpose ; such as lime, marl, soap, ashes and the volatile alkaline salt of putrid matter. It may be asked, whence do natural soils receive their oily particles ? We answer the air supplies them. During the summer months, the atmosphere is full of exhalations arising from the steam of putrid substances, the perspiration of animals and smoke. Every shower brings down these putrescent and oleaginous particles for the nourishment of plants. Of these particles some fall into the sea, where they probably serve for the nourishment of the fuci, and other submarine plants. They are, however, but seemingly lost, as the fishes taken from the sea, and the weeds thrown upon the beach, restore them again under a different form.

The ingenious Mr. Tull, and others, contend that earth is the food of plants. If so, all soils equally tilled would prove equally prolific. The increased fertility of a well pulverized soil, induced him to imagine that the plough could so minutely divide the particles of earth, as to fit them for entering into the roots of

plants. An open soil, if not too light in its own nature, will always produce plentiful crops. It readily receives the air, rains and dews into its bosom, and at the same time gives the roots of plants a free passage in quest of food. This is the true reason why land well tilled is so remarkably fruitful. Water is thought, by some, to be the food of vegetables, when in reality it is only the vehicle of nourishment. Water is a heterogeneous fluid, and is nowhere to be found in a pure state. It always contains a solution of animal, vegetable or mineral substances. These contribute to the nourishment of plants, and the element in which they are minutely suspended, acts only as a vehicle, in guiding them through the fine vessels of the vegetable body. As water is necessary to the commencement of vegetation, so is it also necessary to its progress. Plants will not continue to vegetate unless their roots are supplied with water; and if they are kept long without it, the leaves will droop and become flaccid, and assume a withered appearance. Now this is evidently owing to the loss of water. For if the roots are again well supplied with water the weight of the plant is increased, and its freshness restored. But many plants will grow, thrive and effect the development of all their parts, if the root is merely immersed in water, though not fixed in the soil. Lilies, hyacinths and a variety of plants and bulbous roots, may be so reared, and are often to be met with so vegetating; and many plants will also vegetate though wholly immersed. Most of the marine plants are of this description. It cannot be doubted, therefore, that water serves as an important vehicle of vegetable aliment.

The ingenious Dr. Priestley proves to a demonstration that the putrid air arising from decaying substances, and the perspiration of animals, is not only absorbed by vegetables, but also adds to their increase. He contends that all plants, by their leaves, as well as by their roots, imbibe these putrid vapors, which constitute a part of their food. "During the summer months," says he, "the atmosphere is full of putrid exhalations arising from the steam of dunghills, the perspiration of animals and smoke. Every shower brings down these oleaginous particles for the nourishment of plants. It is pleasing to observe how the dissolution of one

body is necessary for the life and increase of another. All nature is in motion. In consequence of the putrid fermentation that is every where carried on, a quantity of vegetable nutriment ascends into the atmosphere. Summer showers return much of it again ; but part falls into the sea and is lost. To this we may add the animal and vegetable substances consumed on board of ships, all of which are buried in the ocean. The industry of man restores them to the earth ; and we may presume that the fish taken from the sea leave a balance in favor of mankind. Thus Providence, with the most consummate wisdom, keeps up the necessary rotation of things. Hitherto I have considered plants as nourished by their roots ; I shall now take a view of them as nourished by their leaves. An attention to this part of the vegetable system is essentially necessary to the rational farmer. Vegetables that have a succulent leaf, such as vetches, peas, beans and buck wheat, draw a great part of their nourishment from the air, and on that account impoverish the soil less than wheat, oats, barley or rye, the leaves of which are of a firmer texture. Rape and hemp are oil-bearing plants, and consequently impoverishers of the soil ; but the former less so than the latter, owing to the greater succulency of the leaf. The leaves of all kinds of grain are succulent for a time, during which period the plant takes little from the earth ; but as soon as the ear begins to be formed, they lose their softness and diminish in their attractive power. The radical fibres are then more vigorously employed in extracting the oily particles of the earth for the nourishment of the seed. Such, I apprehend is the course of nature.

“ The air contains, especially during the summer months, all the principles of vegetation ; *oil*, composed of gasses, vegetable extracts, earths, manures, &c. for the perfect food, water to dilute it and salts to assimilate it. These are greedily absorbed by the vessels of the leaves and bark, and conveyed to the innermost parts of the plant for its growth and fructification.

“ In order that we may have a distinct view of the motion of the sap, it will be necessary to reflect, that the root, stem, branches and leaves are constructed in the same manner. *Sallops*, willows, vines and most shrubs will grow in an inverted

state, with their tops downwards in the earth. Dr. Bradley describes the manner of inverting a young cherry tree, the roots of which will put forth leaves, and the branches become roots. Hence it is obvious that the nutritive matter may be conveyed as well by the leaves as the roots, their vascular structure being the same.

“During the heat of a summer’s day, all plants perspire freely from the pores of their leaves and bark. At that time the juices are highly rarified. The diameters of the *tracheæ*, or air vessels, are enlarged, so as to press upon and straighten the vessels that carry the sap. In consequence of which their juices, not being able to escape by the roots, are pressed upward, where there is the least resistance, and perspire off the excrementitious part by the leaves and top branches, in the form of vapor. When the solar heat declines, the *tracheæ* are contracted. The sap vessels are enlarged, and the sap sinks down in the manner of the spirits of the thermometer. In consequence of this change, the capillary vessels of the leaves and top branches become empty. Being surrounded with the humid vapors of the evening, they fill themselves from the known laws of attraction, and send down the new acquired juices to be mixed with those that are more elaborated. As soon as the sun has altered the temperature of the air the *tracheæ* become again distended, and the sap vessels are straightened. The same cause always produces the same effect; and this alternate ascent and descent, through the same system of vessels, continues as long as the plant survives.

“Air is to be found in every portion of earth; as it always contains a solution of the volatile parts of animal and vegetable substances, we should be careful to keep our stiff soils as open as possible to its influence. It passes, both in its active and fixed state, into the absorbent vessels of the root, and mixing with the juices of the plant, circulates through every part.”

Vegetables being fixed to a particular place, have few offices to perform. An increase of body and maturation of their seed, seems all that is required of them. For these purposes, Providence has wisely bestowed upon them, organs of a wonderful mechanism. The anatomical investigation of these organs, is

the only rational method of arriving at any certainty concerning the laws of vegetable economy. Upon this subject Dr. Hales judiciously observes, "that as the growth and preservation of vegetable life is promoted and maintained, as in animals, by the very plentiful and regular motion of their fluids, which are the vehicles ordained by nature to carry nutriment to every part, it is, therefore, reasonable to hope, that in them also, by the same method of inquiry, considerable discoveries may in time be made; there being, in many respects, a great analogy between plants and animals."

CHAP. IV.

CASUALTIES AFFECTING THE LIFE OF VEGETABLES.

As plants are, like animals, organized and living beings, they are, like animals also, liable to such accidental injuries and disorders as may affect the health and vigor, or occasion the death of the individual; which is at any rate eventually effected by means of the natural decay and final extinction of the vital principle. Hence the subject of vegetable casualties divides itself into the three following heads: wounds, diseases and natural decay.

WOUNDS.

A wound is a forcible separation of the solid parts of the plant effected by means of some external cause. It may be intentional, as in the case of incision, boring, girdling, grafting, pruning, felling and such like operations; or it may be accidental, as in the case of injuries sustained by the rubbing or browsing of cattle; by the bite and depredation of insects, hares and rabbits; by lightning; by weight of fruit; or by violent storms of wind, hail and snow.

1. *Incision.* Incisions are sometimes necessary to the health

of the tree, in the same manner perhaps as bleeding is necessary to the health of the animal. The trunk of the plum and cherry tree seldom expand freely till a longitudinal incision has been made in the bark ; and hence this operation is often practised by gardeners. If the incision affects the epidermis only, it heals up without leaving any scar ; if it penetrates into the interior of the bark it heals up only by means of leaving a scar ; but if it penetrates into the wood, the wound in the wood itself never heals up completely ; but new wood and bark are formed above it as before.

2. *Boring.* Boring is an operation by which trees are often wounded for the purpose of making them part with their sap in the season of their bleeding, particularly the birch and sugar maple. A horizontal or rather slanting hole is bored in them with a wimble, so as to penetrate an inch or two into the wood, from this the sap flows copiously ; and though a number of holes is often bored in the same trunk, the health of the tree is not materially if at all affected. For trees will continue to thrive though subjected to this operation for many successive years ; and the hole, if not very large, will close up again like the deep incision, not by the union of the broken fibres of the wood, but by the formation of new bark and wood projecting beyond the edge of the orifice, and finally shutting it up altogether.

3. *Girdling.* Girdling is an operation to which trees in newly-settled countries are often subjected when the farmer wishes to clear his land of timber. It consists in making parallel and horizontal incisions with an axe into the trunk of a tree, and carrying them quite round the stem so as to penetrate through the liber into the alburnum, and then to scoop out the intervening portion. If this operation is performed early in the spring and before the commencement of the bleeding season, the tree rarely survives it ; though some trees that are peculiarly tenacious of life, such as the sugar maple and mountain tupelo, have been known to survive it a considerable length of time.

4. *Fractures.* If a tree is bent so as to break only a part of the cortical and woody fibres, and the stem or branch but small, the parts will again unite by being put back into their natural

position, and well propt up. Especially the cure may be expected to succeed if the fracture happens in the spring; but it will not succeed if the fracture is accompanied with contusion, or if the stem or branch is large; and even where it succeeds, the woody fibres do not contribute to the union, but the granular and herbaceous substance only which exudes from between the wood and liber, insinuating itself into all interstices, and finally becoming indurated into wood.

5. *Pruning.* Wounds are necessarily inflicted by the gardener or forester in the pruning or lopping off of superfluous branches, but this is seldom attended with any bad effects to the health of the tree, if done by a skilful practitioner; indeed no further art is required merely for the protection of the tree, beyond that of cutting the branch through in a sloping direction so as to prevent the rain from lodging. In this case the wound soon closes up by the induration of the exposed surface of the section, and by the protrusion of a granular substance, forming a sort of circular lip between the wood and bark; and hence the branch is never elongated by the growth of the same vessels that have been cut, but by the protrusion of new buds near the point of section.

6. *Grafting.* In this operation there is a wound both of the stock and graft; which are united not by the immediate adhesion of the surfaces of the two sections, but by means of a granular and herbaceous substance exuding from between the wood and bark, and insinuating itself as a sort of cement into all open spaces: new wood is finally formed within it, and the union is complete.

7. *Felling.* Felling is the operation of cutting down trees close to the ground which many of them will yet survive, if the stump is protected from the injuries of animals, and the root fresh and vigorous. In this case the fibres of the wood are never again regenerated, but a lip is formed as in the case of pruning; and buds, that spring up into new shoots, are protruded near the section: so that from the old shoot, ten, twelve or even twenty new stems may issue according to its size and vigor. The shoots of the oak and ash will furnish good examples; but there are

some trees, such as the fir, that never send out any shoots after the operation of felling.

8. *Destruction of Buds.* It has been already shown that the buds which expand in the spring are generated in the preceding summer, and augmented and prepared for development in the intervening winter. But if the buds are destroyed in the course of the winter, or in the early part of the spring, many plants will again generate new buds that will develop their parts as the others would have done, except that they never contain blossom or fruit; probably because the fruit bud requires more time to develop its parts, or a peculiar and higher degree of elaboration; and that this hasty production is only the effect of a great effort of the vital principle for the preservation of the individual, and one of those wonderful resources to which nature always knows how to resort when the vital principle is in danger.

9. *Destruction of Leaves.* Sometimes the leaves of a tree are destroyed partially or totally as soon as they are protruded from the bud, whether by the depredations of caterpillars or other insects, or by the browsing of cattle. But if the injury is done early in the spring, new leaves will be again protruded with subsequent shoots. Some trees will bear to be stripped of their leaves even more than once in a season, as is the case with the mulberry tree, which is cultivated for the purpose of feeding silk worms. But if it is stripped more than once in the season it requires now and then a year's rest.

10. *Destruction of Bark.* The decortication of a tree, or the stripping it of its bark, may be intentional or accidental, partial or total. If it is partial and affects the epidermis only, then it is again regenerated, as in the case of slight incision, without leaving any scar. But if the epidermis of the petal, leaf or fruit, is destroyed, it is not again regenerated, nor is the wound healed up except by means of a scar. Such is the case also with all decortications that penetrate deeper than the epidermis, particularly if the wound is not protected from the action of the air. And if the decortication reaches to the wood, then the wound will not heal in the foregoing manner at all. If the decortication is total, the tree dies. Of sixty trees which

Du Hamel barked in the spring, no one survived the experiment above three or four years, though many of them generated a portion both of wood and bark, originating at the summit, and descending sometimes to the extent of a foot.

DISEASES.

Diseases are corrupt affections of the vegetable body, arising from a vitiated state of its juices, and tending to injure the habitual health either of the whole or a part. The diseases that occur the most frequently among vegetables are the following: blight, smut, mildew, honeydew, dropsy, flux of juices, gangrene, etiolation, suffocation, contortion and consumption.

1. *Blight*. Blight is a general name given for various distempers incident to corn and fruit trees. The term has been used in a very vague and indefinite manner. The origin of the disease has been variously accounted for. There appear to be at least three distinct species of it. The first originates in cold and frosty winds in spring, which nip and destroy the tender shoots of the plant, by stopping the circulation of the juices. The leaves wither and fall; the juices burst the vessels, and become the food of numerous insects, which are often mistaken for the cause of the disease, while they are really an effect of it. The second species originates in a sultry and pestilential vapor, and happens in summer when the grain has attained its full growth. The third originates in fungi, which attack the leaves or stem of herbaceous and woody plants; but more generally grasses, and particularly the most useful grains. It generally assumes the appearance of a rusty looking powder, which soils the finger when touched. There are several sorts of these fungi, known to farmers under the names of *red rust*, *red gum*, &c. The only means of preventing the effect of blight is proper culture. Palliatives are to be found in topical applications.

2. *Smut*. Smut is a disease incidental to cultivated corn by which the farina of the grain, together with its proper integuments, and even part of the husk, is converted into a black soot-like powder. If the injured ear is struck with the finger, the powder

will be dispersed like a cloud of black smoke ; and if a portion of the powder is wetted by a drop of water and put under the microscope, it will be found to consist of millions of minute and transparent globules, which seem to be composed of a clear and glairy fluid, encompassed by a thin and skinny membrane.

This disease does not affect the whole body of the crop, but the smutted ears are sometimes very numerously dispersed throughout it. Some have attributed it to the soil in which the grain is sown, and others have attributed it to the seed itself, alleging that smutted seed will produce a smutted crop. But in all this there seems to be a great deal of doubt. Willdenow regards it as originating in a small fungus, which multiplies and extends till it occupies the whole ear. But Mr. F. Bauer of Kew, seems to have ascertained it to be merely a morbid swelling of the ear, and not at all connected with the growth of a fungus.

It is said to be effectually prevented by steeping the grain before sowing in a weak solution of arsenic.

But besides the disease called smut, there is also a disease analogous to it, or a different stage of the same disease, known to the farmer by the name of *bags*, or *smut balls*, in which the nucleus of the seed only is converted into a black powder, while the ovary, as well as the husk, remains sound. The ear is not much altered in its external appearance, and the diseased grain contained in it will even bear the operation of threshing, and consequently mingle with the bulk. But it is always readily detected by the experienced buyer, and fatal to the character of the sample. It is prevented as in the case of smut.

3. *Mildew*. Mildew is a thin and whitish coating with which the leaves of vegetables are sometimes covered, occasioning their decay and death, and injuring the health of the plant. It is frequently found on the leaves of the *Humulus*, *Supulus* and the white and yellow dead nettle. It is found also on wheat in the shape of a glutinous exudation, particularly when the days are hot and the nights without dew. Willdenow says it is occasioned by the growth of a fungus of great minuteness, the *Mucor erisyphe* of Linnæus ; or by a sort of whitish slime

which some species of aphides deposit upon the leaves. In cultivated crops it is said to be prevented by manuring with soot.

4. *Honeydew.* Honeydew is a sweet and clammy substance which coagulates on the surface of the leaves during hot weather, particularly on the leaves of the oak, walnut and beech, and is regarded by Mr. Curtis, who wrote a paper on the subject, as being merely the dung of some species of aphides. This seems to be the opinion of Willdenow also, and it is no doubt possible that it may be the case in some instances or species of the disease. But Sir J. E. Smith contends that it is not always so, or that there are more species of honeydew than one, regarding it particularly as being an exudation, at least in the case of the beech, whose leaves are, in consequence of an unfavorable wind, apt to become covered with a sweet sort of glutinous coating, similar in flavor to the fluid obtained from the trunk.

It is certain, however, that saccharine exudations are found on the leaves of many plants, though not always distinguished by the name of honeydew; which should not perhaps be applied except when the exudation occasions disease. But if it is to be applied to all saccharine exudations whatever, then we must include under the appellation of honeydew the saccharine exudation observed on the orange tree by M. De la Hire, together with that of the lime tree which is more glutinous, and of the poplar which is more resinous; as also that of the *Cistus creticus*, from which the resin *Labdanum* is collected, by means of beating the shrub with leathern thongs, and of the manna which exudes from the ash tree of Italy and larch of France. It is also possible that the exudation of excrement constituting honeydew may occasionally occur without producing disease; for if it should happen to be washed off soon after by rains or heavy dews, then the leaves will not suffer.

5. *Dropsy.* Plants are also liable to a disease which affects them in a manner similar to that of the dropsy in animals, arising from long continued rain or too abundant watering. Willdenow describes it as occasioning a preternatural swelling of particular parts, and including putrefaction. It is said to take place chiefly in bulbous and tuberous roots, which are often found much

swollen after rain. It affects fruits also which it renders watery and insipid. It prevents the ripening of seeds, and occasions an immoderate production of roots from the stem. Succulent plants in particular are apt to suffer from too profuse waterings, and the disease thus occasioned is generally incurable. The leaves drop, even though plump and green; and the fruit rots before reaching maturity. In this case the absorption seems to be too great in proportion to the transpiration; but the soil when too much manured produces similar effects. Du Hamel planted some elms in a soil that was particularly well manured, and accordingly they pushed with great vigor for some time; but at the end of five or six years they all died suddenly. The bark was found to be detached from the wood, and the cavity filled up with a reddish colored water.

6. *Flux of Juices.* Some trees, but particularly the oak and birch, are liable to a great loss of sap, either bursting out spontaneously, owing to a superabundance of sap, or issuing from accidental wounds. Sometimes it is injurious to the health of plants, and sometimes not. There is a spontaneous extravasation of the sap of the vine, known by the name of the tears of the vine, which is not injurious. As it often happens that the root imbibes sap, which the leaves are not yet prepared to throw off because not yet sufficiently expanded, owing to an inclement season, the sap which is first carried up, being propelled by that which follows, ultimately forces its way through all obstructions, and exudes from the bud. But this is observed only in cold climates; for in hot climates, where the development of the leaves is not obstructed by cold, they are ready to elaborate the sap as soon as it reaches them. There is also a spontaneous extravasation of proper juice in some trees, which does not seem in general to be injurious to the individual. Thus the gum which exudes from the cherry, plum, peach and almond trees, is seldom detrimental to their health, except when it insinuates itself into the other vessels of the plant and occasions obstructions. But when the sap ascends more copiously than it can be carried off, it sometimes occasions a fissure of the solid parts, inducing disease or deformity by encouraging the extravasation and

corruption of the ascending or descending juices. Sometimes the fissure is occasioned by means of frost, forming what is called a double alburnum; that is, first a layer that has been injured by the frost, and then a layer that passes into the wood. Sometimes a layer is partially affected, and that is generally owing to a sudden and partial thaw, on the south side of the trunk, which may be followed again by a sudden frost. In this case the alburnum is split into clefts, or chinks, by means of the expansion of the frozen sap. But a cleft thus occasioned often degenerates into a chilblain that discharges a blackish and acrid fluid to the great detriment of the plant, particularly if the sore is so situated that rain or snow will readily lodge in it, and become putrid. The same injury may be occasioned by the bite or puncture of insects while the shoot is yet tender; and as no vegetable ulcer heals up of its own accord, the sooner a remedy is applied to it the better, as it will, if left to itself, ultimately corrode and destroy the whole plant, bark, wood and pith. The only remedy is the excision of the part affected, and the application of a coat of grafting wax.

7. *Gangrene.* Of this disorder there are two varieties, the dry and the wet. The former is occasioned by the means of excessive heat or cold. If by means of cold, it attacks the leaves of young shoots, and causes them to shrink up, converting them from green to black; as also the inner bark, which it blackens in the same manner, so that it is impossible to save the plant except by cutting it to the ground. If by means of heat, the effects are nearly similar, as may often times be seen in gardens, or even in forests, where the foresters clear away the moss and withered leaves from the roots. Sometimes the disease is occasioned by the too rapid growth of a particular branch, depriving the one that is next to it of its due nourishment, and hence inducing its decay. Sometimes it is occasioned by means of parasitical plants, as in the case of the bulbs of the saffron, to which a species of *Lycoperdon* often attaches itself and totally corrupts. The harmattan winds of the coast of Africa kill many plants, by means of inducing a sort of gangrene that withers and blackens the leaves, and finally destroys the whole plant. The nopal of

Mexico is also subject to a sort of gangrene that begins with a black spot, and extends till the whole leaf or branch rots off or the plant dies.

But plants are sometimes affected with a gangrene by which a part becomes first soft and moist, and then dissolves into foul *ichor*. This is confined chiefly to the leaves, flowers and fruit. Sometimes it attacks the roots also, but rarely the stem. It seems to be owing in many cases to too wet or too rich a soil; but it may originate in contusion, and may be caught by infection.

But the nopal is subject also to a disease called by Thiery *la dissolution*, and considered by Sir J. E. Smith as distinct from gangrene. A joint of the nopal, or a whole branch and sometimes an entire plant, changes in the space of a single hour from a state of apparent health to a state of putrefaction or dissolution. Now its surface is verdant and shining, and in an instant it changes to a yellow, and its brilliancy is gone. If the substance is cut into, the parts are found to have lost all cohesion, and are quite rotten; the only remedy is speedy amputation below the diseased part. Sometimes the vital principle collecting and exerting all its energies, makes a stand as it were against the encroaching disease, and throws off the infected part.

8. *Etiolation*. Plants are sometimes affected by a disease which entirely destroys their verdure, and renders them pale and sickly. This is called *etiolation*, and may arise merely from want of the agency of light, by which the extrication of oxygen is effected, and the leaf rendered green. And hence it is that plants placed in dark rooms, or between great masses of stone, or in the clefts of rocks, or under the shade of other trees, look always peculiarly pale. But if they are removed from such situations and exposed to the action of light, they will again recover their green color. Etiolation may also ensue from the depredation of insects, nestling in the radicle, and consuming the food of the plant, and thus debilitating the vessels of the leaf so as to render them insusceptible to the action of light. This is said to be often the case with the radicles of *Secale cereale* or common rye, and the same result may also arise from poverty of soil.

9. *Suffocation.* Sometimes it happens that the pores of the epidermis are closed up and transpiration consequently obstructed, by means of some extraneous substance that attaches itself to and covers the bark. This obstruction induces disease, and the disease is called suffocation. Sometimes it is occasioned by the immoderate growth of lichens upon the bark covering the whole of the plant, as may be often seen on fruit trees, which it is necessary to keep clean by means of scraping of the lichens, at least from the smaller branches. For if the young branches are thus coated, so that the bark cannot perform its proper functions, the tree will soon begin to languish, and will finally become covered with fungi inducing or resulting from decay, till it is at last wholly choked up. But a similar effect is also occasionally produced by insects, in feeding upon the sap or shoot. This may be exemplified in the case of the aphides, which sometimes breed or settle upon the tender shoot in such multitudes as to cover it from the action of the external air altogether. Sometimes the disease is occasioned by an extravasation of juices which coagulate on the surface of the stalk, so as to form a sort of crust, investing it as a sheath, and preventing its further expansion. Sometimes the disease is occasioned from want of an adequate supply of nourishment as derived from the soil, in which the lower part of the plant is the best supplied, while the upper part of it is starved. Hence the top shoots decrease in size every succeeding year, because a sufficient supply of sap cannot be obtained to give them their proper development. This is analogous to the phenomena of animal life when the action of the heart is too feeble to propel the blood through the whole of the system. For then the extremities are always the first to suffer. And perhaps it may account also for the fact, that in bad soils and unfavorable seasons, when the ear of barley is not wholly perfected, yet a few of the lower grains are always completely developed; which not only shows the great care of Providence for the preservation of the species, but points out also the efficient cause.

10. *Contortion.* The leaves of plants are often injured by means of the puncture of insects, so as to induce a sort of

disease that discovers itself in the contortion or convolution of the margin, or wrinkled appearance of the surface. The leaves of the apricot, peach and nectarine, are extremely liable to be thus affected in June and July. The leaf that has been punctured soon begins to assume a rough and wrinkled figure, and a reddish and scrofulous appearance, particularly on the upper surface. The margins roll inwards on the under side, and inclose the eggs which are scattered irregularly on the surface, giving it a blackish and granular appearance, but without materially injuring its health. In the vine the substance deposited on the leaf is whitish, giving the under surface a sort of a frosty appearance, but not occasioning the red and scrofulous aspect of the upper surface of the leaf like that of the nectarine.

Sometimes the upper surface of the leaf is covered with clusters of wart like substances somewhat subulate and acute. They seem to be occasioned by means of a puncture made on the under surface, on which a number of openings are discoverable, penetrating into the warts which are hollow and villous within.

11. *Consumption.* From barren or improper soil, unfavorable climate, careless planting or too frequent flowering, exhausting the strength of the plant, it often happens that disease is induced which terminates in a gradual decline and wasting away of the plant, till at length, it is wholly dried up. Sometimes it is also occasioned by excessive drought, or by dust lodging on the leaves, or by fumes issuing from manufactories which may happen to be situated in the neighborhood; or by the attacks of insects.

There is a consumptive affection that frequently attacks the pine tree, called *Tepedo pinorum*, which affects the alburnum and inner bark chiefly, and seems to proceed from long continued drought, or from frost suddenly succeeding mild or warm weather or heavy winds. The leaves assume a tinge of yellow bordering upon red. A great number of small drops of resin exude from the middle of the boughs of a putrid odor. The bark exfoliates, and the alburnum presents a livid appearance. The tree swarms with insects, and the disease is incurable, inducing inevitably the total decay and death of the individual.

NATURAL DECAY.

In the preceding section we have stated the chief of the diseases to which plants are liable, whether from external injuries, or from internal derangement. But although a plant should not suffer from the influence of accidental injury, or from disease, still there will come a time when its several organs will begin to experience the approaches of a natural decline insensibly stealing upon it, and at last inducing death. For in the vegetable as well as in the animal kingdom, there is a term or limit set, beyond which the individual cannot pass, though the duration of vegetable existence is very different in different species.

Some plants are annuals and last for one season only, springing up suddenly from seed, attaining rapidly to maturity, producing and again sowing their seeds, and afterwards immediately perishing. Such is the character of the various species of corn. Some plants continue to live for a period of two years, and are therefore called biennials, springing up the first year from seed, and producing root and leaves, but no fruit; and in the second year producing both flower and fruit, as exemplified in the carrot, parsnip and cabbage. Other plants are perennials, that is, lasting for many years; of which some are called under shrubs, and die down to the root every year; others are called shrubs, and are permanent both by the root and stem, but do not attain to a great height or great age; others are called trees, and are not only permanent by both root and stem, but attain to a great size and live to a great age. The oak tree in particular is remarkable both for its longevity and size, being at least 100 years before it attains to its utmost perfection, continuing vigorous for perhaps 100 years more, and then beginning to decay.

But even of plants that are woody and perennial, there are parts which perish annually, or which are, at least annually separated from the individual; namely, the leaves, flowers and fruit, leaving nothing behind but the bare caudex, which submits in its turn to the ravages of time, and ultimately to death. Hence the ground of a division of the subject exhibiting, first

the phenomena of the temporary organs, and secondly, the phenomena of the decay of the permanent organs and consequent death of the plant.

DECAY OF THE TEMPORARY ORGANS.

The decay of the temporary organs which takes place annually is a phenomenon familiar to every body, and comprehends the fall of the leaf, the fall of the flower and the fall of the fruit.

1. *The fall of the leaf.* The fall of the leaf, or annual defoliation of the plant, commences for the most part with the colds of the autumn, and is accelerated by the frosts of winter, that strip the forest of its foliage, and the landscape of its verdure. But there are some trees that retain their leaves throughout the whole winter, though changed to a dull and dusky brown, as those of the beach tree; and there are others that retain them even in verdure till the succeeding spring, when they ultimately fall. Such plants are denominated evergreens.

It was at one time indeed a vulgar error, and perhaps it continues to be so still, that evergreens never shed their leaves at all. This error may be traced back even to the period of the fabulous history of the Greeks, with whose mythology it was closely interwoven, at least in one particular example as related by Theophrastus; who says that in the country of Cortynia, in Crete, it was reported there was a plane tree growing by a fountain which never shed its leaves, being the tree under the shade of which Jupiter was said to have had his interview with Europa. But Theophrastus was himself acquainted with the fact of the fall of the leaves of evergreens, as every accurate observer of nature must be, though they do not actually fall till the young leaves have begun to appear, so that trees of this sort are never left wholly without leaves, which it was hence supposed they never shed. In warm climates it is said that many plants retain their leaves for several years; but in temperate and polar climates there are no such plants to be found.

Such is the fact of the annual fall of the leaves. What is the cause of their fall? The solution of this question seems to have

totally baffled the attempts of phytologists, and to have been a puzzle that no one could make out. Du Hamel, one of the most sagacious and industrious of all phytologists, labored hard to explicate the phenomenon, but without success. He observed that leaves which fall the soonest transpire the most, and are consequently the soonest exhausted and rendered unfit for the discharge of their functions; so that the period of the fall of the leaves of different species is probably in proportion to their capacity for transpiration. Their fall is accelerated by frost, or by excessive heat, followed by rain. It is also accelerated, if not actually induced, by the structure of the pedicle which is very different from that of the branch, having no prolongation of pith, and nothing analogous in its mode of insertion, nor in its external figure, which is divisible into an upper and under surface resembling the figure of the leaf. He compares the union of the leaf and stem to that of the joints of the vine twig, which at a certain period of its growth are stronger than the *internodia*, but which readily give way after a frost. The comparison, however, throws but little light on the subject, as the illustration is itself, full as dark as the thing to be illustrated. But he offers an additional conjecture which is considerably more luminous; when the sap begins to flow less plentifully, the leaves, to whose vigor a great supply is necessary, soon become dry and consequently less fit to convey it. But it is known that the branches grow in thickness after they have ceased to grow in length, which must necessarily occasion, in some degree, a disruption of the fibres of the foot stalk and stem or branch, at the point of articulation; and hence the leaf loses its hold, and falls. This is certainly a very plausible conjecture; though it may be doubted whether the explication will apply to the case of evergreens, or of plants in warm climates, that retain their leaves for several years. It is not therefore, altogether satisfactory; and hence other explications have accordingly been offered.

The first of these explications of which we shall now take any notice is that of Willdenow; it is as follows. As the sap is conveyed to the leaves in greater abundance during the summer, the vessels of the petiole become gradually more woody, as well

as the whole of the leaf. The sap in consequence stagnates, and at last the bond of union between the leaf and stem is dried up, and cracks. The wound that the stem thus receives cicatrizes before the petiole separates; and the petiole separates at last in consequence of the interrupted connexion between the leaf and stem, which the crack has occasioned. This, it must be confessed, does not make up for the deficiencies of the hypothesis of Du Hamel; for in the first place there is no proof that the bond of union between the leaf and stem cracks in the manner here supposed. And even upon the supposition of its being the fact, it is, in the second place, extremely improbable that the petiole should after the cracking of this bond of union still continue attached to the stem, till the wound thus occasioned has cicatrized; because when the original bond of union cracks, there remains no other bond of union by which the petiole is to retain its hold.

Another explication is that of Vorlick, as quoted by Willdenow; the leaf which possesses a peculiar vitality within itself, though dependant upon the vitality of the plant, and generally of shorter duration, dies when it reaches maturity; and the plant, being able to exist for a time without leaves, throws off the dead leaf as the animal throws off the dead part from the sound part. But the peculiar vitality which the leaf is here supposed to possess seems to be altogether a groundless assumption, and an unphilosophical multiplication of causes without any apparent necessity. Is it not the individual vitality of the plant extended to a perishable organ, and again withdrawn when that organ has discharged its destined functions, or become by disease or decay unfit for the purposes of vegetation? This, we presume, is a better founded supposition than the foregoing; though the reference to the phenomenon of the throwing off of the dead part from the sound part in the animal subject is sufficiently well adapted to the purposes of illustration; and the analogy sufficiently striking, at least under some of its aspects, to warrant its introduction. It does not, however, seem quite evident that the idea of sloughing is comprehended in the opinion of Vorlick, at least as represented by Willdenow; but if so, the analogy does

not appear to be very well made out. Sloughing, in the animal economy, is that power, or the exertion of that power by which the vital principle is capable of throwing off a part that has accidentally become diseased and unfit for discharging the functions to which it was originally destined ; but not that power by which it is capable of throwing off a distinct organ intended by nature to be finally separated from the individual. Now in the case of the defoliation of the plant, there is, for the most part no disease, but merely a gradual and natural decay which reduces the leaf to a state, indeed, no longer fit for the purposes of vegetation, but to which it was intended by nature to be reduced for the purpose of facilitating its separation from the plant : and hence it always separates in a determinate manner, and at a determinate point, namely, at the base of the foot stalk, which forms as it were a sort of natural joint or articulation, to which there is nothing analogous in the case of sloughing. If this were not the fact, it might be expected that a part of a leaf, or even the whole of it, should occasionally become permanent, as well as in the branches, though no such thing has ever yet happened. And with the sloughing of the diseased part there is yet another circumstance clashing with the analogy that is here instituted. The part supplying the place of the slough, or throwing it off, is formed or exists already formed immediately beneath it, and is precisely of the same character with what the slough originally was ; which slough it pushes off as it comes itself to maturity, or acquires strength sufficient for the effort. But the leaves fall off when they have reached maturity of their own accord, without being at all pushed off by the new ones, which are yet merely in embryo, and do not even occupy the place of old leaves, but are only formed contiguous to them, except in the case of the plane tree, the new leaf of which is formed precisely under the base of the foot stalk of the old leaf ; and yet we would not call the fall of that leaf sloughing, because the new leaf does not after all push off the old one ; and because there is here, as in other cases, the same natural articulation uniting the leaf to the branch or stem, and rendering it a distinct organ that is ultimately and spontaneously to detach itself from the plant. Not that there

exists any example whatever of vegetable sloughing, which the same tree will also furnish in the annual or rather continual exfoliation of its bark, but that the fall of the leaf does not seem to afford that example.

We can foresee an objection that may be urged against the above argument from the fact of the sloughing of the entire skin of the snake, and other species of serpents, which may be regarded as a distinct organ. But although the skin of the snake or any other animal may be regarded as a distinct organ, yet it must be in a light very different from that of an organ attached to the body of a plant or animal by a natural joint or articulation that comes asunder of its own accord; for the skin of the animal in question is forced off in the manner of a slough merely by means of the formation of a new skin beneath it, which has already taken the place of the old skin in the living system, and to which it has just been shown that there exists nothing whatever analogous in the fall of the leaf. So that, after all, the best reason we can give is, perhaps, that the leaves fall in consequence of their being worn out, and no longer necessary to the immediate process of vegetation; which is evidently divisible into animal stages commencing with the approach of spring, and terminating with the return of winter, which is to the vital principle, apparently, a period of rest. If it is necessary, however, to attempt an exemplification of the process by which the leaf is made ultimately to detach itself from the plant, it may be observed that it consists wholly in the change that is effected in the articulation uniting the foot stalk to the branch; for in the case in which the injury extends suddenly beyond the leaf, the leaf may wither and decay, but will not fall off, because the articulation has not been duly prepared, and because the vital principle can now no longer act upon it from the intervention of the dead or diseased portion of the plant beyond which it has withdrawn itself. But in the natural process of vegetation the necessary change is effected by the leaf on the one hand, in its yielding to the influence of physical or chemical agencies, and withering and shrinking into narrow compass, when the usual supply of sap is no longer transmitted to it; and by the vital principle on the

other, in its controlling and directing of chemical agencies so as to facilitate the final detachment of the foot stalk, and form the scar necessary to its own protection. And this effect is operated by the converting of the substance that cements the respective fibres of the leaf stalk and branch together from a soft and glutinous to a dry and brittle consistence, analogous to the change that takes place in the seams of the valves of ripening capsules or pericarps, so that the leaf falls at last merely by force of its own weight, or of the slightest breath of wind, but without the intervention of any previous chink or crack. And if it is necessary to illustrate the fall of the leaf by any analogous process in the animal economy, it may be compared to that of the shedding of the antlers of the stag, or of the hair or feathers of other animals, which being like the leaves of plants, distinct and peculiar organs, fall off and are regenerated annually, but do not slough.

2. *The fall of the flower.* The flowers, which like leaves, are only temporary organs, and for the most part very short-lived; for, as the object of their production is merely that of effecting the impregnation of the germ, that object is no sooner obtained than they begin again to give indications of decay, and speedily fall from the plant; so that the most beautiful of the vegetable is also the most transient. The flower of the *Cactus grandiflorus*, the most magnificent of all flowers, no sooner expands than it begins to decay, and before the sun has risen upon it, its beauty is gone. The flowers of the tulip and poppy, though very gaudy, are very short-lived; and the beautiful blossom of our fruit trees soon begin to fade. The scene often continues blooming indeed, both in the landscape of nature and of art, but that is more owing to the succession of blossoms on the same or on different plants, than to the permanency of individual blossoms. And so also of the flowers that adorn the field or meadow; they spring up in continual succession, but are individually of very short duration.

3. *The fall of the fruit.* The fruit, which begins to appear conspicuous when the flower falls, expands and increases in volume, and, assuming a peculiar hue as it ripens, ultimately

detaches itself from the parent plant and drops into the soil. But it does not in all cases detach itself in the same manner; thus in the bean and pea the seed vessel opens and lets the seeds fall out; while in the apple, pear and cherry, the fruit falls entire, inclosing the seed, which escapes when the pericarp decays. Most fruits fall soon after ripening, as the cherry and apricot, if not gathered; but some remain long attached to the parent plant after being fully ripe, as in the case of *Cratægus* or hawthorn which may be seen in the hedges in the midst of winter, and of *Mespilus*, or medlar, and a variety of others which continue till the succeeding spring. But these, though tenacious of their hold, detach themselves at last, as well as all others, and bury themselves in the soil, about to give birth to a new individual in the germination of the seed. The fall of the flower and fruit is accounted for in the same manner as that of the leaf.

DECAY OF THE PERMANENT ORGANS.

Such then is the process and presumptive rationale of the decay and detachment of the temporary organs of the plant. But there is also a period beyond which even the permanent organs themselves can no longer carry on the process of vegetation. Plants are affected by the infirmities of old age as well as animals, and are found to exhibit also similar symptoms of approaching dissolution. The root refuses to imbibe the nourishment afforded by the soil, or if it does imbibe a portion, it is but feebly propelled, and partially distributed, through the tubes of the alburnum; the elaboration of the sap is now effected with difficulty, as well as assimilation of the proper juice, the descent of which is almost totally obstructed; the bark becomes thick and woody, and covered with moss and lichens; the shoots become stunted and diminutive; and the fruits palpably degenerate, both in quantity and quality. The smaller or terminal branches fade and decay the first, and then the larger branches also, together with the trunk and root; the vital principle gradually declines without any chance of recovery, and is at last

totally extinguished; while the solid mass of the plant exposed to the chemical action of surrounding substances, to which it now yields, withers and dies away, presenting to the eye a decayed and rotten appearance, and crumbling into dust from which it originally sprang. Such is the transient duration of the vegetable, and counterpart of animal life.

EXPLANATION OF PLATE I.

Fig. 1. A transverse section of a branch of ash, as it appears to the eye.

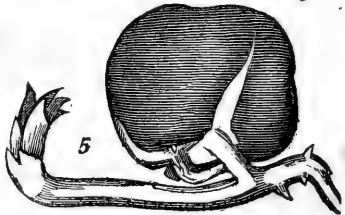
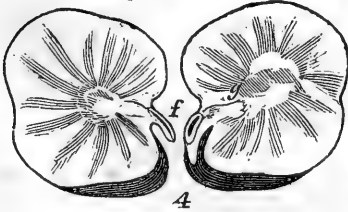
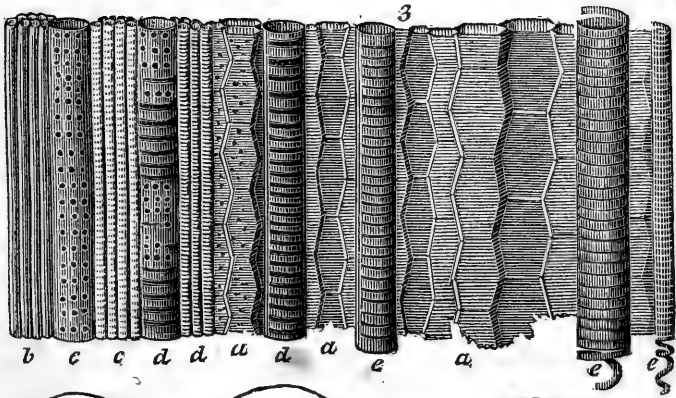
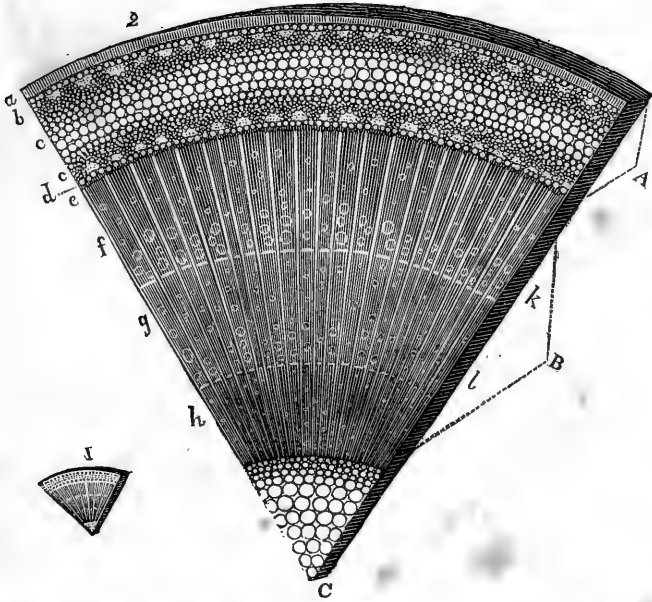
Fig. 2. The same section magnified. A, the bark. B, the wood. C, the pith. *a*, the cuticle. *b*, an arched ring of sap vessels next the cuticle. *cc*, the cellular substance of the bark with its cells, and other arched rings of sap vessels. *d*, a circular line of lymph ducts, immediately below the above arched ring. *e*, the liber. *h*, the first year's growth. *g*, the second. *f*, the third year's growth. *k*, the great air vessels. *l*, the small ones.

Fig. 3. Anatomy of wood after Mirbel, magnified. *a*, the cellular texture. The membraneous sides of all these cells and tubes, are very thin, more or less transparent, often porous, variously perforated or torn. *b*, a bundle of entire vessels without perforations. *c*, tubes pierced with holes ranged in a close spiral line. *d*, tubes having several of these holes running together, as it were, into interrupted spiral clefts. *e*, tubes, which, in some young branches and tender leaves, will unroll to a considerable extent, when they are gently torn asunder.

Fig. 4. A garden bean (*Vicia faba*), laid open, showing its two cotyledons. *f*, the radicle, or that part of the corculum which afterwards forms the root; *g*, the corculum or germ.

Fig. 5. A bean which has made some progress in vegetation, showing the descending root, the ascending plumula and skin of the seed bursting irregularly.

PLATE I.





SYLVA AMERICANA.

PART II.

DENDROLOGY.

ABIES.

Monœcia Monadelphia. LINN. Coniferæ. Juss. *Expectorant, secernant, stimulant.*

WHITE OR SINGLE SPRUCE. *Abies alba.*



PLATE II.

Fig. 1. A branch with a cone. Fig. 2. A seed.

This tree, which appertains to the coldest regions of North America, is called in Canada *Epinette blanche*, in Nova Scotia *White Spruce*, and in New Brunswick and the state of Maine *Single Spruce*. As the last two denominations are generally known, we have adopted that which appeared the best. It is most abundant in Lower Canada, Newfoundland, New Brunswick, Nova Scotia, in Maine, Vermont, New Hamp-

shire and Massachusetts, but is rarely seen farther south except in cold and humid situations. The situations in which the white spruce is the most abundant is of a moist sandy loam.

It usually attains the height of 40 or 50 feet, and a diameter of 12 or 16 inches at three feet from the ground. Its trunk is more tapering than the black spruce, and like which is a regular pyramid, but less branching and tufted. The bark is lighter colored, and the difference is more striking upon the young shoots. The leaves are of a pale, bluish green, whence is derived its specific name *alba*, about four lines in length, encompassing the branches like the black species, but less numerous, more pointed and at a more open angle with the branches. It flowers in May or June, which are succeeded by reddish cones of a lengthened oval form, about two inches in one direction, and six or eight lines in the other : the dimensions vary according to the vigor of the tree, but the form is unchangeable. The scales are loose and thin, with entire edges, unlike those of the black spruce. The seeds, also, are rather smaller, and are ripe about the end of autumn.

The wood is employed for the same uses as the black spruce which will be hereafter described ; it is, however, inferior in quality, and snaps more frequently in burning. The fibres of the roots, macerated in water, are very flexible and tough ; being deprived in the operation of their pellicle, they are used in Canada to stitch together their canoes of birch bark, the seams of which are afterwards smeared with a resin that distils from the tree. The bark is sometimes used in tanning, though much inferior to the hemlock spruce. The branches are not used for beer, because the leaves when bruised diffuse an unpleasant odor, which they are said to communicate to the liquid. The resin of this tree is composed of a fragrant essential oil, and probably containing sylvic or pinic acid. It is solid, dry, brittle, of a pale yellowish brown color, frequently intermixed with white streaks and whitish when broken. Medicinally it is a stimulant and rubefacient, and is employed externally in form of plaster in chronic catarrh, hooping cough, rheumatic pains, etc.

AMERICAN SILVER FIR. *Abies balsamifera*.

PLATE III.

Fig. 1. A branch with a conc. Fig. 2. A seed.

The coldest regions of North America are the native country of this species of spruce. In the United States, Canada and Nova Scotia, it is called *Silver Fir*, *Fir Balsam*, and *Balsam of Gilead*. It does not constitute masses of woods, but is disseminated, in a greater or less abundance, among the hemlock and black spruces. Farther south it is found only on the summit of the Alleghanies, and particularly on the highest mountains of North Carolina. Like the

other spruces it generally flourishes best in a moist sandy loam.

Its height rarely exceeds 40 feet, with a diameter of 12 or 15 inches. The trunk tapers from a foot in diameter at the surface of the ground to 7 or 8 inches, at the height of 6 feet. When standing alone and developing itself naturally, its branches, which are numerous and thickly garnished with leaves, diminish in length in proportion to their height, and form a pyramid of perfect regularity. The bark is smooth and delicate. The leaves are 6 or 8 lines long, and are inserted singly on the sides and on the top of the branches; they are narrow, rigid and flat, of a bright green above and a silvery white beneath; whence probably is derived the name of the tree. It flowers in May, and is followed by cones of a fragrant odor, which are nearly cylindrical, 4 or 5 inches long, an inch in diameter, and always directed upwards. The seeds are ripe in autumn, and if permitted to hang late will fall apart and scatter themselves.

The wood of the silver fir is light and slightly resinous, and the heart is yellowish. It is sometimes used for the staves of

casks used for packing fish ; but for this purpose many other kinds of wood are preferred. The resin of the pines is extracted by means of incisions in the body of the tree, at which it exudes from the pores of the bark and from the sap vessels of the alburnum. In the silver fir this substance is naturally deposited in vesicles on the trunk and limbs, and is collected by bursting these tumors and receiving their contents in appropriate vessels. This resin is sold in Europe and the United States under the name of *Balm of Gilead*, though every body knows that the true balm of Gilead is produced by the *Amyris gileadensis*, a very different vegetable and a native of Asia ; perhaps the name has been borrowed in consequence of some resemblance between the substances in taste and smell. The fresh turpentine is a greenish transparent fluid of an acrid penetrating taste ; given inconsiderately it produces heat in the bladder, and applied to wounds it causes inflammation and acute pains. It has been highly celebrated in England, and is recommended in certain stages of the pulmonary consumption.

HEMLOCK SPRUCE. *Abies canadensis*.



PLATE IV.

Fig. 1. A branch with a cone. Fig. 2. A seed.

The hemlock spruce is known only by this name throughout the United States, and by that of *Perusse* among the French Canadians. It is natural to the coldest regions of America, and begins to appear about Hudson's Bay, near lake St. John, and in the neighborhood of Quebec it fills the forests, and in Nova Scotia, New Brunswick, the state of Maine, Vermont and a considerable part of New Hampshire, it constitutes three-fourths of the evergreen

woods. Farther south it is less common, and in the Middle and Southern States is seldom seen except on the Alleghanies; even there it is often confined to the sides of the torrents and to the most humid and gloomy exposures. Moist grounds appear not to be in general the most favorable to its growth. It flourishes best in a sandy loam at the foot of hills where corn will thrive.

The hemlock spruce arrives at the height of 70 or 80 feet, with a circumference of 6 or 9 feet, and uniform for two thirds of its length. In a favorable soil it has an elegant appearance while less than 30 feet high, owing to the symmetrical arrangement of its branches and to its tufted foliage, and at this age it is employed in landscape gardening. When arrived at its full growth, the large limbs are usually broken off 4 or 5 feet from the trunk, by the weight of snows, and the dried extremities are seen starting out through the little twigs which spring around them. In this mutilated state, by which it is easily recognized, it has a disagreeable aspect, and presents, while in full vigor, an image of decrepitude. The bark is of a grayish color when young, but grows lighter when old, generally covered with moss. The leaves are 6 or 8 lines long, flat, numerous, irregularly disposed in two ranks, and downy at their unfolding. It flowers in May, and is succeeded by cones of an ash-colored bay, which are a little longer than the leaves, oval, pendulous, and situated at the extremity of the branches. Its seed comes to maturity about the end of autumn.

Unhappily the properties of its wood are such as to give this species only a secondary importance, notwithstanding its abundant diffusion: it is the least valuable in this respect of all the large resinous trees of North America. But the regret which we should experience to see it occupying so extensively the place of more useful species, is forbidden by a property of its bark inestimable to the country where it grows, that of being applicable in tanning. The wood is found to decay rapidly when exposed to the vicissitudes of the weather, and is therefore improper for the external covering of houses. But as the white pine becomes rarer this species is substituted for it as extensively as possible: it is firmer, though coarser grained, affords a tighter hold to nails,

and offers more resistance to the impression of other bodies. The most common use, in which great quantities of it are consumed in the Northern States is for the first sheathing of wooden houses, which are afterwards covered with white pine *clap boards*. For economy the interior frame is sometimes made of hemlock spruce, and it is found when protected from humidity, to be as durable as any other species. It is well adapted to lathes of the interior walls, and is exported in this form to England. In the Eastern States it is taken for the posts of rural fence, which last about fifteen years, and are preferable to those of gray and red oak. Its bark is used as a substitute for that of the oaks in the preparation of leather. It is taken from the tree in June, and half of the epidermis is shaven off before it is thrown into the mill. Its deep red color is imparted to the leather, which is said to be inferior to oak bark, but the two species united are better than either of them alone. The bark contains a small quantity of resin, commonly called *Hemlock Balsam*, which is applied to similar purposes as the resin of the white spruce.

BLACK OR DOUBLE SPRUCE. *Abies nigra*.



PLATE V.

Fig. 1. A seed. Fig. 2. A branch with a cone.

This species is indigenous to the same countries as the white spruce, and is called *Epinette noire* and *Epinette a la biere* in Canada, *Double Spruce* in the state of Maine, and *Black Spruce* in Nova Scotia, though the last two denominations are known throughout all these countries. We have preferred that of *Black Spruce*, which expresses a striking character of the tree, and is contrasted with that of the white species. From the influence of the

soil upon the wood it is sometimes called *Red Spruce*. The black spruce is most abundant in the countries lying between the 44th and 53d degrees of latitude, and between the 55th and 75th degrees of longitude ; and it is so multiplied as often to constitute a third part of the forests by which they are uninterruptedly covered. Farther south it is seldom seen except in cold and humid situations, particularly on the top of the Alleghanies. The finest forests are to be found in valleys where the soil is black, humid, deep and covered with a thick bed of moss.

The trunk, when it attains its fullest developement, is 70 or 80 feet in height and from 15 to 20 inches in diameter. The summit is a regular pyramid, and has a beautiful appearance on insulated trees. This agreeable form is owing to the spreading of the branches in a horizontal direction. The trunk is smooth, and is remarkable for its perpendicular ascension and for its regular diminution from the base to the summit, which is terminated by an annual shoot of 12 or 15 inches in length. The heart is most generally white, but in some situations reddish. The leaves are of a dark, gloomy green, about four lines long, firm, numerous, and attached singly over the surface of the branches. The flowers appear in May at the extremity of the highest twigs, and are succeeded by small, reddish, oval cones, pointing towards the earth, and varying in length from eight lines to two inches. They are composed of thin scales, slightly notched at the base, and sometimes split for half their length on the most vigorous trees, on which the cones are also the largest : they are not ripe till the end of autumn, when they open for the escape of the seeds, which are small, light and surmounted by a wing, by means of which they are wafted abroad by the wind.

The distinguishing properties of the wood of black spruce are strength, lightness and elasticity. It furnishes the best yards and topmasts that can be used. The red variety is superior in size to the other, which grows in a poorer soil, and is less supple and more liable to be crooked. The knees of vessels are frequently of black spruce where the oak is rare. When these pieces are of oak, they are formed of two limbs united at the base ; but when of spruce, they are made from the base of the

trunk and one of the principal roots. It is often used for the rafters of houses, and is more esteemed than the hemlock spruce. It is sometimes sawn into boards of considerable width, which are less valuable than those of white pine. Sometimes they are used for floors, but they are liable to crack. The red spruce is sometimes employed for the staves of fish casks. With the young branches, especially those of the black spruce, is made the salutary drink known by the name of *Spruce Beer*, which in long voyages is found an efficacious preventative of the scurvy. The twigs are boiled in water, a small quantity of molasses or maple sugar is added, and the mixture is left to ferment. The essence of spruce is obtained by evaporating, to the consistence of an extract, water in which the summits of the young branches have been boiled. This species is not resinous enough to afford turpentine as an article of commerce. The wood is filled with air and snaps in burning like chesnut.

ACER.

Polygamia Monœcia LINN. *Acerineæ*. Juss. *Aperient, tonic.*

WHITE MAPLE. *Acer eriocarpum*.



PLATE VI.

Fig. 1. A leaf. Fig. 2. The seed.

In the Atlantic parts of the United States this species is often confounded with the red maple, which it nearly resembles; west of the mountains, they are constantly distinguished, and the *Acer eriocarpum* is known by no other name than *White Maple*. It is found on the banks of all the rivers which flow from the mountains to the ocean, though it is less common along the streams which water the southern parts of the Carolinas and

of Georgia. In no part of the United States is it more multiplied than in the Western Country, and nowhere is its vegetation more luxuriant than on the banks of the Ohio, and of the great rivers which empty into it. The white maple is found in a sandy loam, on the banks of such rivers only as have limpid waters and a gravelly bed, and never in swamps and other wet grounds inclosed in forests, where the soil is black and miry. These situations, on the contrary, are so well adapted to the red maple, that they are frequently occupied by it exclusively.

The trunk of this tree is low, seldom exceeding 25 feet in height, though it is often met with on the banks of the Alleghany and Monongahela rivers 12 or 15 feet in circumference. It divides itself into a great number of limbs so divergent, that they form a head more spacious than that of any other tree in our country. The brilliant white of the leaves beneath forms a striking contrast with the bright green above, and the alternate reflection of the two surfaces in the water, heightens the beauty of this wonderful moving mirror, and aids in forming an enchanting picture to the boatman gliding through these regions of solitude, and fills his eye with unwearied admiration. The white maple puts forth green and yellow flowers early in the spring: its flowers are small and sessile with a downy ovary. The fruit is larger than that of any other species which grows east of the Mississippi. It consists of two capsules joined at the base, each of which incloses one roundish seed, and is terminated by a large, membranous, falciform wing. In Pennsylvania it is ripe about the first of May, and a month earlier in Georgia. At this period, the leaves which have attained half their size are very downy underneath; a month later, when fully grown, they are perfectly smooth. They are opposite and supported by long petioles; they are divided by deep sinuses into four lobes, are toothed on the edges, of a bright green on the upper surface, and of a beautiful white beneath.

The wood of this maple is very white and of a fine texture; but it is softer and lighter than that of any other species in the United States, and from its want of strength and durability it is little used. It is sometimes used in cabinet making, instead of

holly, for inlaying furniture, of mahogany, cherry tree and walnut : though it is less proper for this purpose, as it soon changes color. Wooden bowls are also made of it when ash or poplar cannot be procured. The charcoal of this wood is preferred by hatters to every other, for heating their boilers, as it affords a heat more uniform, and of longer duration. In Ohio, the sap is converted into sugar by the same process as that of the sugar maple. Like the red maple, it yields but half the product from a given measure of sap ; but the unrefined sugar is whiter and more agreeable to the taste than that of the sugar maple. The sap is in motion earlier in this species than in the sugar maple, beginning to ascend about the middle of January ; so that the work of extracting the sugar is sooner completed. The cellular integument rapidly produces a black precipitate with sulphate of iron.

MOUNTAIN MAPLE. *Acer montanum*.

This species is more abundant in Canada, Nova Scotia, and along the whole range of the Alleghanies than in any other part of North America. It is sometimes called *Low Maple*, from the dwarfish stature of the tree. It is generally called *Mountain Maple*, which seems to be more appropriate, as it grows of preference on the declivities of mountains exposed to the north, and in cool, moist and shady situations, on the abrupt and rocky banks of torrents and rivers.

The mountain maple seldom rises above 20 feet in height, and it often blooms at an elevation less than six feet. It most frequently grows in the form of a shrub, with a single and straight stock. The leaves are large, opposite and divided into three acute and indented lobes : they are slightly hairy at their infolding, and when fully grown, they are uneven and of dark green upon the upper surface. It puts forth small blossoms, of a greenish color, which are produced in semi-erect spikes from two to four inches in length. The seeds which are smaller than those of any other of the American maple, are fixed upon slender, pendulous foot stalks ; they are reddish at their maturity, and

each of them are surmounted by a membranous wing, and has a small cavity upon one side.

The mountain maple is too small to be profitably cultivated for its wood, and as its flowers, its roots and its bark are destitute of any very sensible odor, it promises no resources to medicine. It is sometimes grafted on the sycamore, and like the moose wood, it is thus augmented to double its natural size.

ASH-LEAVED MAPLE. *Acer negundo*.



PLATE VII.

Fig. 1. A leaflet. Fig. 2. The seed.

In the country west of the Alleghanies, where this tree is uncommon, it is called *Box Elder*; and is called by the French of Illinois, *Erable a Giguieres*. This tree is seldom found in the Northern States or in the maritime parts of the Southern. It grows on the banks of the Delaware in the neighborhood of Philadelphia, and even there it is rare. West of the mountains, on the contrary, it is extremely multiplied. It grows most abundantly in

the bottoms which skirt the rivers, where the soil is deep, fertile, constantly moist, and often inundated with water.

The ash-leaved maple attains the height of 40 or 50 feet, and a diameter of 15 or 20 inches. The bark of the trunk is brown and has a disagreeable odor in the cellular integument. The proportion of the sap to the heart is large, except in very old trees: in these the heart is variegated with rose-colored and bluish veins. It branches at a small height and expands into a head like that of the apple tree. The leaves are opposite, and are from 6 to 15 inches long, according to the vigor of the tree,

and the moisture of the soil in which it grows. Each leaf is composed of two pair of leaflets with an odd one. The leaflets are petiolated, oval-acuminate, and sharply toothed: towards autumn, the common petiole is of a deep red. It puts forth greenish flowers in April or May. The barren and fertile ones are borne on different trees, and are supported by slender pendulous peduncles, 6 or 7 inches in length. The seeds are double the length of those of the mountain maple surmounted with membranous wings.

No particular use is made of the wood in the arts, though from its luxuriant growth it would afford a profitable product as fuel.

BLACK SUGAR MAPLE. *Acer nigrum*.



PLATE VIII.

Fig. 1. A leaf. Fig. 2. The seed.

In the Western States, and the parts of Pennsylvania, between the mountains and the Ohio, this species is called *Sugar Tree*, and more frequently *Black Sugar Tree*; probably, on account of the dark color of its leaves in comparison with those of the sugar maple, which sometimes grows with it. In the extensive country of Genesee both species are indiscriminately called *Rock Maple* and *Sugar Maple*. The two species have been confounded by botanists in

describing the vegetable productions of America. Its most northern regions are in New Hampshire and Vermont, on the Connecticut; but from its inferior size it may be inferred that it belongs to a more southern climate. Accordingly, a few degrees lower, it forms a large part of the forests of Genesee, and covers

the immense valleys, through which flow the great rivers of the west, where it is one of the most common and one of the loftiest trees. The soil in which it best flourishes is a rich, strong, sandy loam.

It usually grows to the height of 40 or 50 feet with a diameter of 15 or 20 inches. When the tree stands alone, it naturally assumes a regular and agreeable shape. Its leaves are 4 or 5 inches long, and exhibit, in every respect, nearly the same conformation as those of the true sugar maple. They differ from them, principally, in being of a deeper green and of a thicker texture, and in having more open sinuses: they are also slightly downy, which is most sensibly perceptible on the main rib. It puts forth flowers of a greenish color in April or May, which, like those of the sugar maple, are suspended by long, flexible peduncles: the seeds, also, are similar, and are ripe about the same time, that is, about the first of October.

The wood is much like that of the sugar maple, but coarser grained, and less brilliant when polished. It is little used in the arts, because wherever it abounds, other trees are found more useful. It is considered after the hickories as the best of fuel. Its most important use is for making sugar, which is made in the same manner as that of the other species.

RED-FLOWERING MAPLE. *Acer rubrum*.

PLATE IX.

Fig. 1. A leaf. Fig. 2. The seed.

Different names are given to this tree, in different parts of the United States: east of the Alleghanies it is called *Red-Flowering Maple*, *Swamp Maple* and *Soft Maple*; in the Western Country simply *Maple*. The first denomination, which is most generally in use, is also the most appropriate, as the young shoots, the flowers and the fruit are red. Toward the north, the red-flowering maple appears first in the latitude of 48 degrees; but it soon becomes more

common in proceeding southward, and is found abundant to the extremities of Florida and Lower Louisiana. Of all the trees which flourish in wet grounds occasionally overflowed, this species is most multiplied in the Middle and Southern States. It occupies, in great part, the borders of the creeks, and abounds in all the swamps which are often inundated, and always miry. West of the mountains it is seen growing in a sandy loam on elevated situations.

In the maple swamps of New Jersey and Pennsylvania it is found 60 or 70 feet in height, and 3 or 4 feet in diameter. It is the earliest tree whose blossoms announce the return of spring. It flowers from the middle to the last of April. The blossoms of a beautiful purple or deep red, unfold more than a fortnight before the leaves. They are sessile, aggregate, and situated at the extremity of the branches. The leaves are smaller than those of the white maple, but in some respects, they resemble them. They are glaucous, or whitish underneath, and are

palmed or divided into 3 or 4 acuminate lobes, irregularly toothed. The extremities of this tree, which are formed by numerous twigs united at the base, have a remarkable appearance when garnished with flowers and seeds of a deep red, before vegetation has begun generally to revive. The fruit is suspended by long flexible peduncles, and is of the same hue with the flowers, though it varies in size and in the intensity of its coloring, according to the exposure and dampness of the soil. It ripens on the last of April or first of May. Before this tree exceeds 25 or 30 feet in height and 7 or 8 inches in diameter, its bark is perfectly smooth and marked with white blotches, by which it is easily distinguishable. Afterwards the trunk becomes brown and chapped. In this tree, as in others which grow in wet places, the sap bears a large proportion to the heart, if indeed the name *heart* can properly be given to the irregular star which occupies the centre of large trunks, with points, from one to three inches in length, projecting into the sap.

The wood of the red-flowering maple is applicable to interesting uses. It is harder than that of the white maple, and of a finer and closer grain: hence it is easily wrought in the lathe, and acquires by polishing a glossy and silken surface. It is sufficiently solid, and for many purposes it is preferred by workmen to other kinds of wood. It is much used for yokes and the handles of agricultural implements, wooden dishes and other domestic wares. It sometimes happens that in very old trees, the grain instead of following a perpendicular direction, is undulated, and this variety is termed *Curled Maple*. This singular arrangement is never witnessed in young trees, nor in the branches of such as exhibit it in the trunk: it is less conspicuous at the centre, than near the circumference. Trees offering this disposition, however, are rare. The serpentine direction of the fibre, which renders them difficult to split and to work, produces in the hands of a skilful mechanic, the most beautiful effects of light and shade. These effects are rendered more striking, if, after smoothing the surface of the wood with a double-ironed plane, it is rubbed with a little sulphuric acid, and afterwards with linseed oil. On close examination, the varying shades are found to be owing entirely

to the inflection of the rays of light; which is more sensibly perceived in viewing it in different directions by candle light. In cabinet making, furniture is made of it, which, in richness and lustre, exceeds the finest mahogany. It is much used for the stocks of fowling pieces and rifles, which to elegance and lightness unite a solidity resulting from the accidental direction of the fibre. The cellular integument is of a dusky red, which, by boiling, yields a purplish color, and on the addition of sulphate of iron, becomes dark blue approaching to black. With a portion of alum in solution, it is used for dyeing black. The French Canadians make sugar from the sap of this maple, but, as in the white maple, the product of a given measure is only half as great as is obtained from the sugar maple. The wood does not burn well, and is not much esteemed for fuel.

SUGAR MAPLE. *Acer saccharinum.*



PLATE X.

Fig. 1. A leaf. Fig. 2. The seed.

This species, the most interesting of American maples, is called *Rock Maple*, *Hard Maple* and *Sugar Maple*. The first of these names is most generally used, but we prefer the last, because it indicates one of the most valuable properties of the tree. It is found most abundantly between the 46th and 43d degrees of latitude, which comprises Canada, New Brunswick, Nova Scotia, Vermont, New Hampshire and the state of Maine: in these regions, it

enters largely into the composition of the forests with which they are still covered. Farther south, it is common only in Genesee, in New York, and in the upper parts of Pennsylvania. In the

lower parts of Virginia, of the Carolinas, and of Georgia, and likewise the Western States this tree is unknown or rare. The sugar maple covers a greater extent of American soil than any other species of this genus. It flourishes most in mountainous places, where the soil though fertile is cold and humid. Besides the parts which we have particularly mentioned, where the face of the country is generally of this nature, it is found along the whole chain of the Alleghanies to their termination in Georgia, and on the steep and shady banks of the rivers which rise in these mountains.

The sugar maple reaches the height of 70 or 80 feet with a proportional diameter ; but it does not commonly exceed 50 or 60 feet with a diameter of 12 or 18 inches. Well-grown, thriving trees are beautiful in their appearance, and easily distinguishable by the whiteness of their bark. The leaves are about five inches broad, but they vary in length according to the age and vigor of the tree. They are opposite, attached by long petioles, palmated or equally divided into five lobes, entire at the edges, of a bright green above, and glaucous or whitish underneath. In autumn they turn reddish with the first frost. It puts forth small yellowish flowers in May, which are suspended by slender, drooping peduncles. The seed is contained in two capsules united at the base and terminated in a membranous wing. It is ripe in the beginning of October, though the capsules attain their full size six weeks earlier. Externally they appear equal, but one of them is always empty. The fruit is matured only once in two or three years.

The wood when cut is white, but after being wrought and exposed for some time to the light it takes a rosy tinge. Its grain is fine and close, and when polished, it has a silky lustre. It is very strong and sufficiently heavy, but wants the property of durability, for which the oak is highly esteemed. When exposed to moisture it soon decays, and for this reason it is not much used in civil and naval architecture. In the Eastern States where the oak is not plentiful, this timber is substituted for it in preference to the beech, the birch and the elm. When perfectly seasoned, which requires two or three years, it is used by wheel-

wrights for axletrees and spokes, and for the runners of common sleds, and by cabinet and chair makers. The sugar maple timber is also sometimes used for the frames of houses, keels and lower frames of ships, and many other purposes which do not expose it to sudden decay by alternate moistening and drying. This wood exhibits two accidental forms in the arrangement of the fibre, of which cabinet makers take advantage for making beautiful articles of furniture. The first consists in undulations like those of the curled maple, the second, which occurs only in old trees that are still sound, and which appear to arise from an inflection of the fibre from the circumference toward the centre, produces spots of half a line in diameter, sometimes contiguous, and at other times several lines apart. The more numerous the spots, the more beautiful and the more esteemed is the wood : this variety is called *Birds-eye Maple*. Like the curled maple it is used for inlaying mahogany. Bedsteads are made of it and portable writing desks, which are elegant and highly prized. To obtain the finest effect, the log should be sawn in a direction as nearly as possible parallel to the concentric circles. When cut at the proper season, the sugar maple forms excellent fuel. Its ashes are rich in the alkaline principle and more abundant in quantity than those obtained from any other tree. The charcoal procured from this wood and used in forges and domestic economy, is of the most valuable kind ; and that made in Vermont, New Hampshire and Maine is one fifth heavier than that from the same tree in the more southern states ; a proof that a northern climate is adapted to the growth and firmness of this tree. The wood of this maple is easily distinguished from that of the red-flowering maple, which it resembles in appearance, by its weight and hardness. There is, besides, a very simple and certain test : a few drops of sulphate of iron being poured on samples of the different species, the sugar maple turns greenish, and the white maple and red-flowering maple change to a deep blue.

The sap of the sugar maple furnishes no inconsiderable resource for the economy, the comfort, and even the wealth of our northern citizens ; especially to those occupying regions newly settled.

The method of procuring the sap and forming the sugar, is simple, and nearly the same in most places where any is resorted to. The common process to collect the sap is to perforate the tree with an auger, in two places about four inches apart, and eighteen or twenty inches from the ground. It is found that a more abundant flow of sap is obtained from a shallow, than a deep hole. Into these holes, two tubes are inserted, which from the direction given the auger in boring, nearly meet at the outer ends. The tubes are made of elder, sumac or other shrubs with a large pith, and conduct the sap into small troughs or buckets, from whence it is conveyed to the camp, or the place where temporary preparations are made for boiling, etc. These preparations are little more than a boiler, containing from fifteen to fifty gallons, suspended upon a bar supported by crotches, at a convenient distance from the ground for building the fire; moulds to receive the sirup when of sufficient consistence to form into cakes; and an axe for preparing the fuel.

The evaporation is carried on by a constant and brisk boiling of the sap, which is frequently replenished as the bulk is diminished, until a sirup is formed of sufficient strength to become solid as it cools. A scum which is constantly rising to the surface during the first part of the process is frequently removed, and before the sirup is left to cool and harden, it is strained through woollen cloth to separate the remaining impurities. The time for stopping the evaporation is determined by rubbing a drop of the sirup between the fingers, which will granulate if the process has been carried to sufficient length. When the ebullition is so violent as to give signs of rising over the sides of the boiler, it is quelled by a piece of lard, butter or rind of pork.

Maple molasses is made by discontinuing the evaporation before the liquid is of sufficient consistence to consolidate by cooling, and by the drainings from the sirup as it forms into sugar. Sugar of the finest character and grain may be formed from the sap of the maple, and though the more common kind is neither very white, nor very delicate, it has a peculiar flavor, much admired by those not accustomed to its use.

The time for collecting the sap is about the last of February,

and continues from four to six weeks ; after which the liquid is less abundant and less rich in the saccharine principle, and is finally so weak, that it can no longer be reduced to sugar. The tree gives the most abundant discharge of its sap, early in the season, and in clear pleasant days, preceded by cold frosty nights.

The quantity of sap discharged from a tree of an average size, varies in different years and different days.

Trees are sometimes supposed to average about four pounds of sugar in a season, but frequently do not produce more than half that quantity. A single tree discharges in one day from two quarts, to two or three gallons of sap.

The following statement appeared some years since in the Greensburgh Pennsylvania Gazette. "Having introduced," says the writer, "twenty tubes into a sugar maple, I drew from it the same day, twenty-three gallons and three quarts of sap, which gave seven pounds and a quarter of sugar. Thirty-three pounds have been made this season from the same tree, which supposes one hundred gallons of sap." From this statement, it appears that but little more than three gallons were required for a pound, though four gallons are commonly allowed.

Maple sugar is made in most of the Northern and Western States, and in Canada ; and it has been supposed that New York and Pennsylvania contain maples enough to supply the consumption of sugar in the whole of the United States. But as a country becomes settled, the groves and forests of maple disappear, and the expense of converting the sap into sugar is increased ; so that the whole country will, within a moderate period of time, be supplied with this useful article in domestic economy, from foreign importations, or from the juice of the cane in our own country.

Though the ease and abundance with which sugar is made from the cane, and the expense of fuel to procure it from the sap of the maple would not favor the cultivation of this stately and beautiful tree for the supply of our tables, the value of its timber, and the elegant and cleanly shade it furnishes, would probably render the cultivation of it, especially by the sides of

our roads, an article of domestic and political economy, as well as a public ornament and comfort.

Most kinds of domestic animals are excessively fond of the sap of the maple, and frequently break through their inclosures to get access to the vessels containing it.

If the sap be exposed for a few days to a warm sun, it is formed into vinegar of a good quality. Maple beer, which is a pleasant beverage, is also made from the same material, by the addition of yeast and the essence of spruce.

STRIPED MAPLE. *Acer striatum.*

In Nova Scotia, New Brunswick, the state of Maine, New Hampshire and Vermont, this maple is known by the name of *Moose Wood*: in New Jersey and Pennsylvania it is called *Striped Maple*. This last denomination, which is preferable, as being descriptive, we have thought proper to adopt. It makes its first appearance in about latitude 47 degrees, and abounds in Nova Scotia, the state of Maine and New Hampshire, where it fills the forests. In approaching the Hudson it becomes more rare, and beyond this boundary, it is confined to the mountainous tracts of the Alleghanies, on which it is found, in cold shaded exposures, along the whole range to their termination in Georgia.

In many of the forests of Maine and New Hampshire, the striped maple constitutes a great part of the undergrowth; for its ordinary height is less than 10 feet, though it sometimes exceeds more than twice this stature. The trunk and branches are clad in a smooth, green bark, longitudinally marked with black stripes, by which it is easily distinguishable, at all seasons of the year, from whence it derives its specific name. It is one of the earliest trees whose vegetation announces the approach of the genial season. Its buds and leaves, when beginning to unfold, are rose-colored, and have a pleasing effect; but this hue soon changes to green. On luxuriant trees, the leaves are of a pretty thick texture, and finely serrate. They are four or five inches broad, rounded at the base, and divided into three deep and acute lobes.

It puts forth greenish flowers in May, which are grouped on long pendulous peduncles. The fruit, which in the main resembles that of the other maples, is remarkable for a small cavity on one side of the capsules : it is produced in abundance, and is ripe about the end of September.

The inferior size of this tree forbids its use in any kind of construction ; but as it is white and fine-grained, the cabinet makers of Halifax employ it instead of the holly, for forming the white lines, with which they inlay mahogany. Its principal advantage to the inhabitants consists in furnishing them, at the close of winter, when their forage is exhausted, a resource for sustaining their cattle, till the advancing season has renewed the herbage. As soon as the buds begin to swell, the famished horses and neat cattle are turned loose into the woods, to browse on the young shoots, which they consume with avidity. This tree is now cultivated in Europe, and has been grafted on the lofty sycamore, where it expands to four times its natural dimensions.

ALNUS.

Monœcia Tetrandria. LINN. Amentacæ. JUSS. *Astringent, tonic, emollient.*

BLACK ALDER. *Alnus glauca.*

The Black Alder which is unknown in the Southern, and rare in the Middle States, is not uncommon in Massachusetts, New Hampshire and Vermont ; but even here it is less multiplied than the common alder, which abounds throughout the United States. It grows in cool, moist places, and upon the margin of rivulets.

The black alder sometimes arrives at the height of 18 or 20 feet, and about three inches in diameter. The bark of the trunk and of the secondary branches is smooth, glossy and of a deep brown color sprinkled with white. Its leaves are oval, distinctly furrowed on the surface, and doubly denticulated at the edge : they are of a pale bluish green and about three inches in length and two inches in breadth. It flowers in June and July.

The diminutive size of this tree entirely excludes its wood from use in the arts. The bark is employed by hatters, for dyeing black. It has also been used in intermittent fevers, dropsies and cutaneous diseases. Its bitterness and astringency, however, are of an inferior order, and it does not seem entitled to a very high rank on the list of tonics.

COMMON ALDER. *Alnus serrulata*.

This species of alder, is found in the Northern, Middle and Western States, and is every where designated by the name of *Common Alder*. It frequently grows along the sides of brooks, and abounds still more in places covered with stagnant water.

The ordinary height of the common alder is 8 or 10 feet, and about two inches in diameter, though often less. Its leaves are of a beautiful green, about two inches long, and are in shape similar to those of the black alder. This shrub blooms in January: the sexes are separate on the same stock. The barren flowers are disposed, like those of the birch, around a common axis, in flexible pendulous aments about two inches long. The fertile flowers are in the form of small, oval bodies, garnished with a dull, red fringe: they are converted into small, scaly cones, which open, when arrived at maturity, to release the minute, flat seeds.

The wood of the common alder, when first laid open, is white, and it becomes reddish by contact with the air. It is too small to be applicable to any use in the arts. With sulphate of iron the bark forms a black dye for coloring wool, and as it can be procured at a very low price, it is extensively substituted for gall nuts by hatters and dyers.

ANDROMEDA.

Decandria Monogynia. LINN. Ericææ. JUSS. *Tonic, astringent, refrigerant.*

SOREL TREE. *Andromeda arborea.*

This is the only species of *Andromeda* which rises to a sufficient height to be ranked among forest trees. It begins to appear on the Alleghanies in Virginia, and is found to their termination in Georgia. It grows also in the Southern States on the steep banks of the rivers that flow from the mountains; but it becomes more rare in following them from their source, whether eastward or westward, and ceases entirely in the maritime parts of the Carolinas and Georgia.

It abounds in the fertile valleys at the foot of the lofty mountains of North Carolina, where they are found 50 feet in height and 12 or 15 inches in diameter. This is an extraordinary size for a tree of this genus, which is very numerous in the Atlantic States, and three-fourths of whose species to the number of eight or ten, rarely exceed six feet in height and an inch in diameter. The growth of the sorel tree is observed to be stunted in dry and gravelly lands, so that it presents itself in the form of a bush. The leaves are downy in the spring, but they become smooth and glabrous in acquiring their growth. They are alternate, oval-acuminate, finely denticulated, and from four to five inches long. It puts forth small white flowers, from July to September, formed into spikes five or six inches long. United in groups they have a fine effect, and render this tree very proper for the embellishment of gardens. The seeds are exceedingly minute, and are contained in small capsules.

On the trunk of the sorel tree the bark is thick and deeply furrowed. The wood is of a pale rose color and very soft. It burns with difficulty, and is wholly rejected in the arts. The acidity of the leaves has procured it the name of *Sorel Tree*. In drying they become black, and, when sumac is not to be obtained, they are used to impart color to wool.

ANONA.

Polyandria Polyginia. LINN. Anonæ. JUSS. Tonic, aperient.

PAWPAW. *Anona triloba*.

This tree is called by the French of upper Louisiana and of the two Canadas, *Assiminier*, and by the Americans, *Pawpaw*. It is seldom found north of the river Schuylkill, and is extremely rare in the low, maritime parts of the Southern States. It is not uncommon in the bottoms which stretch along the rivers of the Middle States; but it is most abundant in the rich valleys intersected by the western waters, where at intervals, it forms thickets exclusively occupying several acres. In Kentucky and in the western part of Tennessee, it is sometimes seen also in forests where the soil is luxuriantly fertile; of which and its presence is an infallible proof.

It seldom exceeds 30 feet in height and a diameter of six or eight inches, though it generally stops short at half this elevation. The trunk is covered with a silver-gray bark, which is smooth and finely polished. The leaves are borne on short petioles, and are alternate, five or six inches in length, and of an elongated form, widening from the base to the summit. They are of a fine texture, and the superior surface is smooth and brilliant. The flowers, which are attached by short peduncles, are pendent, and of a purple hue. When the fruit is ripe, which takes place towards the beginning of August, it is about three inches long, one and a half thick, of a yellowish color, and of an oval form, irregular and swelling into inequalities. Its pulp is soft and of an insipid taste, and it contains several large, triangular stones.

The wood is spongy, extremely soft, destitute of strength, and applicable to no use in the mechanical arts. A spirituous liquor may be distilled from its fruit. The cellular integument of the bark, and particularly that of the roots, exhales in summer a nauseous odor, so powerful as to occasion sickness if it is long respired in open air.

BETULA.

Monœcia Tetrandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

BLACK BIRCH. *Betula lenta.*

PLATE XI.

Fig. 1. A leaf. Fig. 2. A fertile ament.

The agreeable foliage of this species, and the valuable properties of its wood, render it the most interesting of the American birches. Wherever it grows in the United States, it is known by the name of *Black Birch*: its secondary denominations are *Mountain Mahogany* in Virginia, and *Sweet Birch* and *Cherry Birch* in Connecticut, Massachusetts, and further north. In Canada it is universally called *Cherry Birch*. It grows in Nova Scotia, in the state of Maine, New

Hampshire, Vermont, though more rarely than the yellow birch. It abounds in the Middle States, particularly in New York, Pennsylvania and Maryland; farther south it is confined to the summit of the Alleghanies, on which it is found to their termination in Georgia, and to the steep and shady banks of the rivers which issue from these mountains. It flourishes best in a deep, loose and cool soil.

When it has attained its greatest expansion, it often exceeds 70 feet in height, and two or three feet in diameter. The bark upon the trunk of trees less than eight inches in diameter, is smooth, grayish, and perfectly similar in its color and organization to that of the cherry tree. On old trees, the epidermis detaches itself transversely, at intervals, in hard, ligneous plates, six or eight inches broad. At the close of winter the leaves, during a

fortnight after their birth, are covered with a thick, silvery down, which disappears soon after. The leaves are about two inches long, serrate, cordiform at the base, acuminate at the summit, of a pleasing tint and fine texture, and not unlike the leaves of the cherry tree. The young shoots are brown, smooth, and dotted with white, as also are the leaves. The barren flowers of the black birch are disposed in flexible aments about four inches long. The fertile aments, which are commonly situated at the extremity of the young branches, are ten or twelve lines long, and five or six lines in diameter, straight, cylindrical, and nearly sessile at the season of maturity of the seed, which is about the first of November.

The wood of the black birch, when freshly cut, is of a rosy hue, which deepens by exposure to the light. Its grain is fine and close, whence it is susceptible of a brilliant polish; it possesses also a considerable share of strength. The union of these properties renders it superior to the other species of American birch; and in Massachusetts, Connecticut and New York, it is next in esteem to the wild cherry tree among cabinet makers. Tables and bedsteads of this wood, when carefully preserved, acquire with time the appearance of mahogany, hence it is employed for the frames of arm-chairs, and of sofas: the coach makers also use it for the frames of their panels. Shoe lasts are made of black birch, but they are less esteemed than those of beech. Such are the principal uses of the wood, from which it may easily be gathered to what subsidiary purposes it is applicable. The leaves and bark, when bruised, diffuse a very sweet odor, and as they retain this property when dried and carefully preserved, they afford an agreeable infusion, with the addition of a little sugar and cream.

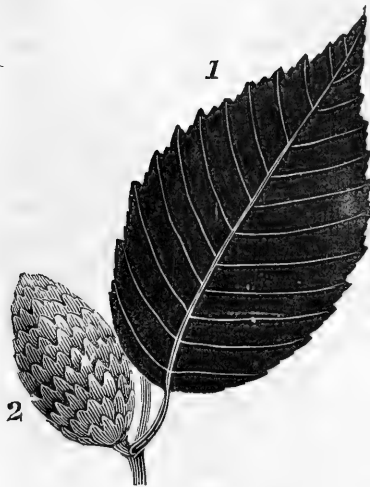
YELLOW BIRCH. *Betula lutea*.

PLATE XII.

Fig. 1. A leaf. Fig. 2. A fertile ament.

This species of birch abounds in the forests of Nova Scotia, of New Brunswick, in the state of Maine, New Hampshire and Vermont, where it is designated by no other name than *Yellow Birch*. On the western bank of the Hudson it is rare; and in New Jersey and Pennsylvania only a few individuals of the species are met with, in moist and shady situations. It is confounded by the inhabitants of these States with the black birch, which is very abundant, and

to which it bears a striking resemblance. It is generally found on cool and rich soils among the ashes, the hemlock spruce, and the black spruce.

When it arrives at its greatest magnitude, it is more than 70 feet in height and two feet in diameter. It is a beautiful tree, and its trunk is of nearly an uniform diameter, straight, and destitute of branches for 30 or 40 feet. It is particularly remarkable for the color and arrangement of its epidermis, which is of a brilliant golden yellow, and which frequently divides itself into very fine strips, rolled backwards at the ends, and attached in the middle. The young shoots, and the leaves at their unfolding are downy; towards the middle of summer when fully expanded, the leaves are perfectly smooth, except the petiole, which remains covered with a fine, short hair: they are about three and a half inches long, one and a half broad, oval-acuminate, and bordered with sharp and irregular teeth. The leaves, the bark and the young shoots, have an agreeable taste and smell,

similar to those of the black birch, though less sensible, which they lose in drying. In its fructification, the yellow birch nearly resembles the black birch. The fertile aments are borne on short peduncles, and are twelve or fifteen lines long, five or six lines in diameter, straight, of an oval shape, and nearly cylindrical. The scales which compose them are trifid, pointed, and about three lines in length: viewed through the lens, they are seen to be downy. Beneath these scales are the small, winged seeds, which are ripe about the first of October.

The wood of the yellow birch is inferior in quality and in appearance to that of the black birch, and never assumes as deep a shade; but it is strong, and when well polished makes handsome furniture. In Nova Scotia and in the state of Maine, it is used for that part of the frame of vessels which remains always in the water. In Maine it is also used for the yokes of cattle and for the frames of sledges; and in Nova Scotia the young saplings are almost exclusively employed for the hoops of casks. The bark is highly esteemed in tanning; and its wood is considered an excellent combustible.

CANOE BIRCH. *Betula papyracea.*



By the French Canadians this tree is called *Bouleau Blanc*, White Birch, and *Bouleau a Canot*, Canoe Birch: it is known to the Americans also by these denominations, and sometimes by that of *Paper Birch*. The name of *Canoe Birch* appears to be the most proper, as it indicates an important use which is made of its bark. The canoe birch is most multiplied in the forests in the country lying north of the 43d degree

PLATE XIII.

Fig. 1. A leaf. Fig. 2 A fertile ament.

of latitude, and between the 75th degree of west longitude and the Atlantic ocean ; comprising Lower Canada, New Brunswick, the state of Maine, New Hampshire and Vermont. It ceases below the 43d degree of latitude, and is not found in the southern part of Connecticut, nor below Albany, in the state of New York. The soil in which this species of birch best flourishes, is fertile and principally covered with large stones, overgrown with moss.

The canoe birch attains its largest size, which is about 70 feet in height and three feet in diameter, on the declivity of hills and in the bottom of fertile valleys. Its branches are slender, flexible, and covered with a shining, brown bark, dotted with white. The leaves are borne by petioles four or five lines long, and are of a middling size, oval, unequally denticulated, smooth, and of a dark green color. The aments are pendulous, and about an inch in length : the seeds are ripe towards the middle of July.

The heart or perfect wood of this tree, when first laid open, is of a reddish hue, and the sap is perfectly white. It has a fine, glossy grain, with a considerable share of strength : that it is but little employed is attributed partly to its speedy decay when exposed to the succession of dryness and moisture, and partly to the existence, in the countries which produce it, of several species of wood, which are far preferable for the uses of the carpenter and the wheelwright. It is sometimes employed by cabinet makers for tables which are stained in imitation of mahogany. A section of the trunk of this tree, one or two feet in length, immediately below the first ramification, exhibits very elegant undulations of the fibre, representing bunches of feathers or sheaves of corn : these pieces are divided into thin plates for inlaying mahogany, and other embellishments in cabinet making. The wood affords excellent fuel. On trees not exceeding eight inches in diameter, the bark is of a brilliant white. This bark is devoted to many uses : in the newly-settled parts of the countries where it grows, the people place large pieces of it immediately below the shingles of the roof of their houses ; baskets, boxes, port folios, etc. are also made of it ; divided into very thin sheets, it forms a substitute for paper. But the most important purpose to which it is applied, and one in which it is replaced by

the bark of no other tree, is the construction of canoes. To procure proper pieces, the largest and smoothest trunks are selected : in the spring two circular incisions are made several feet apart, and two longitudinal ones on opposite sides of the tree ; after which, by introducing a wooden wedge, the bark is easily detached. These plates are usually ten or twelve feet long, and two feet nine inches broad. To form the canoe they are stitched together with fibrous roots of the white spruce, about the size of a quill, which are deprived of the bark, split, and suppled in water. The seams are coated with resin of the balm of Gilead. Great use is made of these canoes by the Indians and by the French Canadians in their long journies into the interior of the country ; they are very light, and are easily transported on the shoulders from one lake or river to another, which is called the *portage*. A canoe calculated for four persons with their baggage weighs from forty to fifty pounds ; some of them are made to carry fifteen passengers. Such are the ordinary uses of the bark and of the wood of this tree.

WHITE BIRCH. *Betula populifolia*.

This species, like the canoe birch, grows in Canada and in the northern extremity of the United States. It is found also in the lower parts of New York, New Jersey and Pennsylvania. In Virginia it is more rare. In the environs of New York and of Philadelphia it is called *White Birch*, and this name is habitually used in the state of Maine, where that of *Old Field Birch* is also frequently employed to distinguish the white birch from the canoe birch. The white birch is most frequently found in places scantily furnished with woods, where the soil is dry and meagre, and generally exhausted by culture.

The ordinary height of the white birch is 20 or 25 feet. Single trees, which grow accidentally in moist places, expand to an ampler size, and are sometimes 30 or 35 feet high, and eight or nine inches in diameter, on which the branches are numerous, slender, and generally drooping. The leaves are

smooth on both surfaces, heart-shaped at the base, very acuminate, and doubly and irregularly toothed. The petioles are slightly twisted, and the leaves are thus rendered more tremulous than those of trees on which this disposition is not observed. The buds, a few days after their development, are slightly coated with a yellowish, odoriferous substance. The trunk of this species is covered with a white, but most generally light gray bark resembling the canoe birch; but its epidermis, on being separated from the cellular integument, is incapable of being divided like that of the preceding species, into thin sheets. It flowers in July.

The wood of this birch is very soft, brilliant when polished, and perfectly white. From its speedy decay, and from the inferior size of the tree it is employed for no use as timber. It makes very good fuel when green, and the charcoal produced from it is superior to that of white maple.

RED BIRCH. *Betula rubra*.



PLATE XIV.

Fig. 1. A leaf. Fig. 2. A barren ament.

In Pennsylvania and New Jersey the name of *Red Birch* is given to the *Betula rubra*, to distinguish it from the white birch; but farther south, where the white birch does not exist, or is comparatively rare, this species is simply called *Birch*. The northern part of New Jersey may be assumed as the most northern point at which this species of birch is found. It is abundant in Pennsylvania, Maryland, Virginia and the upper part of the Carolinas and Georgia. This

birch is not, like the other species of this genus, seen growing in

the midst of the forest, but is found only on the banks of rivers. It expands with the greatest luxuriance on the sides of limpid streams which have a gravelly bed, and whose banks are not marshy like those of the rivers in the maritime parts of the Carolinas and those of Georgia.

When it has attained its greatest magnitude it is 70 feet in height, and two or three feet in diameter. On the trunk and on the largest limbs of a lofty red birch, the bark is thick, deeply furrowed, and of a greenish color. On trees not exceeding eight or ten inches in diameter, the epidermis is reddish or cinnamon-colored; whence probably is derived the appropriate denomination of *Red Birch*. The epidermis of this species, like that of the canoe birch, divides itself transversally into thin, transparent sheets, which appear to be composed of a mixed substance, instead of presenting a pure, homogeneous texture; hence they have not an uniform transparency, nor a perfectly even surface: compared with the bark of the canoe birch, they are like coarse paper compared with fine. When this tree is fully expanded, its summit is ample, but the uncommon thickness of its branches prevents it from appearing tufted. The twigs which form the extremity of the tree, are long, flexible and pendulous, and the limbs are of a brown complexion spotted with white: their bark is slightly uneven, while, on the other branches, it is smooth and glossy. The petioles of this tree are short and downy; the leaves are about three inches long and two inches broad, of a light green on the upper surface, and whitish beneath: they are doubly denticulated at the edge, very acuminate at the summit, and terminated at the base in an acute angle, more regular than is seen in the leaf of any other tree. The fertile aments are five or six inches long, straight and nearly cylindrical. The seeds are ripe in the beginning of June.

The wood of the red birch is sufficiently compact and nearly white: very little difference in color is observed between the sap and heart. This wood offers the same singularity with that of the june berry, being longitudinally marked by red vessels, which intersect each other in different directions. This wood is employed for bowls, trays and brooms: it is also employed

for hoops, particularly for rice casks where the oak and hickory cannot be obtained.

BIGNONIA.

Didynamia Angiospermia. LINN. Bignoniæ. JUSS. *Cathartic, narcotic.*

CATALPA. *Bignonia catalpa.*



PLATE XV.
Fig. 1. A leaf. Fig. 2. A seed.

In [the Atlantic States, the Catalpa begins to be found in the forests, on the banks of the river Savannah, and west of the Alleghanies, on those of the Cumberland, between the 35th and 36th degrees of latitude. Farther south it is more common, and abounds near the borders of all the rivers which empty into the Mississippi, or which water West Florida. In the Carolinas and in Georgia the catalpa is called *Catawbaw Tree*, from a tribe of Indians by that name who

inhabited that part of the country. The French of Upper Louisiana call it *Bois Shavanon*, from the Shavanon tribe of Indians who once existed in West Tennessee.

In the regions where it grows most abundantly it frequently exceeds 50 feet in height, with a diameter from 18 to 24 inches. It is easily recognized by its bark, which is of a silver-gray color, and but slightly furrowed, by its ample leaves, and by its wide spreading summit, disproportioned in size to the diameter of its trunk. It differs from other trees also by the fewness of its branches. The leaves are heart-shaped, petiolated, often six or seven inches in width, glabrous above and downy beneath,

particularly on the principal ribs ; they are late in venturing out in the spring, and are among the first to shrink at the approach of autumn. The flowers which are collected in large bunches at the extremity of the branches, are white, with violet and yellow spots, and are beautiful and showy. The capsules are cylindrical and pendent, of a brown color when ripe, three or four lines in diameter and twelve or fifteen inches in length. The seeds are thin, flat and developed in a long, narrow, membranous wing terminated by a hairy tuft. Each seed, with its wing, is about an inch long, and a line and a half broad.

That the catalpa is a tree of rapid growth is proved by the distance of the annual concentric circles. Its wood is of a grayish white color, of a fine texture, very light, and very brilliant when polished. It resembles the butternut wood, with this exception, that the butternut wood is of a reddish hue, and is less durable when exposed to the weather. Posts of the catalpa perfectly seasoned have been proved to be very durable. In the spring, if a bit of the cellular integument of the catalpa bark is removed, a venomous and offensive odor is exhaled. In a thesis supported at the Medical College of Philadelphia, this bark is maintained to be tonic, stimulant, and more powerfully antiseptic than the Peruvian bark. It is stated that the honey collected from the flowers of this tree is poisonous, and that its effects, though less alarming, are analogous to those of honey of the yellow jasmine. Its bark is considered to be a good antidote for the bite of snakes, the machineel poison, etc.

CARPINUS.

Monœcia Polyandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

AMERICAN HORNBEAM. *Carpinus Americana.*

The American Hornbeam is found as far north as Nova Scotia, New Brunswick and Lower Canada ; but it is repressed by the severity of the climate, and is less multiplied than in New Jersey, Pennsylvania and the Southern States. By the Americans it is called *Hornbeam*, and by the French of Upper Louisiana *Charme*.

It prospers in almost every soil and exposure, except in places that are too long inundated, or that are absolutely sterile.

The ordinary stature of this tree is from 12 to 15 feet, and it is sometimes 25 or 30 feet high and six inches in diameter. Its leaves are oval-acuminate and finely denticulated. The sexes are united on the same stock, and the fertile flowers are collected in long, loose, pendulous, leafy aments at the extremity of the branches. The scales or leaves which surround them are furnished at the base with a hard, oval seed. It flowers in May or June. The fructification is always abundant, and the aments remain attached to the tree long after the foliage is shed. The bark of the trunk is smooth and spotted with white.

The wood is white and exceedingly compact and fine-grained. The dimensions of the tree are so small as to render it almost useless even for fuel, but it is employed for hoops when better species cannot be obtained.

IRON WOOD. *Carpinus ostrya*.



PLATE XVI.

Fig. 1. A leaf. Fig. 2. The fruit.

East of the Mississippi the Iron Wood is diffused throughout the United States and New Brunswick, Nova Scotia and Lower Canada. In New York, New Jersey, Pennsylvania and the Southern States, where it is the most abundant, it bears the name of *Iron Wood*; in Vermont, New Hampshire and Maine, it is called *Lever Wood*; and by the French of Illinois, *Bois dur*, hard wood. Though this wood is multiplied in the forests, it nowhere constitutes masses

even of inconsiderable extent, but is loosely disseminated, and found only in cool, fertile, shaded situations.

It seldom arrives to more than 35 or 40 feet in height and 12 or 15 inches in diameter, and commonly not exceeding half these dimensions. In the winter this tree is recognized by a smooth, grayish bark, finely divided, and detached in strips not more than a line in breadth. The leaves are alternate, oval-acuminate, and finely and unequally denticulated. The fertile and barren flowers are borne at the extremity of different branches of the same tree, and the fruit is in clusters like hops. The small, hard, triangular seed is contained in a species of reddish, oval, inflated bladder, covered at the age of maturity with a fine down, which causes a violent irritation of the skin if carelessly handled.

The wood is perfectly white, compact, fine-grained and heavy. The concentric circles are closely compressed, and their number in a trunk of only four or five inches in diameter evinces the length of time necessary to acquire this inconsiderable size. To its inferior dimensions must be ascribed the limited use of the tree, the superior properties of whose wood are attested by its name. In New England the iron wood is used for levers, brooms and scrubbing brushes. Though its uses are unimportant, they might probably be more diversified; it is well adapted for mill cogs, mallets, etc.

CASTANEA.

Monœcia Polyandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

CHINQUAPIN. *Castanea pumila.*

PLATE XVII.

Fig. 1. A leaf. Fig. 2. The fruit. Fig. 3. A nut.

The Chinquapin is bound-
ed northward by the eastern
shore of the river Delaware,
on which it is found to the
distance of a hundred miles
from Cape May. It is more
common in Maryland, and
still more so in the lower
part of Virginia, of the
Carolinas, Georgia, the Flor-
idas and Louisiana, as far
as the river Arkansas. In
West Tennessee it is mul-
tiplied around the prairies
inclosed in the forests, and
it abounds throughout the
Southern States where the
chesnut is wanting. In the south of the United States the chinquapin fructifies on the most arid lands : its perfect developement requires a cool and fertile soil. As it springs every where with facility, except in places liable to be covered with water, it is among the most common shrubs.

This tree sometimes grows to the height of 30 or 40 feet and 12 or 15 inches in diameter, although its usual height is 10 or 12 feet. The leaves are three or four inches long, sharply toothed, and similar in form to those of the American chesnut, from which they are distinguished by their inferior size, and by the whitish complexion of their lower surface. The fructification, also, resembles that of the chesnut in form and arrangement, but the flowers and fruit are only half as large, and the nut is convex on both sides and about the size of the wild hazel nut.

The wood of this species is finer-grained, more compact, heavier, and perhaps more durable than that of the chesnut. It is well fitted for posts, and lasts in the earth more than forty years. The saplings of this species are laden with branches while they are no thicker than the finger, and are thus rendered too knotty for hoops. Its bark is astringent and tonic, and has been used with success in intermittents.

AMERICAN CHESNUT. *Castanea vesca.*

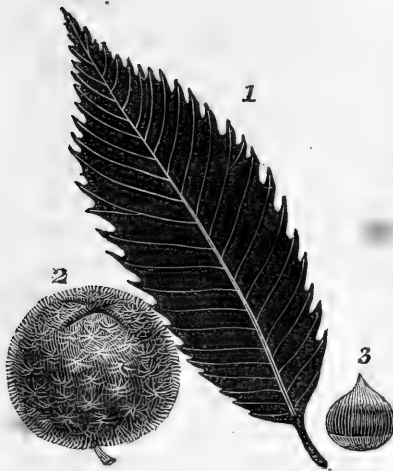


PLATE XVIII.

Fig. 1. A leaf. Fig. 2. The fruit. Fig. 3. A nut.

The Chesnut does not venture beyond the 44th degree of latitude. It is found in New Hampshire between the 43d and 44th degrees, but such is the severity of the winter that it is less common than in Connecticut, New Jersey and Pennsylvania. It is the most multiplied in the mountainous districts of the Carolinas and of Georgia, and abounds on the Cumberland Mountains and in East Tennessee. The coolness of the summer and the mildness

of the winter in these regions are favorable to the chesnut; the face of the country, also, is perfectly adapted to a tree which prefers the sides of mountains or their immediate vicinity, where the soil in general is gravelly, though deep enough to sustain its perfect development. It is a stranger in Vermont, the state of Maine, and a great part of Genesee, to the maritime parts of Virginia, to the Carolinas, Georgia, the Floridas and Louisiana as far as the mouth of the Ohio.

The American chesnut sometimes attains the height of 70 or 80 feet with a circumference of 15 or 16 feet. Though this

tree nearly resembles that of Europe in its general appearance, its foliage, its fruit and the properties of its wood, it is treated by botanists as a distinct species. Its leaves are six or seven inches long, one and a half broad, coarsely toothed, of an elongated oval form, of a fine, brilliant color and of a firm texture, with prominent parallel nerves beneath. The barren flowers are whitish, unpleasant to smell, and grouped on axillary peduncles four or five inches long. The fertile aments are similarly disposed, but less conspicuous. It flowers in June. The fruit is spherical, covered with fine prickles, and stored with two dark brown seeds or nuts, about as large as the end of the finger, convex on one side, flattened on the other, and coated round the extremity with whitish brown. They are smaller and sweeter than the wild chesnuts of Europe. They are ripe about the middle of October.

The wood is strong, elastic and capable of enduring the succession of dryness and moisture. Its durability renders it especially valuable for posts, which should be made of trees less than ten inches in diameter, and charred before they are set in the earth. It is also used for rails, and is said to last more than fifty years. For shingles this wood is superior to any species of oak, though it has the same defect of warping. It is not extensively used for staves, and its pores, like those of the red oak, are so open that it is proper only for dry wares. The chesnut is little esteemed for fuel and is not much used: it is filled with air and snaps when it burns. The coal is excellent.

CELTIS.

Polygamia Monœcia. LINN. *Urticæ.* JUSS. *Tonic, anodyne.*

HACK BERRY. *Celtis crassifolia.*

PLATE XIX.

Fig. 1. A leaf. Fig. 2. The fruit.

The banks of the Delaware above Philadelphia may be considered as the north-east limit of the hack berry. East of the mountains it is restricted within narrow boundaries, and is a stranger to the lower part of Virginia and to the more southern states. It is abundant on the banks of the Susquehannah and of the Potomac. It is profusely multiplied, in the Western Country in all the valleys that stretch along the rivers, and wherever the soil is

fertile throughout Kentucky and Tennessee. On the Ohio it is called *Hoop Ash*, and in Kentucky, *Hack Berry*.

It attains the summit of 70 or 80 feet with a disproportionate diameter of 18 or 20 inches. In rich soils the luxuriance of its vegetation is shown by sprouts, 6 or 10 feet in length, garnished on each side with large, substantial leaves. The hack berry is easily distinguished by the form of its trunk, which is straight and undivided to a great height, and by its bark, which is grayish, unbroken and covered with asperities unqually distributed over its surface. Its leaves are larger than those of any other species of nettle tree, being six inches long and three or four broad. They are oval-acuminate, denticulated, cordiform at the base, of a thick, substantial texture and of a rude surface. It puts forth flowers in May which are small, white and often united in pairs

on a common peduncle. The fruit is round, about as large as a pea and black at its maturity.

The wood is fine-grained and compact, but not heavy, and when freshly exposed it is perfectly white: sawn in a direction parallel or oblique to its concentric circles it exhibits the fine undulations that are observed in the elm and locust. On laying open the sap of this tree in the spring it changes in a few minutes from pure white to green. This wood is little appreciated on account of its weakness and its speedy decay when exposed to the weather. It is rejected by wheelwrights, but is sometimes employed in building for the covering which supports the shingles. As it is elastic and easily divided it is used for the bottom of common chairs, and by the Indians for baskets. On the banks of the Ohio it is frequently taken for the rails of rural fence, and is wrought with the greatest ease, as it is straight-grained and free from knots: it is said also to afford excellent charcoal.

AMERICAN NETTLE TREE. *Celtis occidentalis*.



PLATE XX.

Fig. 1. A leaf. Fig 2. The fruit.

The American Nettle Tree, if not rare, is little multiplied in comparison with the oaks, the walnuts and the maples. As it is scattered singly through the forest, it is difficult to fix the point at which it ceases towards the north, but it probably is not found beyond the river Connecticut. In the Middle, Western and Southern States it bears the name which we have adopted, and among the French of Illinois, that of *Bois inconnu*, unknown wood. It prefers a cool

and shady situation, with a deep and fertile soil.

The American nettle tree grows to the height of 60 or 70 feet with a diameter of 18 or 20 inches. Its branches are numerous and slender, and the limbs take their rise at a small distance from the ground, and seek a horizontal or an inclined direction. The bark is rough and entire upon the trunk, and smooth and even on the secondary branches. The leaves are alternate, about three inches long, of a dark green color, oval-oblique at the base, very acuminate at the summit, denticulated, and somewhat rough. The flowers open in April or May, and are small, white, single and axillary : the fruit, also, is small and single, of a round form, and of a dull red color.

When perfectly seasoned, the wood is of a dark brown color, hard, compact, supple and tenacious : it makes excellent hoops, whip stocks, is used by wheelwrights for shafts and for other purposes, and is proper for sculpture.

CERASUS.

Icosandria Monogynia. LINN. Rosaceæ. JUSS. *Refrigerant, tonic, astringent.*

RED CHERRY TREE. *Cerasus borealis.*

The Red Cherry Tree is common only in the Northern States and in Canada, New Brunswick and Nova Scotia. It is rarely met with in New Jersey and Pennsylvania, and is wholly unknown in the Southern States. In the state of Maine and Vermont, it is called *Small Cherry* and *Red Cherry*, the last of which we have adopted. It flourishes best in a common soil, in cleared grounds, and in such parts of the forests as have been burnt.

The size of the red cherry tree places it among trees of the third order : it rarely exceeds, and often does not equal, 25 or 30 feet in height and six or eight inches in diameter. The trunk is covered with a smooth, brown bark, which detaches itself laterally. Its leaves are five or six inches long, oval, denticulated and very acuminate. Its flowers put forth in May or June, and are collected in small, white bunches, and give birth to a red

fruit of an inconsiderable size, which is ripe in the month of July. This fruit is intensely acid, and is not abundant even on the largest trees.

The wood is fine-grained and of a reddish hue; but the inferior size of the tree forbids its use in the mechanic arts.

WILD ORANGE TREE. *Cerasus Caroliniana.*

This beautiful species of cherry tree is found on the Bahama Isles, and on the continent of North America it appears to be nearly confined to the islands on the coast of the Carolinas, of Georgia and of the Floridas. Except the margin of the sea, it is rarely found on the main land, even at the distance of eight or ten miles from the shore, where the temperature is five or six degrees colder in the winter, and proportionably milder in the summer. It flourishes best on a common garden soil.

The wild orange grows to the height of 20 or 30 feet, and ramifies at a small height, and forms a spacious and tufted summit, which is owing, perhaps, to its growing upon open grounds instead of being compressed in the forest, and forced to shoot upwards in order to enjoy the light. The bark of the trunk is of a dun complexion, and is commonly without cracks. Its leaves are oval-acuminate, evergreen, smooth and shining on the upper surface, and about three inches in length. Its flowers open in May, are numerous, white and arranged in little bunches an inch or an inch and a half long, which spring at the base of the leaf. The fruit is small, oval, and nearly black: it consists of a soft stone surrounded with a small quantity of green pulpy substance, which is not eatible. This fruit persists through a great part of the following year, so that in the spring the tree is laden at the same time with fruit and flowers. This tree may be considered as one of the most beautiful vegetable productions of this part of the United States, and it is selected with the more reason by the inhabitants to plant about their houses, as it grows with rapidity and affords an impenetrable shade.

The perfect wood is rose-colored and very fine-grained; but as this species is not extensively multiplied it is not much used:

there is the less occasion for it as other wood, in no respect inferior, is procured with facility. In the bark of the roots there is a strong odor resembling that of the wild cherry stone, from which a fragrant, spirituous liquor may be obtained.

WILD CHERRY TREE. *Cerasus Virginiana*.



PLATE XXI.

Fig. 1. A leaf. Fig. 2. The fruit.

The Wild Cherry Tree is one of the largest productions of the American forest. In the Atlantic as well as the Western States, this tree is known only by the name which we have adopted. It is more or less abundant as the soil and climate are more or less favorable to its growth, to which the extremes of heat and cold in the seasons, and of dryness and humidity in the soil, are alike unpropitious. It abounds in Illinois, in Genessee and in Upper Canada ; but it is no

where more profusely multiplied nor more fully developed than beyond the mountains in the state of Ohio, Kentucky and Tennessee.

In the state of Maine, where the winter is long and intense, it hardly exceeds 30 or 40 feet in height, and from 8 to 12 inches in diameter ; in the southern and maritime parts of the Carolinas and of Georgia, where the summer is intemperately hot and where the soil is generally arid and sandy, it is rarely seen, and on the banks of rivers where the ground is too wet, its dimensions are stunted ; but in the upper parts of these states, where the climate is milder and the soil more fertile, it is sufficiently common, though less multiplied than in Virginia and Pennsylvania.

On the banks of the Ohio, this tree grows to the stature of 80 to 100 feet with a circumference of 12 to 16 feet, with a trunk of an uniform size and undivided to the height of 25 or 30 feet. Its bark is so peculiar 'as to render it distinguishable at first sight, when from its height the form of its leaves cannot be discerned. The trunk is regularly shaped, but the bark is blackish and rough, and detaches itself semi-circularly in thick, narrow plates, which are renewed after a considerable lapse of time. The leaves are 5 or 6 inches long, oval-acuminate, denticulated, of a beautiful brilliant green, and furnished at the base with two reddish glands. It puts forth white flowers in May or June, collected in spikes which have a beautiful effect. The fruit is about the size of a pea, disposed in the same manner as the flowers, and nearly black at its maturity, which is in August or September; soon after which, notwithstanding its bitterness, it is devoured by the birds.

The perfect wood is of a dull, light-red tint, which deepens with age. It is compact, fine-grained and brilliant, and not liable to warp when perfectly seasoned. It is extensively employed by cabinet makers for every species of furniture; and when chosen near the ramification of the trunk it rivals mahogany in beauty. This wood is generally preferred to the black walnut, whose dun complexion with time becomes nearly black. On the banks of the Ohio it is employed in ship building, and the French of Illinois use it for the felloes of wheels. The fruit is employed to make a cordial, by infusion in rum or brandy, with the addition of a certain quantity of sugar. The bark of this tree is bitter and aromatic, its taste being strong, penetrating and not disagreeable. It is undoubtedly a useful tonic, and appears to possess, in some degree, a narcotic and antispasmodic property. The latter quality is strongest in the recent state, and in the distilled water. The powdered bark may be given in doses of from 10 to 15 grains. This tree probably contains prussic acid.

CHAMÆROPS.

Polygamia Diœcia. LINN. Palmæ. JUSS. *Weak tonic, farinaceous.*

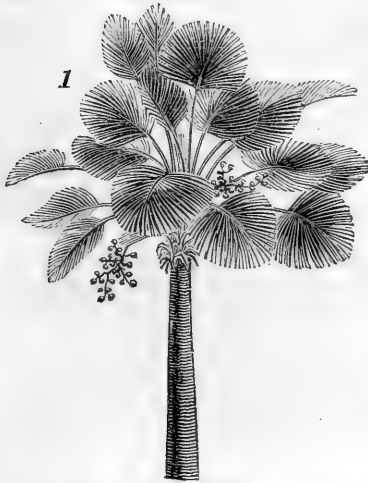
CABBAGE TREE. *Chamærops palmetto.*

PLATE XXII.

Fig. 1. The top of a cabbage tree with its fruit.

From its lofty height, this vegetable is considered in the United States as a tree; and upon the shores of the ocean, where it grows, it is called *Cabbage Tree*. Its northern limit is near Cape Hatteras, from which it spreads to the extremity of East Florida, and probably encircles the Gulf of Mexico. Farther south this tree is not confined, as in the United States, to the immediate vicinity of the sea.

A trunk from 40 to 50 feet in height, of an uniform diameter, and crowned with a regular and tufted summit, gives the cabbage tree a beautiful and majestic appearance. Its leaves are of a brilliant green, palmated, and borne by petioles from 18 to 20 inches long, nearly triangular and united at the edges; they vary in length and breadth from one to five feet, and are so arranged that the smallest occupy the centre of the summit, and the largest the circumference. Before their developement they are folded like a fan, and as they open, the outside sticks break off and fall, leaving the base surrounded with filaments woven into a coarse and flimsy russet web. The base of the undisclosed bundle of leaves is white, compact and tender. It puts forth in March long clusters of small greenish flowers, which are succeeded by a black, inesculent fruit, about the size of a pea.

In the Southern States the wood of this tree, though extremely porous, is preferred to every other for wharves; its superiority

consists in being secure from injury by sea worms, which, during the summer, commit such ravages in structures accessible to their attacks ; but when exposed to be alternately wet and dry in the flowing and ebbing of the tide, it decays as speedily as other wood. This use of the cabbage tree is rapidly diminishing its numbers, and probably the period is not far distant when it will cease to exist within the boundaries of the United States. This wood is found eminently proper for constructing forts, as it closes without splitting on the passage of the ball. The base of the leaves, when tender, is eaten with oil and vinegar, and resembles the artichoke and the cabbage in taste, whence is derived the name of *Cabbage Tree*. But to destroy a vegetable which has been a century in growing, to obtain three or four ounces of a substance neither richly nutritious nor peculiarly agreeable to the palate, would be pardonable only in a desert which was destined to remain uninhabited for ages. With similar prodigality of the works of nature, the first settlers of Kentucky killed the buffalo, an animal weighing twelve or fifteen hundred pounds, for the pleasure of eating its tongue, and abandoned the carcase to the beasts of the wilderness.

CORNUS.

Tetrandria Monogynia. LINN. Caprifoliæ. JUSS. *Tonic, cathartic.*

DOGWOOD. *Cornus florida.*

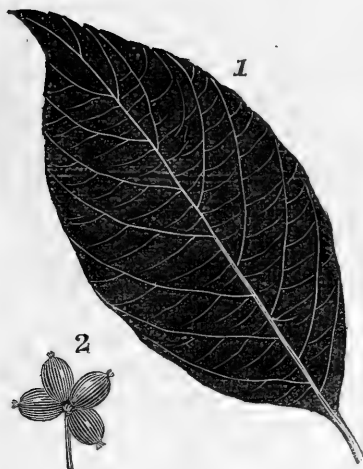


PLATE XXIII.

Fig. 1. A leaf. Fig. 2. The seed.

The Dogwood is first seen in Massachusetts and New Hampshire, between the 42d and 43d degrees of latitude, and in proceeding southward, it is met with uninterruptedly throughout the Eastern and Western States, and the Floridas, to the banks of the Mississippi. Over this vast extent of country, it is one of the most common trees, and it abounds particularly in New Jersey, Pennsylvania, Maryland and Virginia, wherever the soil is moist, gravelly and somewhat unea-

ven; farther south, in the Carolinas, Georgia and the Floridas, it is found only on the borders of swamps. In the most fertile districts of Kentucky and West Tennessee it does not appear in the forests except where the soil is gravelly and of a midling quality. In the United States at large, it is known by the name of *Dogwood*, and in Connecticut it is also called *Box Wood*.

The dogwood sometimes reaches 30 or 35 feet in height, and 9 or 10 inches in diameter; but it does not generally exceed the height of 18 or 20 feet, and the diameter of 4 or 5 inches. The trunk is strong, and is covered with a blackish bark, chapped into many small portions, which are often in the shape of squares more or less exact. The branches are proportionally less numerous than other trees, and are regularly disposed nearly in the form of crosses. The young twigs are observed to incline

upwards in a semi-circular direction. The leaves are opposite, about three inches in length, oval, of a dark green above and whitish beneath : the upper surface is very distinctly sulcated. Towards the close of summer they are often marked with black spots, and at the approach of winter they change to a dull red. In New York and New Jersey the flowers are fully blown about the middle of May, while the leaves are only beginning to unfold themselves. The flowers are small, yellowish and collected in bunches, which are surrounded with a very large involucre composed of four white floral leaves, sometimes inclining to violet. This fine involucre constitutes all the beauty of the flowers, which are very numerous, and which, in their season, robe the tree in white, like a full-blown apple tree, and render it one of the fairest ornaments of the American forests. The seeds of a vivid, glossy red, and of an oval shape, are always united. They remain upon the trees till the first frosts.

The wood is hard, compact, heavy and fine-grained, and is susceptible of a brilliant polish. The sap is perfectly white, and the heart is of a chocolate color. This tree is not large enough for works which require pieces of considerable volume : it is used for the handles of light tools, such as mallets, small vices, etc. It is employed by engravers for cuts used in printing. Some farmers select it for harrow teeth, for the hames of horses' collars, and also for lining the runners of sledges ; but to whatever purpose it is applied, being liable to split, it should never be wrought till it is perfectly seasoned. The shoots when three or four years old, are found proper for the light hoops of small, portable casks. In the Middle States, the cogs of mill wheels are made of dogwood. Such are the profitable uses of this tree ; it affords also excellent fuel, but it is too small to be brought into the markets of the cities. The liber of this wood is extremely bitter, and proves an excellent remedy in intermitting fevers. The bark of this wood has a close analogy to the Peruvian bark, and has proved, in many cases, to be capable of supplying its place with success. We are told of a respectable physician of Pennsylvania, who, during twenty years, had constantly employed it, and who estimated 35 grains of it to be equivalent to 30 grains

of the Peruvian bark. The only inconvenience accompanying its use was that, if taken within a year after being stripped from the tree, it sometimes occasioned acute pains in the bowels: but this evil was remedied by adding to it 5 grains of Virginia snake root, *Aristolochia serpentaria*. The bark may be substituted for gall nuts, of which an excellent ink may be made by putting one half of an ounce of it with 2 scruples of sulphate of iron, 2 scruples of gum arabic and 16 ounces of rain water. By shaking the infusion well together it will be fit for use in a few days.

CUPRESSUS.

Monœcia Monadelphia. LINN. Coniferæ. JUSS. *Expectorant, secernant, stimulant.*

CYPRESS. *Cupressus disticha.*



PLATE XXIV.

Fig. 1. A leaf. Fig. 2. A cone.

This species is the most interesting of its genus for the varied application of its wood and for its extraordinary dimensions in a favorable soil and climate. In Louisiana it is called *Cypre* or *Cypres*, and in the ancient Southern States *Cypress*, and sometimes *Bald Cypress*. The names of *Black* and *White Cypress*, in the Carolinas and Georgia, are founded only on the quality and color of the wood. The banks of Indian River, a small stream that waters a

part of Delaware in latitude $38^{\circ} 50'$, may be assumed as its northern boundary. Hence in proceeding southward, it becomes constantly more abundant in the swamps; but in Maryland and Virginia it is confined to the vicinity of the sea, where the winter

is milder and the summer more intense. Beyond Norfolk its limits coincide exactly with those of the *pine-barrens*, and in the Carolinas and Georgia it occupies a great part of the swamps which border the rivers after they have found out their way from among the mountains and have entered the low lands. The Mississippi, from its mouth to the river of the Arkansas, is bordered with marshes, which at the annual overflowing of this mighty stream, form a vast expanse of waters. In Louisiana those parts of the marshes where the cypress grows almost alone are called *Cyprières*, cypress swamps, and they sometimes occupy thousands of acres.

In the swamps of the Southern States and the Floridas, on whose deep, miry soil a new layer of vegetable mould is every year deposited by the floods, the cypress attains its utmost developement. The largest stocks are 120 feet in height, and from 25 to 40 feet in circumference above the conical base, which at the surface of the earth, is always three or four times as large as the continued diameter of the trunk : in felling them the Negroes are obliged to raise themselves upon scaffolds five or six feet from the ground. The base is usually hollow for three-fourths of its bulk, and is less regularly shaped than that of the large tupelo. Its surface is longitudinally furrowed with deep channels, whose ridges serve as cramps to fix it more firmly in the loose soil. The roots of the largest stocks, particularly of such as are most exposed to inundation, are charged with conical protuberances, commonly from 18 to 24 inches, and sometimes 4 or 5 feet in thickness : they are always hollow, smooth on the surface, and covered with a reddish bark like the roots, which they resemble, also, in the softness of their wood ; they exhibit no sign of vegetation, and no cause can be assigned for their existence ; they are peculiar to this tree, and begin to appear when it is 20 or 25 feet in height ; they are not made use of except by the Negroes for bee hives. Amidst the pine forests and *savannas* of the Floridas, is seen here and there a bog or a plash of water filled with cypresses, whose squalid appearance, when they exceed 18 or 20 feet in height, proves how much they are affected by the barrenness of a soil which

differs from the surrounding waste only by a layer of vegetable mould a little thicker upon the quartzous sand. The summit of the cypress is not pyramidal like that of the spruces, but is widely spread and even depressed upon old trees. The foliage is open, light and of a fresh agreeable tint : each leaf is four or five inches long, and consists of two parallel rows of leaflets upon a common stem. The leaflets are small, fine and somewhat arching, with the convex side outwards. In autumn they change from a light green to a dull red, and are shed soon after. This tree blooms in Carolina about the first of February. The male and female flowers are separately borne by the same tree, the first in flexible pendulous aments, and the second in bunches scarcely apparent. The cones are about as large as the thumb, hard, round, of an uneven surface, and stored with small, irregular, ligneous seeds, containing a cylindrical kernel : they are ripe in October, and retain their productive virtues two years.

The wood is fine-grained, and, after being for some time exposed to the light, of a reddish color : it possesses great strength and elasticity, and is lighter and less resinous than that of the pines. To these properties is added the faculty of long resisting the heat and moisture of the southern climate. The color of the bark and the properties of the wood vary with the nature of the soil ; the stocks which grow near the natural bed of the rivers, and are half the year surrounded with water to the height of three or four feet, have a lighter-colored bark than those which stand retired in places that the waters do not reach, or where they sojourn but a moment. The wood, also, is whiter, less resinous and less heavy. These are called *White Cypresses*. The others, of which the bark is browner and the wood heavier, more resinous, and of a duskier hue, are called *Black Cypresses*. When destined to be employed in the arts, both varieties should be felled in the winter, and kept till, by a long process, the wood has become perfectly dry. A resin of an agreeable odor and a red color exudes from the cypress ; it is not abundant enough to be collected for commerce, though more copious than that of the white cedar, which is probably the reason of the wood being denser and stronger : it is preferred to that of the pines for the

dressing of suppurating wounds. By boiling the leaves three hours in water they afford a fine durable cinnamon color. This wood is extensively employed for building wherever it abounds. Of whatever materials the building is constructed, the roof is universally covered with cypress shingles, which, if made of trees felled in the winter, last forty years. Cypress boards are preferred to those of pine for the inside of brick houses, and for window sashes, and the panels of doors exposed to the weather: cabinet makers also choose it for the inside of mahogany furniture. It is highly proper for the masts and sides of vessels, and wherever it grows it is chosen for canoes, which are fashioned from a single trunk, and are often 30 feet long and 5 feet wide, light, solid and more durable than those of any other tree. It makes the best pipes to convey water under ground; especially the black variety, which is more resinous and solid.

WHITE CEDAR. *Cupressus thyoides*.



PLATE XXV.
Fig. 1 A leaf. Fig. 2. A cone.

Among the resinous trees of the United States, the White Cedar is one of the most interesting for the varied utility of its wood. North of the river Connecticut it is rare and little employed in the arts. In the Southern States it is not met with beyond the river Santee, but it is found, though not abundantly, on the Savannah: it is multiplied only within these limits and to the distance of 50 miles from the ocean. At New York, New Jersey and Penn-

sylvania, it is known by the name of *White Cedar*, and in Maryland, Virginia and North Carolina, by that of *Juniper*. We

have adopted the first denomination, which is not unknown where the second is habitually used, because the tree belongs to a different genus from the junipers. In Massachusetts, Vermont, New Hampshire and the more northern parts of America, the arbor vitæ is called white cedar, but we have thought proper to retain the name for the species we are now considering. The white cedar grows only in wet grounds. In the maritime districts of New Jersey, Maryland and Virginia, it nearly fills the extensive marshes which lie adjacent to the *salt meadows*, and are exposed in high tides to be overflowed by the sea. In New Jersey it covers almost alone the whole surface of the swamps.

The white cedar is 70 or 80 feet high, and sometimes more than three feet in diameter. When the trees are close and compressed, the trunk is straight, perpendicular and destitute of branches to the height of 50 or 60 feet. The epidermis is very thin on the young stocks ; but as they grow older it becomes thick, of a soft filaceous texture, of a reddish color, and similar to that of an old vine. When cut, a yellow transparent resin of an agreeable odor exudes, of which a few ounces could hardly be collected in a summer from a tree of three feet in circumference. The foliage is ever green : each leaf is a little branch numerously subdivided, and composed of small, acute, imbricated scales, on the back of which a minute gland is discerned with the lens. In the angle of these ramifications grow the flowers, which open in April or May and are scarcely visible, and which produce very small rugged cones of a greenish tint, that change to bluish towards autumn, when they open to release the fine seeds.

The wood is light, soft, fine-grained and easily wrought. When perfectly seasoned and exposed for some time to the light it is of a rosy hue. It has a strong aromatic odor, which it preserves as long as it is guarded from humidity. The perfect wood resists the succession of dryness and moisture longer than that of any other species, and for this quality, principally, as well as its extreme lightness, it is employed for shingles, which last from 40 to 50 years. The superior fitness of this wood for various household utensils, has given rise, in Philadelphia, to a

distinct class of mechanics called *cedar coopers*, and a considerable number of workmen are employed for the domestic and foreign market. They fabricate principally pails, wash tubs and churns of different forms. This ware is cheap, light and neatly made; and instead of becoming dull, like that of other wood, it grows whiter and smoother by use. This wood, when selected with care, makes excellent sound-boards for piano fortes. Charcoal highly esteemed in the manufacture of gun powder is made of young stocks about an inch and a half in diameter deprived of their bark; and the seasoned wood affords beautiful lamp black, lighter and more intensely colored, though less abundant, than that obtained from the pine. The farmers of the borders of the cedar swamps employ this tree for field fence: the rails, formed of young stocks entire or split in the middle, last from 50 to 60 years when deprived of the bark. This wood has long since ceased to be employed for the frames of houses, as it is more profitably used for other purposes in joinery, for which it is superior to white pine, being still more durable and more secure from worms.

DIOSPYROS.

Polygamia Diœcia. LINN. *Guaiacanæ.* JUSS. *Tonic, warming stomachic.*

PERSIMON. *Diospyros Virginiana.*



PLATE XXVI.

Fig. 1. A leaf. Fig. 2. The fruit.

The banks of the river Connecticut, below the 42d degree of latitude, may be considered as the northern limit of this tree; but it is rendered rare in these parts by the severity of the winter, while in New Jersey it is common and still more so in Pennsylvania, Maryland and the Southern States: it abounds, also, in the western forests. It is every where known to Americans by the name which we have adopted; the French call it *Plaqueminer*, and its fruit *plaquimines*.

The persimon varies surprisingly in size in different soils and climates. In New Jersey it is not more than half as large as in the more southern states, where, in favorable situations, it is sometimes 60 feet in height and 18 or 20 inches in diameter. The trunk of a full-grown tree is covered with a deeply-furrowed blackish bark, from which a greenish gum exudes without taste or smell. The leaves are from four to six inches in length, oblong, entire, of a fine green above and glaucous beneath: in autumn they are often variegated with black spots. The terminal shoots are observed to be usually accompanied, at the base, by small, rounded leaves. This tree belongs to the class of vegetables whose sexes are confined to different stocks. Both the barren and fertile flowers are greenish and not strikingly apparent. They put forth in June or July. The ripe fruit is

about as large as the thumb, of a reddish complexion, round, fleshy and furnished with six or eight semi-oval stones, slightly swollen at the sides and of a dark purple color. It is not eatible till it has been touched with frost, by which the skin is shrivelled, and the pulp, which before was hard and extremely harsh to the taste, is softened and rendered palatable. The fruit is so abundant in the Southern States, that a tree often yields several bushels. In the south it adheres to the branches long after the shedding of the leaf, and when it falls it is eagerly devoured by wild and domestic animals.

The fresh sap wood is of a greenish color, which it preserves after it is seasoned, and the heart wood is brown, hard, compact, strong and elastic. It is employed for screws, tinmen's mallets, and shoe lasts. It is used by coach makers for the shafts of chaises, and is found preferable to the ash. The fruit is sometimes pounded with bran, and formed into cakes which are dried in an oven, and kept to make beer, for which purpose they are dissolved in warm water with the addition of hops and leven. It was long since found that brandy might be made from this fruit, by distilling the water, previously fermented, in which they have been bruised. This liquor is said to become good as it acquires age. The inner bark is extremely bitter, and has been used with success in intermitting fevers.

FAGUS.

Monœcia Polyandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

RED BEECH. *Fagus ferruginea.*

PLATE XXVII.
Fig. 1. A leaf and fruit. Fig. 2. A nut.

This species of Beech is almost exclusively confined to the north-eastern parts of the United States, and to the provinces of Canada, New Brunswick and Nova Scotia. In the state of Maine, New Hampshire and Vermont it is so abundant as often to constitute extensive forests, the finest of which grow on fertile, level or gently sloping lands which are proper for the culture of corn.

The red beech equals the white species in diameter, but not in height; and as it ramifies nearer the earth, and is more numerous divided, it has a more massy summit and the appearance of more tufted foliage. Its leaves are equally brilliant, a little larger and thicker and have longer teeth. Its fruit is of the same form, but is only half as large, and is garnished with firmer and less numerous points. The flowers are similar to those of the white beech though smaller, and put forth in May or June. To these differences must be added a more important one in the wood: a red beech 15 or 18 inches in diameter consists of 3 or 4 inches of sap and 13 or 14 inches of heart, the inverse of which proportion is found in the white beech.

The wood of the red beech is stronger; tougher and more compact. In the state of Maine and the British Provinces, where the oaks are rare, it is employed with the sugar maple and

yellow birch for the lower part of the frames of vessels. It is also employed for hoops, shoe lasts, the handles of tools, and is especially proper for the tops of cards, because when perfectly seasoned, it is not liable to warp. This wood is used for fuel, but it is less esteemed than the sugar maple. The beech nuts are of a triangular form, with a smooth, tough skin, and a fine interior pellicle adhering to the kernel. They are united in pairs in capsules garnished with soft points, from which they escape about the first of October, the season of their maturity. The fruit should be gathered as soon as it is ripe, as it is liable to be injured by the rain. They should be collected in dry weather, and spread like corn, in a garret or other place secure from humidity, and frequently turned. They are found to be better when dried insensibly in this manner than when exposed to the sun. A rich oil may be extracted from these nuts, and when done with skill equals one sixth of the fruit.

WHITE BEECH. *Fagus sylvestris*.



PLATE XXVIII.

Fig. 1. A leaf and fruit. Fig. 2. A nut.

The White Beech is one of the tallest and most majestic trees of the American forests. It grows the most abundantly in the Middle and Western States. Though it is common in New Jersey, Pennsylvania, Maryland and throughout the country east of the mountains, it is insulated in the forests, instead of composing large masses, as in Genessee, Kentucky and Tennessee. A deep, moist soil and a cool atmosphere are the most suitable to the growth of this tree.

On the banks of the Ohio the white beech attains the height of more than 100 feet with a circumference of 8 to 11 feet. In these forests, where these trees vegetate in a deep and fertile soil, their roots sometimes extend to a great distance even with the surface, and being entangled so as to cover the ground, they embarrass the steps of the traveller and render the land peculiarly difficult to clear. This tree is more slender and less branchy than the red beech; but its foliage is superb, and its general appearance magnificent. The leaves are oval-acuminate, smooth, shining and bordered in the spring with a soft, hairy down. The sexes are borne by different branches of the same tree. The barren flowers are collected in pendulous, globular heads and the others are small and of a greenish hue. They put forth in May. The fruit is an erect capsule covered with loose, flexible spines, which divides itself at maturity into four parts, and gives liberty to two triangular seeds. The bark upon the trunk of beeches is thick, gray, and, on the oldest stocks, smooth and entire.

The perfect wood of the white beech bears a small proportion to the sap, and frequently occupies only 3 inches in a trunk 18 inches in diameter. On the banks of the Ohio and in some parts of Kentucky, where the oak is too rare to afford bark enough for tanning, the deficiency is supplied by that of this wood; the leather made with it is white and serviceable, though avowedly inferior to what is prepared with the bark of the oak. The beech wood employed for fuel, bears a small proportion to the oak and the hickory; hence we presume that it is comparatively little esteemed. Its uses in the arts are similar to those of the red beech.

FRAXINUS.

Polygamia Diœcia. LINN. *Jasminææ*. JUSS. *Tonic, seccernant, stimulant.*

WHITE ASH. *Fraxinus Americana.*



PLATE XXIX.

Fig. 1. A leaflet. Fig. 2. The seed.

The White Ash is one of the most interesting among the American species for the qualities of its wood, and the most remarkable for the rapidity of its growth and for the beauty of its foliage. It abounds in New Brunswick and Canada; in the United States it is most multiplied north of the river Hudson, and is more common in Genessee, than in the southern part of New York, in New Jersey and Pennsylvania. A cold climate seems most congenial

to its nature. It is every where called *White Ash*, probably from the color of its bark, by which it is easily distinguished. The situations most favorable to this tree are the banks of rivers and the edges and surrounding acclivities of swamps.

The white ash sometimes attains the height of 80 feet with a diameter of three feet, and is one of the largest trees of the United States. The trunk is perfectly straight and often undivided to the height of more than 40 feet. On large stocks the bark is deeply furrowed, and divided into small squares from one to three inches in diameter. The leaves are twelve or fourteen inches long, opposite and composed of three or four pair of leaflets surmounted by an odd one. The leaflets, which are borne by short petioles, are three or four inches long, about two inches broad, oval-acuminate, rarely denticulated, of a delicate texture and an

undulated surface. Early in the spring they are covered with a light down, which gradually disappears, and at the approach of summer they are perfectly smooth, of a light green color above and whitish beneath. It puts forth white or greenish flowers in the month of May, which are succeeded by seeds that are 18 lines long, cylindrical near the base, and gradually flattened into a wing, the extremity of which is slightly notched. They are united in bunches four or five inches long, and are ripe in the beginning of autumn. The shoots of the two preceding years are of a bluish gray color and perfectly smooth: the distance between their buds sufficiently proves the vigor of their growth.

In large trees the perfect wood is reddish and the sap is white. This wood is highly esteemed for its strength, suppleness and elasticity, and is employed with advantage for a great variety of uses, of which we shall mention only the most common. It is always selected by coach makers for shafts, for the felloes of wheels, and for the frames of carriage bodies; it is also used for chairs, scythe and rake handles, the hoops of pails, the circular pieces of boxes and sieves; for wooden bowls and other domestic wares. In the state of Maine it is extensively used for staves, which are of a quality between those of white and those of red oak, and are esteemed best for containing salted provisions. It is admitted also into the lower frame of vessels, but is considered inferior to the yellow birch, and to the heart of the red beech. In all the Atlantic States the blocks used in ships and the pins for attaching the cordage are made of ash, for which purpose the white ash is employed in the northern and the red ash in the southern ports. On account of its strength and elasticity, the white ash is esteemed superior to every other wood for oars.

CAROLINIAN ASH. *Fraxinus platycarpa.*

This species of ash is confined to the Southern States. It abounds particularly on the river Cape Fear in North Carolina, and upon the Ashley and the Cooper in South Carolina. The marshy borders of creeks and rivers, and all places exposed to

long inundations, are congenial to this ash, which delights in more abundant moisture than the other species.

Its vegetation is beautiful, but its stature rarely exceeds 30 feet, and it fructifies at half this height. In the spring the lower side of the leaves and young shoots are covered with thick down, which disappears at the approach of summer. The leaves commonly consist of two pair of leaflets with a terminal odd one. The leaflets are large, nearly round, petiolated and distinctly toothed. The flowers, as in the other species, are small and not very conspicuous; the seeds, unlike those of any other ash with which we are acquainted, are flat, oval and broader than they are long.

From its inferior dimensions this tree is not much used in the arts; although it possesses properties of eminent utility.

BLUE ASH. *Fraxinus quadrangulata*.

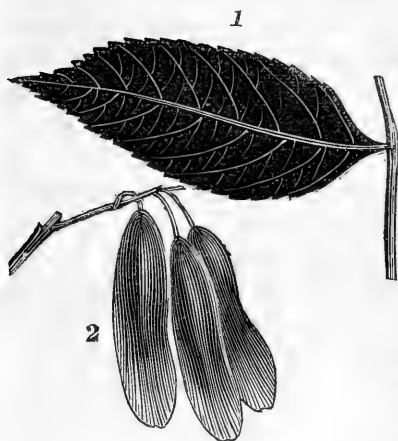


PLATE XXX.

Fig. 1. A leaflet. Fig. 2. The seed.

The Blue Ash is unknown to the Atlantic parts of the United States, and is found only in Tennessee, Kentucky and the southern part of Ohio. It requires the richest soil to bring this tree to perfection.

The blue ash frequently exceeds 60 or 70 feet in height and 18 or 20 inches in diameter. Its leaves are from 12 to 18 inches long, and are composed of two, three or four pair of leaflets with an odd one. The leaflets are large, smooth, oval-acuminate, distinctly

toothed and supported by short petioles. The young shoots to which the leaves are attached are distinguished by four opposite membranes, three or four lines broad and of a greenish color,

extending through their whole length : this character disappears the third or fourth year, leaving only the traces of its existence. The seeds are flat from one extremity to the other, and a little narrowed towards the base.

The wood of the blue ash possesses the characteristic properties of the genus, and of all the species of the Western States it is the most extensively employed and the most highly esteemed. Besides the habitual use that is made of it for the frame of carriages and for the felloes of wheels, it is generally selected for the flooring of houses, frequently for the exterior covering, and sometimes for the shingles of the roof; but for the last purpose the tulip tree is preferred. It is said that a blue color can be extracted from the bark of this tree.

BLACK ASH. *Fraxinus sambucifolia*.

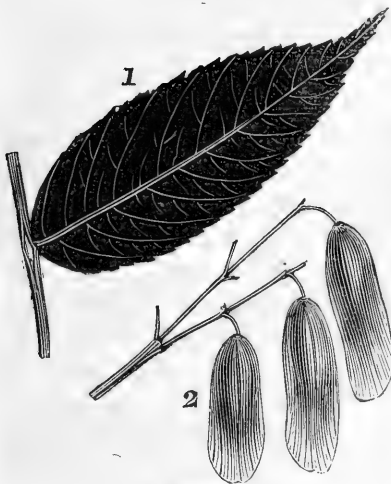


PLATE XXXI.

Fig. 1. A leaflet. Fig. 2. The seed.

In the extensive country comprising the northern section of the United States and the provinces of New Brunswick and Nova Scotia the White Ash and the Black Ash, which is sometimes called *Water Ash* and *Brown Ash*, are the most abundant in the forests and the most perfectly known to the inhabitants. The black ash requires a moister soil than the white ash, and longer exposed to inundations.

The black ash is 60 or 70 feet high and about two feet in diameter. It is easily distinguished from the white ash by its bark, which is of a duller hue, less deeply furrowed, and has the layers of the epidermis applied in broad sheets. The buds are of a deep blue, and the young shoots of a bright green

sprinkled with dots of the same color which disappears as the season advances. The leaves at their unfolding are accompanied by stipulæ which fall after two or three weeks: they are twelve or fifteen inches long when fully developed, and composed of three or four pair of leaflets with an odd one. The leaflets are sessile, oval-acuminate, denticulated, of a deep green color, smooth on the upper surface, and coated with red down upon the main ribs beneath: when bruised they emit an odor like that of elder leaves. Its flowers open in May or June, which are of a greenish color, and are succeeded by seeds disposed in bunches four or five inches long, flat, and, like those of the blue ash, are nearly as broad at the base as at the summit.

The perfect wood is of a brown complexion and fine texture; it is tougher and more elastic than that of the white ash, but less durable when exposed to the vicissitudes of dryness and moisture, and for this reason it is less extensively used. Coach makers do not employ it, and it is never wrought into oars, hand spikes and pulleys. In New Hampshire and the state of Maine it is preferred to the white ash for hoops, which are made of saplings from six to ten feet in length split in the middle. As this wood may be separated into thin, narrow strips, by malling, it is selected in the country for the bottoms of chairs, for baskets and riddles. This wood is more liable than any other species to be disfigured with knobs, which are sometimes of a considerable size and are detached from the body of the tree to make bowls. The wood of these excrescences has the advantage of superior solidity, and when carefully polished exhibits singular undulations of the fibre; divided into thin layers it might be employed to embellish mahogany. The ashes of this wood are singularly rich in alkali, from which, in Vermont and New Hampshire, great quantities of potash are made.

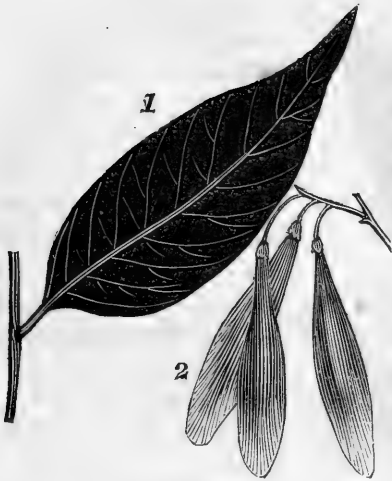
RED ASH. *Fraxinus tomentosa*.

PLATE XXXII.

Fig. 1. A leaflet. Fig. 2. The seed.

Of all the ashes this species is the most multiplied in Pennsylvania, Maryland and Virginia. Like the white ash it prefers swamps and places frequently inundated or liable to be covered with water by copious rains.

The red ash is a beautiful tree, rising perpendicularly to the height of 60 feet with a diameter of 15 or 18 inches. It is inferior to the white ash not only in size but in the rapidity of its growth; the length of the annual shoots and the distance of the buds

are but half as great as in the white ash. The bark upon the trunk is of a deep brown color. The leaves are from twelve to fifteen inches long and are composed of three or four pair of very acuminate, leaflets, terminated with an odd one. Their lower surface, as well as the shoots of the same season to which they are attached, is covered with thick down: on insulated trees this down is red at the approach of autumn, whence, probably, is derived the name of the tree. It puts forth greenish flowers in May, which are followed by seeds, similar in form and arrangement, though shorter, to those of the white ash.

The wood of this species is of a brighter red than that of the white ash, and possesses all the properties for which the other is esteemed, and in the Middle and Northern States they are indifferently applied to the same diversified uses; that of the red ash, however, is somewhat harder and consequently less elastic.

GREEN ASH. *Fraxinus viridis*.

PLATE XXXIII.

Fig. 1. A leaflet. Fig. 2. The seed.

The Green Ash is more common in the western districts of Pennsylvania, Maryland and Virginia than in any other part of the United States; but even here it is less multiplied than the white ash and black ash. It is found on the islands of the Susquehannah, and grows most abundantly on the banks of the Monongahela and the Ohio.

This tree attains the height of 25 or 30 feet, with a diameter of four or five inches. It may be easily

recognized by the brilliant color of the young shoots and of its leaves, of which the two surfaces are nearly alike, are from six to fifteen inches in length, according to the vigor of the tree and to the coolness of the soil, and are composed of three, four or five pair of petiolated, oval acuminate and distinctly denticulated leaflets, surmounted by an odd one. It puts forth greenish flowers in May, which are succeeded by seeds, similar in form to those of the white ash, though only half as large.

The wood of the green ash is distinguished by the same properties with that of the preceding species; but as the others are common in the same regions, and are so much superior in size it is only accidentally employed.

GLEDITSCHIA.

Polygamia Diœcia. LINN. Leguminosæ. Juss. *Aperient, emollient.*

WATER LOCUST. *Gleditschia monosperma.*

The Water Locust is first seen in the Atlantic States in the lower part of South Carolina, in which place, as well as in Georgia and East Florida, this tree, though not very rare, is not common. In the Western Country it is found 3 or 4 degrees farther north in Illinois. In the southern and maritime parts of the United States this tree is designated by no other name than the one which we have adopted, and grows only in large swamps that border the rivers, where the soil is constantly wet and often inundated at the season of the rising of the waters.

The water locust grows to the height of 50 or 60 feet, and from one to two feet in diameter. The bark upon the trunk of young trees is smooth; on old stocks it is cracked, but less deeply furrowed than that of the oaks and the walnuts. The branches, like those of the sweet locust, are armed with thorns, which are less numerous, smaller and more pointed; they are often simple, or accompanied near the base with a single secondary thorn. The leaves nearly resemble those of the sweet locust, from which they differ in being a little smaller in all their proportions. The flowers, which are not conspicuous, open in June, and are of a greenish color and destitute of odor. These are succeeded by reddish pods about an inch in diameter, and are united in bunches of three, each of which contains a single naked seed.

The wood of this tree resembles that of the sweet locust in its loose texture and yellow color; but as it grows in wet grounds, it is consequently inferior in quality.

SWEET LOCUST. *Gleditsia triacanthos.*

PLATE XXXIV.

Fig. 1. A leaf. Fig. 2. A seed.

The Sweet Locust belongs peculiarly to the country west of the Alleghanies, and it is scarcely found in any part of the Atlantic States. In the fertile bottoms which are watered by the rivers emptying into the Mississippi, in Illinois, and, still more in the southern parts of Kentucky and Tennessee, the sweet locust is abundant, in the most fertile soils. In different parts of the United States, this species is called indifferently *Sweet Locust* and *Honey Locust*; the

French of Illinois call it *Fevier*.

In situations favorable to its growth, the sweet locust attains the height of 70 or 80 feet with a diameter of 3 or 4 feet, with a trunk undivided for 40 feet. This tree is easily known by its bark, which, at intervals of a few inches, detaches itself laterally in plates three or four inches wide and two or three lines thick, and by the form of its trunk, which appears to be twisted, and which presents three or four crevices of inconsiderable depth, opening irregularly from the bottom towards the top. The large thorns which cover the branches, and frequently the trunk of young trees, afford another very distinct character. These thorns are sometimes several inches long, ligneous, of a reddish color, and armed, at some distance from the base, with two secondary thorns about half the size of the first. The leaves are pinnated and composed of small, oval, serrate, sessile leaflets. This foliage is elegant and of an agreeable tint; but it is thin, and scarcely obstructs the passage of the sun beams. It is shed

annually at the approach of winter. The flowers, which open in June, are small, not very conspicuous and disposed in bunches. The fruit is in form of flat, crooked, pendulous pods, from twelve to eighteen inches long, and of a reddish-brown color. The pods contain hard, smooth, brown seeds, enveloped in a pulpy substance, which, for a month after their maturity, is very sweet, and which then becomes extremely sour.

The perfect wood or heart of the sweet locust nearly resembles that of the water locust, but its grain is coarser, and its pores more open : in these respects it is more strikingly characterized even than the wood of the red oak, when perfectly seasoned. It is little esteemed in Kentucky, where it is more employed, and consequently can be better appreciated, than elsewhere. It is used neither by the carpenter nor the wheelwright : it is sometimes taken by the farmers for rails to fence their fields, but only when they are unable to procure better wood. The only destination for which it appears to be peculiarly adapted is the forming of hedges, which would be rendered impenetrable by its long thorns. Beer is sometimes made by fermenting the pulp of the fruit while fresh ; but the practice is not general, as the apple tree and peach tree, particularly the last, have become common, and afford a much superior beverage.

GORDONIA.

Monadelphia Polyandria. LINN. Malvaceæ. JUSS. *Emollient, aperient.*

LOBLOLLY BAY. *Gordonia lasyanthus.*



PLATE XXXV.

Fig. 1. A leaf. Fig. 2. A seed vessel.

The Loblolly Bay is confined to the maritime parts of the United States, to the Floridas, and to Lower Louisiana. In the *pine-barrens*, tracts 50 or 100 acres are met with at intervals, which, being lower than the adjacent ground, are kept constantly moist by the waters collected in them after the great rains. These spots are entirely covered with the loblolly bay, and are called *Bay Swamps*. Although the layer of vegetable mould is only three

or four inches thick, and reposes upon a bed of barren sand, the vegetation of these trees is surprisingly luxuriant.

The loblolly bay grows to the height of 50 or 60 feet, with a diameter of 18 or 20 inches. For 25 to 30 feet its trunk is perfectly straight. The small divergency of its branches near the trunk gives it a regularly pyramidical form; but as they ascend they spread more loosely, like those of other trees of the forest. The bark is very smooth while the tree is less than six inches in diameter; on old trees it is thick and deeply furrowed. The leaves are ever green, from three to six inches long, alternate, oval-acuminate, slightly toothed, and smooth and shining on the upper surface. The flowers are more than an inch broad, white and sweet-scented; they begin to appear about the middle of July and bloom in succession during two or three

months. This tree possesses the agreeable singularity of bearing flowers when it is only three or four feet high. The fruit is an oval capsule, divided into five compartments, each of which contains small, black, winged seeds. These seeds appear to germinate successfully only in places covered with *sphagnum*, a species of moss which copiously imbibes water.

In trunks of these trees which exceed fifteen inches in diameter four-fifths of the wood is heart. The wood is of a rosy hue, and of a fine, silky texture; it appears to be very proper for the inside of furniture, though the cypress is generally preferred. It is extremely light; when seasoned it is very brittle, and it rapidly decays unless it is kept perfectly dry: hence it is entirely neglected in use for timber, and it is not employed for fuel. The value of the bark in tanning compensates in some measure for the uselessness of its wood: it is employed for this purpose throughout the maritime parts of the Southern States and of the Floridas. For although this branch of industry is by no means as extensively practised in this part of the country, as in the Northern States, and though these regions afford many species of oak, yet the species whose bark is proper for tanning are not sufficiently multiplied to supply the consumption.

FRANKLINIA. *Gordonia pubescens.*

This species of *Gordonia* appears to be restricted by nature within very narrow bounds, having hitherto been found only on the banks of the Altamaha in Georgia. It was discovered there in 1770, by John Bartram, who gave it the name of *Franklinia* in honor of Dr. Franklin. It flourishes best in a sandy peat.

The *Franklinia* is much smaller than the preceding species, and rarely exceeds 30 feet in height and six or eight inches in diameter. The bark of the trunk presents a smooth and angular surface, like that of the hornbeam. The leaves are alternate, oblong, narrowed at the base and toothed: they are annually shed in autumn. It blooms in Carolina about the beginning of July, and a month later near Philadelphia. The flowers are

more than an inch in diameter, white and of an agreeable odor. Like those of the preceding species, they open in succession during two or three months, and begin to appear when the tree is only three or four feet high. The fruit is in form of round, ligneous capsules, which, when ripe, open at the summit in four seams, to release the small seeds.

No particular use is made of this tree, except for ornament.

GYMNOCLADUS.

Dicæcia Decandria. LINN. Leguminosæ. JUSS. *Aperient, emollient.*

COFFEE TREE. *Gymnocladus, canadensis.*

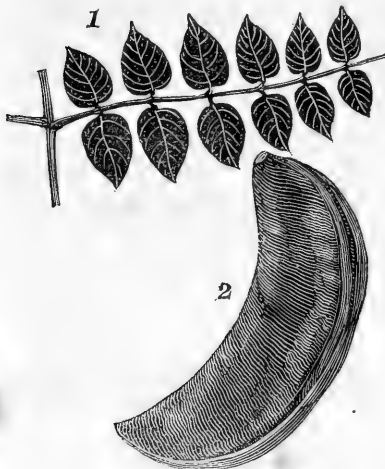


PLATE XXXVI.
Fig. 1. A leaf. Fig. 2. A pod.

Upper Canada beyond Montreal, and that part of Genessee which borders on Lake Ontario and Lake Erie, are the most northern countries which produce the coffee tree; but it is much less abundant in these climates than in Kentucky and Tennessee, and in the tracts which border on the Ohio and Illinois rivers, between the 35th and 40th degrees of latitude. The French of Canada call this tree *Chicot*; those of Illinois *Gros Fevier*; and the inhabitants of the

Western States, *Coffee Tree*. The richest lands are required for the production of this tree.

It usually grows to the height of 50 or 60 feet, with a diameter of 12 or 15 inches. In summer this tree when fully grown has a fine appearance: its straight trunk is often destitute of branches for 30 feet, and supports a summit not very widely spread, but

of a regular shape and tufted foliage : in the winter when its leaves are fallen, the fewness of its branches and the size of the terminal ones, which are very large, in comparison with those of other trees, give it a peculiar appearance somewhat resembling a dead tree. This is probably the reason of its being called *Chicot*, stump tree, by the French Canadians. To this peculiar character is added another of the epidermis, which is extremely rough, and which detaches itself in small, hard, transverse strips, rolled backward at the ends, and projecting sufficiently to render the tree distinguishable at the first sight. The leaves are 3 feet long, and 20 inches wide on young and thriving trees ; on old ones they are not more than half as large. These leaves are doubly compound, with oval-acuminate leaflets from one to two inches long, which are of a dull green, and in autumn the petiole is of a violet color. The barren and fertile flowers are borne on different trees. The flowers open from May to July and are white and large. The fruit consists of large bowed pods, of a reddish-brown color, and of a pulpy consistency within. They contain several large, gray seeds which are extremely hard.

The wood of the coffee tree is very compact and of a rosy hue. The fineness of its grain renders it fit for cabinet making, and its strength proper for building. Like the locust, it has a valuable property of rapidly converting its sap into perfect wood, so that a trunk six inches in diameter has only six lines of sap, and may be employed almost entire. The live bark is very bitter, so that a morsel no bigger than a grain of maize chewed for some time produces a violent irritation of the throat.

HOPEA.

Polyadelphia Polyandria. LINN. Guaiacanæ. Juss. *Tonic, warming, stomachic.*

SWEET LEAF. *Hopea tinctoria.*

The Sweet Leaf is common in Virginia, West Tennessee and in the upper part of the Carolinas and of Georgia ; but it is still more abundant within the limits of the *pine-barrens*, where the

soil is light and the winter less rigorous than at a greater distance from the ocean.

This tree varies in size according to the situation in which it grows ; on the banks of the Savannah and on the borders of the large swamps, where the soil is deep, loose and fertile, it grows from 25 to 30 feet in height and from seven to eight inches in diameter at the height of five feet from the ground. Commonly it does not exceed half these dimensions, and in the pine barrens, where it is profusely multiplied, it is sometimes only three or four feet in height. The sprouts from the trunks consumed in the annual conflagration of the forests never surpass this height, and, as they do not fructify, the tree is multiplied by its running roots, which shoot at the distance of a few feet. The trunk is clad in a smooth bark, and, if wounded in the spring, it distils a milky fluid of an unpleasant odor. The leaves are three or four inches long, smooth, totally thick, alternate, of an elongated oval shape, slightly denticulated, and of a sugary taste. In sheltered situations they persist during two or three years, but in the *pine-barrens* they turn yellow with the first frost and fall towards the first of February. The flowers spring from the base of the leaves, and appear early in the season : they are yellowish, sweet-scented, and composed of a great number of stamens shorter than the petals and united in separate groups at the base. The fruit is cylindrical, minute and of a deep blue color at its maturity.

The wood of this tree is very soft and is totally useless. The foliage is the only part which is of any utility ; when dry it affords, by decoction, a beautiful yellow color, which is rendered permanent by the addition of a little alum, and is used to dye wool and cotton. But if these leaves had possessed any considerable value they would doubtless have found their way into commerce.

I L E X.

Tetrandria Tetragynia. LINN. Celastrineæ. JUSS. *Cathartic, emetic.*

AMERICAN HOLLY. *Ilex opaca.*

PLATE XXXVII.

Fig. 1. A leaf. Fig. 2. The fruit.

The American Holly is first met with in Connecticut and is common in all the more Southern States, in the Floridas, in Lower Louisiana and in West Tennessee, but it is observed to become more rare in approaching the mountains. On the eastern shore of Maryland, and in certain parts of Virginia it grows almost exclusively on open grounds and in dry gravelly soils; while in South Carolina, Georgia and Lower Louisiana it is seen only in shady places,

on the edges of swamps, where the soil is cool and fertile.

In favorable situations this tree attains the height of 40 feet, with a diameter of 12 or 15 inches. Its leaves are ovate, acute, spinous, glabrous and flat, and are of a light-green color. Its flowers are whitish and not conspicuous, and put forth in the month of May. They are succeeded by numerous red berries which remain long attached to the branches. Upon the trunk of old trees the bark is smooth and of a whitish-gray color; on the young branches it is green and shining.

The wood of the American holly is heavy and compact, with a white sap and brown heart. Its grain is fine and close; hence it is very brilliant when polished. Its principal use is for inlaying mahogany furniture: the black lines with which cabinet makers sometimes adorn their work are of holly dyed in the coppers of

the latter. As it turns well, it is chosen for light screws and for the small boxes in which apothecaries put their opiates. When perfectly dry, this wood is very hard and unyielding, hence it is excellently adapted for the pulleys used in ships. The attempt has been successfully made for employing the holly for hedges, which are very dense and which have the recommendation of preserving their foliage through the year. The berries of the holly are purgative, and, taken to the number of 15 or 20, they excite vomiting.

JUGLANS.

Monœcia Polyandria. LINN. Terebinthaceæ. JUSS. *Cathartic, emetic, narcotic.*

BITTERNUT HICKORY. *Juglans amara.*

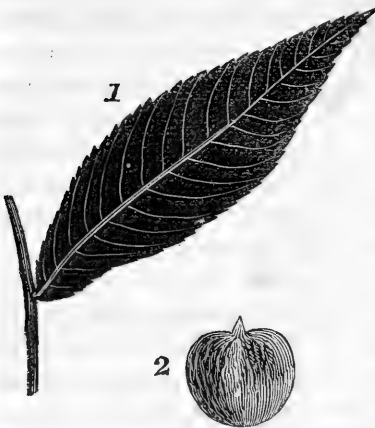


PLATE XXXVIII.

Fig. 1. A leaflet. Fig. 2. A nut without its husk.

This species is generally known in New Jersey by the name of *Bitternut Hickory*; in Pennsylvania it is called *White Hickory* and sometimes *Swamp Hickory*; farther south it is compounded with the pignut hickory; the French of Illinois, like the inhabitants of New Jersey, give it the name of *Bitternut*, which, as it indicates one of the peculiar properties of the fruit, we have chosen to retain. It is nowhere found much beyond the boundaries of Vermont, in latitude 45°.

It is not seen in the state of Maine, where the borders of the rivers offer situations, analogous to those in which it abounds, a few degrees farther south.

Near New York, and in the bottoms which stretch along the Ohio it grows to the height of 70 or 80 feet with a circumference

of 10 or 12 feet. It attains these dimensions only in spots where the soil is excellent, constantly cool, and often inundated by creeks and rivers. It is probably because it thrives most in such situations, that it is sometimes called *Swamp Hickory*. Of all the hickories the vegetation of this species is the latest; the leaves do not unfold until a fortnight after the others. On flourishing trees at an age to bear fruit, they are twelve or fifteen inches in length and nearly as much in breadth; the size, as in other vegetables, varies according to the nature of the soil, and the situation of the leaf upon a lower or an upper branch. Each leaf is composed of three or four pair of leaflets, and terminated by an odd one, which is larger than the preceding pair. The leaflets are about six inches in length, and an inch in breadth, sessile, oval-acuminate, deeply toothed, smooth and of a pretty dark green. When the tree has shed its leaves, it may still be distinguished by its yellow and naked buds. In Pennsylvania and New Jersey, this tree blooms about the last of May. The peduncles of the barren flowers are in pairs, each supporting three flexible and pendulous aments: they are attached at the basis of the shoots of the same season, while the fertile aments, which are not conspicuous, are placed at the extremity. The fruit is ripe about the beginning of October; the husk is thin, fleshy and surmounted on its upper half by four appendages in the form of wings. It never becomes ligneous, like those of the other hickories, but softens and decays. The form of the nut of this species is more constant and more regular than in the others. It is broader than it is long, being six or seven lines one way and ten lines the other. The shell is white, smooth and thin enough to be broken by the fingers. The kernel is remarkable for the deep inequalities produced on every side by its foldings. It is so harsh and bitter, that squirrels and other animals will not feed upon it, while any other nut is to be found.

In the texture of its bark, and in the color of its heart and sap, this tree resembles the other hickories, and its wood possesses, though in an inferior degree, the weight, strength, tenacity and elasticity, which so plainly distinguish them. It is used for fuel, but it is not much superior to white oak. In some parts of

Pennsylvania where this tree is multiplied, an oil is extracted from the nuts, which is used for the lamp and for other inferior purposes.

WATER BITTERNUT HICKORY. *Juglans aquatica.*

This species of hickory is confined to the Southern States, and is confounded with the pignut hickory, though different from it in many respects. It always grows in swamps, and in the ditches which surround the rice fields.

It grows to the height of 40 or 50 feet, and its general appearance resembles the other hickories. Its leaves are eight or nine inches long, and of a beautiful green. They are composed of four or five pair of sessile leaflets surmounted by a petiolated odd one. The leaflets are serrate, four or five inches long, eight or nine lines broad, and very similar to the leaves of the peach tree. The husk is thin, and the nuts are small, angular, a little depressed at the sides, somewhat rough, of a reddish color and very tender. The kernel is formed in folds like that of the preceding species: as may be supposed it is not eatable.

The wood of this tree, though partaking of the common properties of the hickories, is in every respect inferior to the others, from the nature of the grounds on which it grows. The southern parts of the United States possess many sorts of timber more useful in building, to which purpose this, like the other hickories, is poorly adapted.

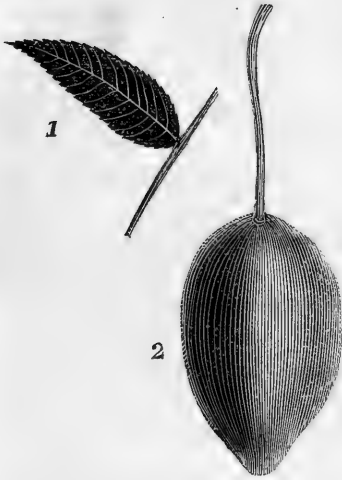
BUTTERNUT. *Juglans cathartica.*

PLATE XXXIX.

Fig. 1. A leaflet. Fig. 2. A nut with its husk.

This species of walnut is known in the United States, under different denominations. In Massachusetts, New Hampshire and Vermont, it bears the name of *Oil Nut*; in Pennsylvania and Maryland and on the banks of the Ohio, it is generally known by that of *White Walnut*; in Connecticut, New York, New Jersey, Virginia and the mountainous districts of the upper parts of the Carolinas, it is called *Butternut*. The last of these names we have

adopted, because it is most generally used. This tree is found in the Canadas, in all of the New England States, New York, New Jersey, Kentucky, Tennessee and on the banks of the Missouri, and in the bottoms which border on the Ohio. It flourishes most abundantly in a cold unproductive soil, interspersed with large rocks, and on the steep, elevated banks of rivers.

In favorable situations this tree grows to the height of 50 or 60 feet with a circumference of 10 or 12 feet, five feet from the ground. Its roots extend even with the surface of the earth, in a serpentine direction, and with little variation in size, to the distance of 40 feet. The trunk ramifies at a small height, and the branches, seeking a direction more horizontal than those of other trees, and spreading widely, form a large and tufted head, which gives the tree a remarkable appearance. The bark of the secondary branches is smooth and grayish. The buds, like those of the black walnut, are uncovered. In spring its vegetation is forward, and its leaves unfold a fortnight earlier than those of the

hickories. Each leaf is composed of seven or eight pair of sessile leaflets, and terminated by a petiolated odd one. The leaflets are from two to three inches in length, lanceolate, serrate and slightly downy. The barren flowers stand on large cylindrical aments, which are single, four or five inches long, and attached to the shoots of the preceding year; the fertile flowers, on the contrary, come out on the shoots of the same spring, and are situated at the extremity. The ovarium is crowned by two rose-colored stigmas. The fruit is commonly single, and suspended by a thin, pliable peduncle, about three inches in length; its form is oblong-oval without any appearance of seam. It is often two and a half inches in length, and five inches in circumference, and is covered with a viscid adhesive substance, composed of small transparent vesicles, which are easily discerned with the aid of a lens. The nuts are hard, oblong, rounded at the base, and terminated at the summit, in an acute point; the surface is very rough, and deeply and irregularly furrowed. They are ripe from the middle to the end of September, a fortnight earlier than the other species of walnut. The kernel is thick and oily, and soon becomes rancid; hence, doubtless, are derived the names of *Oil nut* and *Butternut*.

The black walnut and butternut, when young, resemble each other in their foliage, and in the rapidity of their growth; but when arrived at maturity, their forms are so different, as to be distinguishable at first sight. Remarkable peculiarities are also found, on examining their wood, especially when seasoned; the black walnut is heavy, strong, and of a dark brown color; while the butternut is light, of little strength, and of a reddish hue; but they possess in common, the great advantage of durability, and of being secure from the annoyance of worms. From its want of solidity and from the difficulty of procuring pieces of considerable length, the timber of the butternut is seldom used in the construction of houses. As it long resists the effects of heat and moisture, it is esteemed for the posts and rails of rural fence. For corn shovels and wooden dishes, it is preferred to the red-flowering maple, because it is lighter and less liable to split. In Vermont, it is used for the panels of coaches and

chaises ; the workmen find it excellently adapted to this object, not only from its lightness, but because it is not liable to split, and receives paint in a superior manner.

The medicinal properties of the butternut bark, have long since been proved, by several eminent physicians of the United States. An extract in water, or even a decoction sweetened with honey, is acknowledged to be one of the best cathartics afforded by *materia medica* ; its purgative operation is always sure, and unattended, in the most delicate constitutions, with pain or irritation. Experience has shown that it produces the best effects in many cases of dysentery. It is commonly given in the form of pills, and to adults, in doses from half a dram to a dram. It is not however in general use, except in the country. It is obtained by boiling the bark entire in water, till the liquid is reduced by evaporation, to a thick, viscid substance, which is almost black. This is a faulty process ; the exterior bark, or the dead part which covers the cellular integument, should first be taken off, for by continued boiling, it becomes charged with four-fifths of the liquid, already enriched with extractive matter. This bark is also successfully employed as a revulsive, in inflammatory ophthalmias and in the tooth ache : a piece of it soaked in warm water, is applied in these cases to the back of the neck. In the country it is sometimes employed for dying wool of a dark brown color ; but the bark of the black walnut is preferable. On a live tree, the cellular integument, when first exposed, is of a pure white, in a moment it changes to a beautiful lemon color, and soon after to a deep brown. If the trunk of this tree is pierced in the month which precedes the unfolding of the leaves, a pretty copious discharge ensues of a slightly sugary sap, from which, by evaporation, sugar is obtained inferior to that of the sugar maple.

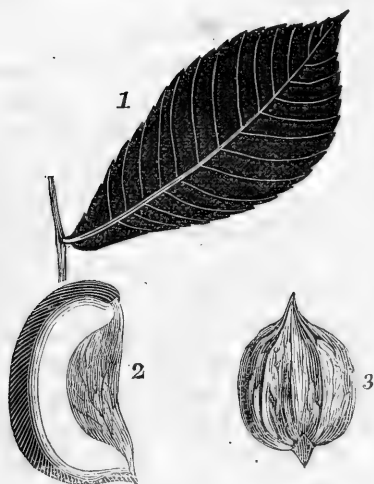
THICK SHELLBARK HICKORY. *Juglans laciniosa*.

PLATE XL.

Fig. 1. A leaflet. Fig. 2. A section of the husk.

Fig. 3. A nut.

This species bears a striking analogy to the shellbark hickory, and is frequently confounded with it by the inhabitants of the Western Country: some of them distinguish it by the name of *Thick Shellbark Hickory*, which should be preserved as its appropriate denomination. East of the Alleghanies this tree is rare, and is found only in a few places; it grows on the banks of the Schuylkill, and in the vicinity of Springfield, in Pennsylvania, where its fruit is called *Springfield nut*.

It is also found in the county of Gloucester in Virginia, under the name of *Gloucester Walnut*. It abounds on the banks of the Ohio and the rivers which empty into it.

It grows to the height of 80 feet and its ample head is supported by a straight trunk, in diameter, proportioned to its elevation. The bark exhibits the same singular arrangement with that of the shellbark hickory: it is divided into strips from one to three feet long, which are warped outwards at the end, and attached only in the middle. They fall and are succeeded by others similarly disposed. It is only observable that in this species the plates are narrower, more numerous, and of a lighter color. The outer scales of the buds do not adhere entirely to the inner ones, but retire as in the shellbark hickory. The leaves also, which vary in length from eight to twenty inches, observe the same process in unfolding, and are similar in size, configuration and texture; but they differ in being composed of

seven leaflets and sometimes of nine instead of five, the invariable number of the shellbark hickory. The barren aments are disposed in the same form, though they are, perhaps a little longer than in the other species. The fertile flowers appear, not very conspicuous, at the extremity of the shoots of the same spring. They are succeeded by a large oval fruit, more than two inches long, and four or five inches in circumference. Like that of the shellbark hickory, it has four depressed seams, which at its complete maturity, open through their whole length for the escape of the nut. The nut of this species is widely different from the other; it is nearly twice as big, it is longer than it is broad, and is terminated at each end in a firm point. The shell is also thicker and of a yellowish hue, while that of the shellbark nut is nearly white.

The thick shellbark hickory, as has been said, is nearly related to the shellbark hickory, and its wood, which is of the same color and texture, unites the peculiar qualities of that species, with such as are common to the hickories. It is applied to similar purposes as that of the shellbark hickory.

NUTMEG HICKORY. *Juglans myristiciformis*.

This species is peculiar to the Middle States, though not much multiplied, where it bears the name of *Nutmeg Hickory*, from the resemblance of its fruit to that of the nutmeg. It is said, however, to abound on the banks of Red River.

The leaves which are composed of four leaflets with an odd one, are systematically arranged. The shoots of the preceding year are flexible and tough. The nuts are very small, smooth, and of a brown color marked with lines of white; the husk is thin and somewhat rough on the surface. The shell is so thick that it constitutes two-thirds of the volume of the nut, which, consequently, is extremely hard, and has a minute kernel. The fruit is still inferior to the pig nut.

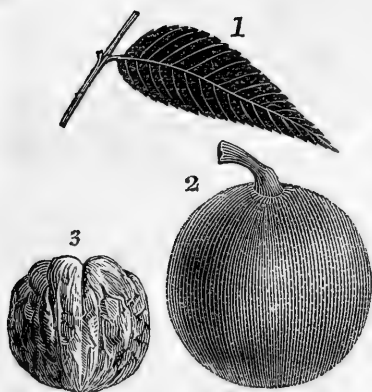
BLACK WALNUT. *Juglans nigra*.

PLATE XLI.

Fig. 1. A leaflet. Fig. 2. A nut with the husk.

Fig. 3. A nut without the husk.

This tree is known in all parts of the United States where it grows, and to the French of the Canadas and Louisiana, by no other name than *Black Walnut*. East of the Alleghanies, the most northern point at which it appears, is about Goshen, in New Jersey in the latitude of $40^{\circ} 50'$. West of the mountains, it exists abundantly two degrees farther north, in that portion of Genessee, which is comprised between the 77th and 79th degrees of longitude.

This tree is multiplied in the forests in the vicinity of Philadelphia, and with the exception of the lower parts of the Southern States, where the soil is too sandy, or too wet as in the swamps, it is met with to the banks of the Mississippi throughout an extent of 2000 miles. East of the Alleghanies in Virginia, and in the upper parts of the Carolinas and of Georgia, it is chiefly confined to the valleys where the soil is deep and fertile, and which are watered by creeks and rivers.

On the banks of the Ohio and on the islands of this beautiful river, the black walnut attains the elevation of 60 or 70 feet, with a diameter of 3 to 7 feet. Its powerful vegetation clearly points out this, as one of the largest trees of America. When it stands insulated, its branches, extending themselves horizontally to a great distance, spread into a spacious head, which gives it a very majestic appearance. The bark is thick, blackish and on old trees deeply furrowed. The leaves when bruised emit a strong aromatic odor. They are about eighteen inches in length,

pinnate, and composed in general of six, seven or eight pair of leaflets surmounted by an odd one. The leaflets are opposite and fixed on short petioles; they are acuminate, serrate and somewhat downy. The barren flowers are disposed in pendulous and cylindrical aments, of which the peduncles are simple, unlike those of the hickories. The fruit is round, odoriferous, of rather an uneven surface, and always appears at the extremity of the branches: on young and vigorous trees, it is sometimes seven or eight inches in circumference. The husk is thick, and is not as in the hickories divided into sections; but when ripe it softens and gradually decays. The nut is hard, somewhat compressed at the sides and sulcated. The kernel, which is divided by firm ligneous partitions, is of a sweet and agreeable taste, though inferior to that of the European walnut. The size of the fruit varies considerably, and depends upon the vigor of the tree, and upon the nature of the soil and climate. Some variations are observed in the form of the fruit, and in the moulding of the shell which are considered only as accidental differences.

When the wood of this tree is freshly cut, the sap is white and the heart of a violet color, which after a short exposure to the air, assumes an intenser shade, and becomes nearly black: hence probably is derived the name *Black Walnut*. There are several qualities for which its wood is principally esteemed: it remains sound for a long time, even when exposed to the influences of heat and moisture; but this observation is only applicable to the heart, the sap speedily decays: it is very strong and very tenacious: when thoroughly seasoned it is not liable to warp and split; and its grain is sufficiently fine and compact to admit of a beautiful polish. It possesses in addition to these advantages, that of being secure from worms. On account of these excellencies, it is preferred and successfully employed in many kinds of work. East of the Alleghanies, its timber is not extensively used in building houses, but, in some parts of Kentucky and Ohio, it is split into shingles which serve to cover them: sometimes also this timber enters into the composition of the frame. But it is chiefly in cabinet making, that this wood is employed

wherever it abounds. By selecting pieces from the upper part of the trunk, immediately below the first ramification, furniture is sometimes made, which from the accidental curlings of the grain is highly beautiful : but as its color soon changes to a dusky hue the wild cherry wood is frequently preferred for this use. The black walnut is also employed for the stocks of military muskets ; it is stronger and tougher than the red-flowering maple, which, from its superior lightness and elegance, is chosen for fowling pieces. In Virginia posts are very commonly made of this wood, and as it lasts undecayed in the ground from twenty to twenty-five years, it appears every way fit for this purpose. It also makes excellent naves for wheels, which farther proves its strength and durability. The timber of this tree is also excellently adapted to certain uses in naval architecture. It should never be wrought till it is perfectly seasoned, after which it is asserted to be more durable, though more brittle than the white oak. It is asserted that this wood, like the live oak, is not liable to be attacked by sea worms in warm climates. The husk of the fruit yields a color similar to that which is obtained from the European walnut. It is used in the country for dyeing woollen stuffs.

PACANENUT HICKORY. *Juglans olivæformis*.

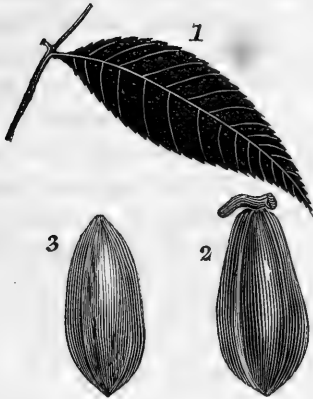


PLATE XLII.

Fig. 1. A leaflet. Fig. 2. A nut with the husk.

Fig. 3. A nut without the husk.

This species, which is found in Upper Louisiana, is called by the French of Illinois and New Orleans, *Pacanièr*, and its fruit *Pacanes*. This name has also been adopted by the inhabitants of the United States, who call it *Pacanenut*. On the borders of the Missouri, Illinois, St. Francis and Arkansas, it is most abundantly multiplied; it is also common on the river Wabash; on the Ohio, it is found for 200 miles from its junction with the Mississippi. This

tree grows most abundantly in cold and wet grounds.

The pacanenut is a beautiful tree, with a straight and well-shaped trunk; in the forest it reaches the height of 60 or 70 feet, with a proportionate diameter. Its buds, like those of the black walnut and butternut, are uncovered. The leaves are from twelve to eighteen inches in length, and are supported by petioles somewhat angular, and slightly downy in the spring. Each leaf is composed of six or seven pair of sessile leaflets, and terminated by a petiolated odd one, which is commonly smaller than the pair immediately preceding. The leaflets, on flourishing trees, are from two to three inches long, ovate, serrate, and remarkable for the circular form of the upper edge, while the lower one is less rounded. It is also to be noticed, that the main rib is placed a little below the middle of the leaflet. The nuts, which are usually abundant, are contained in a husk, from one to two lines thick, and have four slightly prominent angles, corresponding to their internal divisions. They vary in length

from an inch to an inch and a half, are pointed at the extremities, of a cylindrical form, and of a yellowish color marked, at the period of perfect maturity, with blackish or purple lines. The shell is smooth and thin, though too hard to be broken by the fingers: the kernel is full, and not being divided by ligneous partitions, is easily extracted. These nuts which are of a very sweet taste, form an object of petty commerce, between Upper and Lower Louisiana. From New Orleans, they are exported to the West Indies, and to the ports of the Atlantic States.

The wood of the pacanenut is coarse-grained, and like the other hickories, heavy and compact: it also possesses great strength and durability; but in these respects it is inferior to many other species of this genus. Although it merits attention, and by assiduous cultivation, it may be brought to a high degree of perfection.

PIGNET HICKORY. *Juglans porcina*.

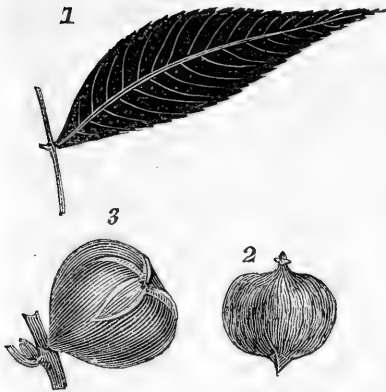


PLATE XLIII.

Fig. 1. A leaflet. Fig. 2. A nut without the husk.

Fig. 3. A nut with the husk.

This tree is generally known in the United States by the name of *Pignut* and *Hognut Hickory*, sometimes of that of *Broom Hickory*. The first of these names is most commonly in use; the others are known in some districts of Pennsylvania. Portsmouth, New Hampshire may be considered as limiting towards the north, the climate of this tree. A little farther south it is abundant, and in the Atlantic parts of the Middle States, it helps to form the mass of the forests.

In the Southern States, especially near the coast, it is less common in the woods, being found on the borders of swamps and in places which are wet without being absolutely marshy, or

exposed to a long inundation. This tree is met with in the Western country, and with the exception of Vermont, New Hampshire and the state of Maine, of the Genessee Country, and of the cold and mountainous tracts along the whole range of the Alleghanies, this tree is more or less abundant in the forests throughout the United States.

The pignut hickory is one of the largest trees of the American forest. It grows to the height of 70 or 80 feet, with a diameter of 3 or 4 feet. In the winter when stript of its leaves, it is easily known by the shoots of the preceding summer, which are brown, less than half as large as those of the mockernut and shellbark hickories, and terminated by small, naked buds. At this season, it is easy, also to distinguish the bitternut hickory, by its naked and yellow buds. The buds of this species, as in the other hickories of this kind, are more than an inch in length, a few days before their unfolding. The inner scales are the largest and of a reddish color. They do not fall till the leaves are five or six inches long. The leaves are compound, and vary in size and in number of leaflets, according to the moisture and fertility of the soil. In rich grounds, they are eighteen inches long; and the complete number of leaflets is three pair with an odd one. The leaflets are four or five inches long, acuminate, serrate, nearly sessile, and glabrous or smooth on both sides. On vigorous trees, which grow in shady exposures, the petiole is of a violet color. The barren aments are smooth, filiform, flexible and pendulous: they are two inches long, and in their arrangement, resemble those of the other hickories. The fertile flowers are greenish, not very conspicuous, and situated at the extremity of the shoot: the fruit succeeds them in pairs as often as single. The husk is thin and of a beautiful green: when ripe, it opens through half its length, for the passage of the nut. The nut is small, smooth, and very hard on account of the thickness of the shell. Its kernel is sweet but meagre and difficult to extract, from the firmness of the partitions. The form and size of these nuts vary more than in any other species. Some are oval, and when covered with their husks, resemble young figs; others are broader than they are long, and others

are perfectly round. Among these various forms, some nuts are as large as the thumb, and others not bigger than the little finger.

The wood of the pignut hickory resembles that of the other species, in the color of its sap and of its heart ; it possesses also their excellencies and their defects. It is the strongest and the most tenacious of the hickories, and for this reason, is preferred to any other for axletrees and axe handles. These considerations highly recommend its cultivation.

SHELLBARK HICKORY. *Juglans squamosa.*

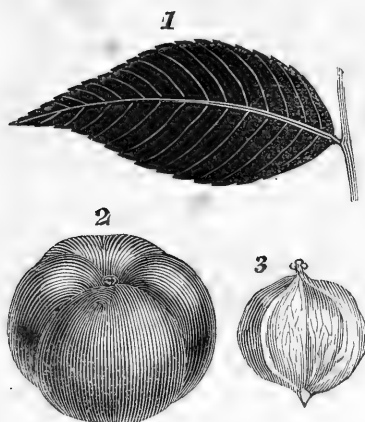


PLATE XLIV.

Fig. 1. A leaflet. Fig. 2. A nut with the husk.

Fig. 3. A nut without the husk.

The singular disposition of the bark, in this species, has given rise to the descriptive names of *Shellbark*, *Shagbark* and *Scalybark Hickory*, the first of which, as being most generally in use in the Middle and Southern States, we have adopted. Many descendants of the Dutch settlers, who inhabit the part of New Jersey near the city of New York, call it *Kisky Thomas Nut*, and the French of Illinois, know it by the name of *Noyer Tendre*, or soft

walnut. This tree is unknown north of Portsmouth, New Hampshire ; and even there, its vegetation being impeded by the rigors of the climate, its stature is low and its fruit small. It abounds on the shores of Lake Erie, about Geneva in Genessee, along the river Mohawk, in New Jersey and on the bank of the Susquehannah and Schuylkill in Pennsylvania. In Maryland, in the lower parts of Virginia and in the other Southern States it is less common. It is met with in South Carolina and also the Western States, though not so abundantly as some other species.

East of the Alleghanies, it grows almost exclusively about swamps and wet grounds, which are exposed to be inundated for several weeks together.

Of all hickories this species grows to the greatest height with proportionally the smallest diameter, for it is sometimes seen 80 or 90 feet in height, and less than two feet thick. The trunk is destitute of branches, regularly shaped, and of an almost uniform size for three-fourths of its length, thus forming a very fine tree. The greatest peculiarity in its appearance, and that by which it is most easily distinguished, is the surface of the trunk. The exterior bark is divided into a great number of long, narrow plates, which bend outwards at the ends, and adhere only in the middle. Bristling in this manner with projecting points, the shellbark hickory attracts the attention of the most careless observer. This remarkable exfoliation of the epidermis takes place, only in trees which exceed ten inches in diameter, though it is much earlier indicated by seams. This characteristic, by which the tree may be recognized in winter when stript of its leaves, does not exist during the first seven or eight years of its growth; and during this period, it may easily be confounded with the mockernut hickory and pignut hickory, if recourse is not had to the buds. In these two species, the buds are formed of scales closely applied one upon another; in the species which we are considering, the two external scales adhere for only half the length of the bud, and leave the upper part uncovered. When the sap begins to ascend in the spring, the outer scales fall, and the inner ones swell and become covered with a yellowish silky down: after a fortnight, the buds, which are already two inches long, open and give birth to the young leaves. The growth of the leaves is so rapid, that in a month they attain their full length, which on young and vigorous trees is sometimes twenty inches. They consist of two pair of leaflets, with a sessile odd one. The leaflets are very large, oval-acuminate, serrate and slightly downy beneath. The barren flowers, which appear in the state of New York about the Middle of May, are disposed on long, glabrous, filiform, pendulous aments, of which three are united on a common petiole, attached at the basis of the young shoots; the

fertile flowers, of a greenish hue and scarcely apparent, are situated at the extremity. The fruit is ripe about the first of October. It varies in size, according to the soil and the exposure in which it is produced, but five and a half inches may be assumed as the average of the circumference. The shape is uniformly round, with four depressed seams, in which the husk opens at the season of perfect maturity, dividing itself completely into equal sections. The separation of the husk, and its thickness disproportioned to the size of the nut, form a character peculiar to the shellbark hickories. The nuts of this species are small, white, compressed at the sides, and marked by four distinct angles, which correspond to the divisions of the husk.

The wood of the shellbark hickory possesses all the characteristic properties of the hickories, being strong, elastic and tenacious. It has also their common defects of soon decaying and of being eaten by worms. As this tree grows to a great height with nearly an uniform diameter, it is sometimes employed for the keels of vessels. Its wood is found to split most easily, and to be the most elastic; for this reason it is used for making baskets, and also for whip handles, which are esteemed for their suppleness. Such are the uses which the shellbark hickory appears peculiarly adapted.

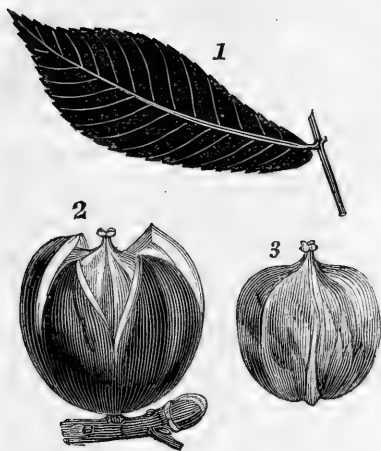
MOCKERNUT HICKORY. *Juglans tomentosa*.

PLATE XLV.

Fig. 1. A leaflet. Fig. 2. A nut with the husk.

Fig. 3. A nut without the husk.

in New Hampshire, though one hundred miles south it is common. It is most abundant in the forests that still remain on the coast of the Middle States, and in those which cover the upper parts of the Carolinas and of Georgia; but in the last-mentioned states, it becomes more rare in approaching the sea, as the sterility of the soil, in general dry and sandy, is unpropitious to its growth. This is said to be the only hickory which springs in the *pine-barrens*: the sprouts are burnt every year, and never rise more than two or three feet. Like most of the walnuts, the mockernut hickory flourishes in rich soils, and chiefly on the gentle acclivities which surround the swamps, where it grows.

In situations favorable to the growth of this tree, it reaches the height of 60 feet, with a diameter of 18 or 20 inches. Its trunk is covered with a thick, hard and rugged bark. The buds are large, of a grayish-white and very hard; in the winter, after the falling of the leaf, they afford the only characteristic by which the tree can be distinguished, when it exceeds eight or ten feet

In the parts of New Jersey which lie on the river Hudson, this species is known by the name of *Mockernut Hickory*, in Pennsylvania, Maryland and Virginia, that of *Common Hickory*. The French of Illinois call it *Noyer dur*, or hard walnut. The first of these denominations, which is descriptive of the fruit, we have adopted. This species is not more multiplied in Pennsylvania and farther south, than the other hickories. It is not found north of Portsmouth

in height. In the beginning of May, the buds swell, the external scales fall off, and the inner ones soon after burst and display the young leaf. The leaves are so rapid in their growth that they will often grow twenty inches in eighteen days. They are composed of four pair of sessile leaflets, and terminated by an odd one. The leaflets are large, oval-acuminate, serrate, pretty thick, and hairy beneath, as is also the common petiole to which they are attached. With the first frost, the leaves change to a beautiful yellow, and fall soon after. The barren flowers appear on pendulous, downy, axillary aments, six or eight inches long; the fertile flowers, which are not very conspicuous, are of a pale rose color, and are situated at the extremity of the young shoots. The fruit is ripe about the middle of November. It is odorous, sessile or rarely pedunculated, and commonly united in pairs. In form and size, it exhibits remarkable varieties: on some trees it is round, with depressed seams, on others oblong, with angular or prominent seams; it is sometimes two inches long, and twelve or fifteen lines in diameter, and at other times less than half this size. It differs also in weight, as well as in configuration and volume, varying from one dram to four. The largest nuts might be confounded with those of the thick shellbark hickory, and the smallest, with those of the pignut hickory. The shell is very thick, somewhat channelled, and extremely hard. The kernel is sweet but minute, and difficult to extract, on account of the strong partitions which divide it; hence, probably, is derived the name of *Mockernut*.

The wood of this tree is of the same color and texture, with the other hickories, and characterized by the qualities which render this class of trees so remarkable. It is particularly esteemed for fuel, for which use trees of six or eight inches in diameter are preferred. At this stage of its growth, while the heart, the proper color which is reddish, is not yet developed, it frequently goes by the name of *White-heart Hickory*. In the country a greenish color is sometimes extracted from the bark, but it is not extensively used.

JUNIPERUS.

Diœcia Monadelphia. LINN. Coniferæ. JUSS. *Expectorant, siccant, stimulant.*

RED CEDAR. *Juniperus virginiana.*

PLATE XLVI.

Fig. 1. A branch with leaves and fruit.

The Red Cedar, which belongs to the Junipers, is the most common species of its genus in the United States, and the only one which attains such dimensions as to be useful in the arts. In some parts of the United States it is improperly called *Savin*. Cedar Island in Lake Champlain, in latitude $44^{\circ} 25'$, may be assumed as one of the remotest points at which it is found towards the north. Eastward on the border of the sea, it is not found beyond the river Kennebec, from

which it spreads without interruption to the Cape of Florida and thence round the Gulf of Mexico to a distance beyond St. Bernard's Bay; an extent of more than 3000 miles. In retiring from the shore it becomes gradually less common and less vigorous, and in Virginia and the more southern states it is rare at the point where the tide ceases to flow in the rivers; farther inland it is seen only in the form of a shrub in open, dry and sandy places. In the Western States it is confined to spots where the calcareous rock shows itself naked, or is so thinly covered with mould as to forbid the vegetation of other trees.

In situations where the soil and climate are favorable to the expansion of this tree, it grows to the height of 40 or 45 feet, with a diameter of 12 or 13 inches. The most striking peculiarity in

the vegetation of the red cedar is that of its branches, which are numerous and close, spring near the earth and spread horizontally, and that the lower limbs are during many years as long as the body of the tree. Its diameter is very much diminished by deep, oblong crevices, in every part of the trunk, which are occasioned by the large branches persisting after they are dead. The foliage is evergreen, numerously subdivided, and composed of small, sharp scales, enchased in one another. The male and female flowers are small, not conspicuous, and borne separately on the same or on different stocks, and put forth in May or June. The seeds are small, ovate berries, bluish when ripe, and covered with a white exudation. They arrive at maturity about the beginning of autumn.

The perfect wood of this tree is of a bright reddish tint, hence the name *Red Cedar*; the sap is perfectly white. The wood is odorous, compact, fine-grained and very light, though heavier and stronger than that of the white cedar or cypress. To these qualities it unites the still more precious character of durability, and is consequently highly esteemed for such objects as require it in an eminent degree. But as it is procured with difficulty, and is every day becoming scarcer, it is reserved exclusively for the most important purposes. In the upper part of the frame of vessels it is joined with the live oak to compensate its excessive weight, and this usage more than any other, has wasted the species. The nearer this tree grows to the sea, and the farther southward, the better the wood. Next to ship building it is commonly used for posts, which are highly esteemed and are reserved for inclosing court yards and gardens in the cities and their vicinity, and likewise for the posts and rails of rural fence. It is eminently fitted for subterranean water pipes, but is rarely employed from the difficulty of obtaining stocks of sufficient diameter. It is also employed for small tubs, which are hooped with brass, and is used in the manufacture of lead pencils. It is likewise used by turners for large stop cocks. The foliage of this tree diffuses a resinous, aromatic odor when bruised; dried and reduced to powder it has the same effect as the common juniper, of increasing the efficacy of blister plasters. The

quantity of gin made from the berries in the United States is small compared with what is imported from Holland. Its leaves are found to be stimulant, diuretic and emmenagogue, and have been used with some success for rheumatism, dropsy and catamenial obstructions, in doses of one or two scruples.

KALMIA.

Decandria Monogynia. LINN. Rhododendræ. JUSS. Tonic, narcotic.

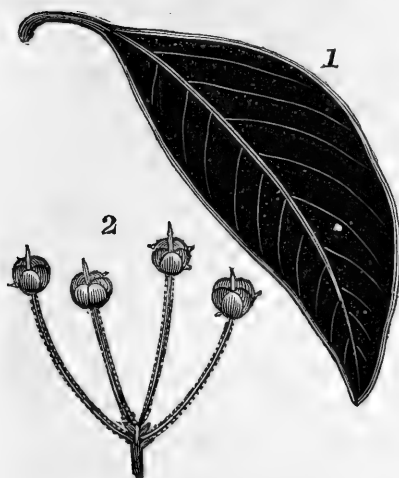
MOUNTAIN LAUREL. *Kalmia latifolia*.

PLATE XLVII.

Fig. 1. A leaf. Fig. 2. A seed vessel.

The Mountain Laurel is a large shrub, which indifferently bears the names of *Mountain Laurel*, *Laurel*, *Ivy* and *Calico Tree*. The west end of Long Island, and the vicinity of Poughkeepsie, which lies on the river Hudson, between the 42d and 43d degrees of latitude, may be considered as the northern limit of this tree. It abounds in New Jersey and Pennsylvania. Proceeding thence southwest, it is found along the steep banks of all the rivers

which rise in the Alleghanies; but it is observed to become less common in following these streams from their source, towards the Ohio and Mississippi on one side, and towards the ocean on the other. It is rare in Kentucky and in West Tennessee, and in the Southern States it disappears entirely when the rivers enter the low country, where the *pine-barrens* commence. Although the mountain laurel abounds along the rivers of the Middle and Southern States, it is proportionally less common than upon the Alleghany Mountains, from Pennsylvania to the termination of

the chain in Georgia. It is nowhere seen more profusely multiplied, nor of a greater height and of more luxuriant vegetation, than in North Carolina, on the loftiest part of the Alleghanies. It occupies tracts of more than one hundred acres, and forms upon the summit, and for a third of the distance down the sides, thickets which are rendered nearly impenetrable by the crooked and unyielding trunks, crossed and locked with each other. As the shrubs which compose these copses are of an uniform height, and richly laden with evergreen foliage, they present, at a distance, the appearance of verdant meadows, surrounded by tall trees. It flourishes best in a soft, loose and cool soil, with a northern exposure.

In favorable situations this shrub grows to the height of 18 or 20 feet, with a diameter of three inches. Its leaves are of a coriaceous texture, oval-acuminate, entire and about three inches long. The flowers put forth from May to July, are destitute of odor, and disposed in corymbs at the extremity of the branches : in general they are of a beautiful rose color, and sometimes of a pure white. They are always numerous, and their brilliant effect is heightened by the richness of the surrounding foliage. The minute seeds are contained in small, globular capsules.

The wood, particularly that of the roots, is compact, fine-grained, and marked with red lines. When dry it is very hard, and it turns and polishes well. It is employed for the handles of light tools, for screws, boxes, etc. ; it is said also to make good clarionets. The leaves are narcotic, and are poisonous to cattle.

L A R I X.

Monœcia Monadelphia. LINN. Coniferæ. JUSS. *Expectorant, secernant, stimulant.*

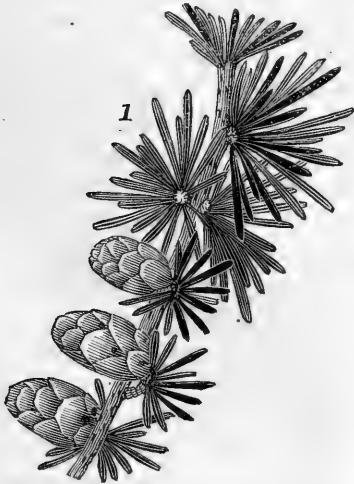
AMERICAN LARCH. *Larix Americana.*

PLATE XLVIII.

Fig. 1. A branch with leaves and cones.

In the north of the United States this tree is commonly designated by the name of *Hackmatack*, but we have preferred that of *American Larch*, which is not unknown where the other is habitually used. The French Canadians call it *Epinette rouge*. This tree is most abundant in Vermont, New Hampshire and the state of Maine; but though the soil is well adapted to its growth, and the winter is long and severe, it does not form a hundredth part of the resinous growth, which

consists principally of the black and the hemlock spruce and the red cedar. It grows in the Canadas, and extends as far north as Lake St. John, where it begins to abound, and to form masses of woods, some of which are several miles in extent. It is profusely multiplied also in Newfoundland, New Jersey, Pennsylvania and the coldest and most gloomy exposures in the mountainous tracts of Virginia, which are the limits of its appearance towards the south: but it is rare in these states, and in lower Jersey it is seen only in the swamps of white cedar, with which it is scantily mingled. In Vermont, New Hampshire and Maine it grows only in low and moist places, and never on uplands, as about Hudson's Bay and in Newfoundland; hence we may conclude that the climate of the northern part of the United States is too mild for its constitution.

The American larch is a magnificent vegetable with a straight, slender trunk 80 or 100 feet in height and 2 or 3 feet in diameter. Its numerous branches, except near the summit, are horizontal or declining. The bark is smooth and polished on the trunk and lower limbs, and rugged on the lower branches. The leaves are flexible, and collected in bunches : they are shed in the fall and renewed in the spring. The flowers like those of the pines, are separate upon the same tree : the male aments, which appear before the leaves, are small, oblong and scaly, with two yellow anthers under each scale : the female flowers are also disposed in aments, and are composed of floral leaves covering two ovaries, which in process of time become small, erect, scaly cones three or four lines long. At the base of each scale lie two minute winged seeds. On some stocks the cones are violet-colored in the spring instead of green ; but this is an accidental variation, for the trees are in no other respect peculiar.

The wood of the American larch is superior to any species of pine or spruce : it is exceedingly strong and singularly durable. In Canada it is considered as the most valuable timber, and has no fault except its weight. In the state of Maine it is esteemed more than any other species of resinous wood for the knees of vessels, and is always used for this purpose when proper pieces can be obtained. This wood is justly appreciated in the United States, but it is little employed because it is rare and may be replaced with other species which are cheaper and more abundant.

LAURUS.

Encandria Monogynia. LINN. Laurinæ. Juss. *Secernant, stimulant, stomachic.*

RED BAY. *Laurus caroliniensis.*



PLATE LXIX.
Fig. 1. A leaf. Fig. 2. A seed.

This species of Laurel is observed in the lower part of Virginia, and it continues to be seen uninterruptedly throughout the maritime districts of the Carolinas and of Georgia, in the Floridas and in Lower Louisiana. It is known only by the name of *Red Bay*. It is profusely multiplied in the *branch swamps* which intersect the *pine-barrens*. It is also seen on the skirts of the great swamps which border the rivers and around the ponds covered with the *Laurus* *astivalis*, or pond bush, that are met with in the barrens. A cool and humid soil appears to be essential to its growth, for it is never found in dry and sandy lands. It is also remarked, that the farther south it grows, the more vigorous and beautiful is its vegetation.

In favorable situations the red bay often attains the height of 60 or 70 feet, and from 12 to 15 inches in diameter: when arrived at this stature, its trunk is generally crooked and divided into several thick limbs, at eight, ten or twelve feet from the ground. Upon old trunks the bark is thick and deeply furrowed; that of the young branches, on the contrary, is smooth and of a beautiful green color. The leaves are about six inches long, alternate, oval-acuminate, whitish or glaucous on the lower surface,

and evergreen. The flowers, which open in April or May, are disposed in small, axillary branches, springing between the leaf and the twig, and are supported by slightly downy peduncles. The fruit or seed is oval and very similar to that of the sassafras. The seeds germinate with ease, and the old trees are surrounded by hundreds of young plants.

The wood of this tree is of a beautiful rose color ; it is strong, has a fine, compact grain, and is susceptible of a brilliant polish. Before mahogany became the reigning fashion in cabinet making, this wood was commonly employed in the Southern States, and afforded articles of furniture of the highest beauty. This wood, like that of the red cedar, may be usefully employed in ship building, as it unites the properties of strength and durability. The leaves of this tree when bruised diffuse a strong odor resembling that of the sweet bay, *Laurus nobilis*, and may be employed in cookery.

SASSAFRAS. *Laurus sassafras*.



PLATE L.

Fig. 1. A leaf. Fig. 2. The fruit.

The Sassafras, on account of its medicinal virtues and the beauty of its foliage is one of the most interesting trees of the American forests. In the United States, the neighborhood of Portsmouth in New Hampshire, in the latitude of 43° , may be assumed as one of the extreme points at which it is found towards the north-east: in the Western Country it is met with one degree farther north. From Boston to the banks of the Mississippi, and from the shores of the ocean

to Virginia and to the remotest wilds of Upper Louisiana beyond the Missouri, comprising an extent in each direction of more than

1800 miles, this tree is sufficiently multiplied to be ranked among the most common trees. It is seen growing on lands of every description, from the dry and gravelly to the most moist and fertile, with the exception of such as are arid and sandy to excess, like the *pine-barrens* of the Southern States: neither is it found in the swamps that border the rivers by which these states are watered.

This tree attains its greatest development on the declivities which skirt the swamps, and such as sustain the luxuriant forests of Kentucky and West Tennessee, where it arrives to the height of 50 or 60 feet, with a proportionate diameter. The bark which covers old trees is of a grayish color and is chapped into deep cracks. On cutting into it, it exhibits a dark dull red, a good deal resembling the color of the Peruvian bark. The bark of the young branches is smooth and of a beautiful green color. The old trees give birth to hundreds of shoots which spring up at little distances, but which rarely rise higher than six or eight feet. The leaves of the sassafras are four or five inches in length, alternate, and petiolated. At their unfolding in the spring they are downy and of a tender texture. They are of different shapes upon the same tree, being sometimes oval and entire, and sometimes divided into lobes, which are generally three in number, and which are rounded at the summit. The lobed leaves are the most numerous and are situated on the upper part of the tree. About New York and Philadelphia this tree is in full bloom in the beginning of May, and six weeks earlier in South Carolina. The flowers unfold before the leaves, and appear in small clusters at the end of the last year's shoots. They are of a greenish-yellow hue, and are but slightly odoriferous. In this species of laurel the sexes are confined to different stocks. The fruit or seed is of an oval form and of a deep blue color, and is contained in small, bright, red cups, supported by peduncles from one to two inches in length. These seeds, when ripe, are eagerly devoured by the birds, and soon disappear from the tree.

The wood of this tree is not strong, and branches of considerable size may be broken with a slight effort. In the young tree the wood is white; in those which exceed fifteen or eighteen

inches in diameter it is reddish and of a closer grain. It is not, however, in these respects to be compared with the oak and hickory. Experience shows, that this wood, stript of its bark, resists for a considerable period the progress of decay ; and it is on this account employed for the posts and rails of rural fence. It is also sometimes used for the joints and rafters in houses built of wood. It is said to be secure from the attack of worms : this advantage is attributed to its odor which it preserves as long as it is sheltered from the sun and rain. Bedsteads made of it are said to be never infested with insects. But for these purposes the sassafras wood is not in habitual use, and is only occasionally employed. For fuel, it is held in little esteem, and it is only in the cities of the Southern States, which are not, like those of the north, abundantly furnished with fuel, that it is brought into the market : it is considered as wood of the third quality. Its bark contains a considerable portion of air, and snaps while burning like that of the chesnut.

The medicinal virtues of the sassafras are so well proved, that during more than two hundred years, since its first introduction into *materia medica*, it has maintained the reputation of an excellent sudorific, which may be advantageously employed in cutaneous affections, in chronic rheumatism, and in siphilitic diseases of long standing. In the last case it is always joined with *lignum vitæ* and *sarsaparilla*. The wood is slightly aromatic and somewhat acrimonious depending on a resin and an essential oil, but the smell and taste which are peculiar to the vegetable are more sensible in the young branches, and incomparably more so in the bark of the roots ; this part of the tree therefore should always be preferred, for the wood appears to contain but a small degree of the qualities assigned it, and even this it loses after being long kept. From the bark of the roots, which is thick and sanguineous, the greatest quantity of essential oil is extracted : this oil, after long exposure to the cold, is said to deposit very beautiful crystals. The flowers of this tree when fresh have likewise a weak aromatic odor. A great number of people in the United States consider them as stomachic and efficacious in purifying the blood ; and for this purpose, during a fortnight in

the spring, they drink an infusion of them with a little sugar, in the manner of tea. The dried leaves and the young branches contain a mucilaginous principle nearly resembling that of the ochro. They are used by some people to thicken their pottage. An agreeable beverage may be made by boiling the young shoots in water, to which a certain quantity of molasses is added, and the whole is left to ferment : this beer is considered as a very salutary drink during the summer. Mucilage of sassafras pith is peculiarly mild and lubricating, and has been used with much benefit in dysentery and catarrh, and particularly as a lotion in the inflammatory stages of the ophthalmia. But except as a diaphoretic the powers of sassafras are very doubtful. It certainly has no antisiphilitic properties.

LIQUIDAMBAR.

Monœcia Polyandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

SWEET GUM. *Liquidambar styraciflua.*



PLATE LI.

Fig. 1. A leaf. Fig. 2. The fruit.

No tree has hitherto been found in North America so extensively diffused as the Sweet Gum. On the sea shore it is first seen towards the north-east, between Portsmouth and Boston, in the latitude of 43° , and is found as far as Mexico towards the south-west: from the coast of Virginia it extends westward to the river Illinois, thus spreading over more than two-thirds of the ancient territory of the United States, together with the Floridas, and Upper

and Lower Louisiana. In the United States this tree is universally called *Sweet Gum*, and by the French of Louisiana, *Copalm*. In the Middle, Southern and Western States, the sweet gum is sufficiently multiplied to be numbered among the most common trees: it is met with wherever the soil is fertile, cool and exposed to temporary inundations. In the south, it grows also in the great swamps, which border the rivers, and here, owing doubtless to the mildness of the winter and to the intense heat of the summer, it displays its amplest dimensions.

In favorable situations the sweet gum grows to the height of 60 feet with a circumference of 15 feet, at five feet from the ground. It ramifies at the height of 15 or 18 feet, and its summit is spacious in proportion to the thickness of the trunk; but it does not generally branch at so small an elevation. When confined amidst other trees, its trunk, like those of the oak and elm, is perfectly straight and of an uniform size to the height of 30 or 40 feet, at which it begins to divide itself into branches: in these situations it is from one to two feet in diameter. On dry and gravelly land its height does not exceed 15, 20 or 30 feet, and its secondary branches are covered with a dry, flaky bark, of which the plates are attached by the edge, instead of the face as on other trees. This tree is garnished with fine foliage, which changes to a dull red with the first autumnal frosts, and falls soon after. The shoots upon which the young leaves appear in the spring are smooth and of a yellowish-green color. The leaves vary in size from three to six inches, according to the vigor of the tree and to the situation of the leaf, being larger and less deeply palmated on the lower branches: they are alternate, petiolated, and divided into five principal lobes: in this last particular they bear some resemblance to the leaves of the sugar maple, from which they differ in having the lobes deeper and more regularly shaped, and being finely denticulated at the edge. It should be remarked also that, at the birth of the leaves, the back part of the principal rib is surmounted by a small tuft of red down. In warm weather a viscous substance exudes from the leaves of such of those trees as grow upon dry grounds; when bruised, they exhale a sensible, aromatic odor.

The barren and fertile flowers open in April and are borne by different branches of the same tree. The fertile flowers are not conspicuous, and the barren ones are in oval aments an inch and a half in length. The fruit is globular and bristling with points: when arrived at maturity, it is about an inch and a half in diameter, and is suspended by a flexible pedicle, one or two inches long: the globes, which are green at first and afterwards yellow, are composed of a great number of closely connected capsules. At the beginning of autumn these capsules open and liberate the seeds, which are small, blackish, oblong, compressed and surmounted by a wing. Each capsule contains one or two seeds united with a great number of minute bodies incapable of germination, resembling oaken sawdust.

The trunk of the full-grown tree is covered with a deeply-furrowed bark, not unlike that of several species of oak. Sweet gums are found of the same size on the same soil, some of which have a large proportion of sap and only five or six inches of heart, while others consist principally of perfect wood, with only a thin layer of sap. The heart is reddish, and when sawn into boards it is observed to be transversely marked at considerable distances with blackish belts. This wood is very compact and fine-grained, and is susceptible of a fine polish. Though inferior in strength to the oak, it suffices for many purposes which require great toughness and solidity. In some parts of the United States it is employed for the frames of wooden houses. As it furnishes boards two or three feet in width, it is sometimes sawn very thin and employed by cabinet makers to line the inside of certain articles of mahogany furniture: it is also employed for bedsteads and for the balusters of stair cases. In a word it may be usefully employed in all work that is sheltered from the air, without which precaution it speedily decays. It is little esteemed for fuel, and, mixed with other species of no greater value, it forms the lowest quality of wood in the market. In summer, upon cutting the live bark and at the same time slightly wounding the sap of this tree, a resinous substance of an agreeable odor distils in small quantities.

LIRIODENDRON.

Polyandria Polygynia. LINN. Magnoliacæ. JUSS. *Tonic, aperient.*

POPLAR OR TULIP TREE. *Liriodendron tulipifera.*



PLATE LII.
Fig. 1. A leaf. Fig. 2. A cone.

This tree, which surpasses most others of North America in height and in the beauty of its foliage and of its flowers, is one of the most interesting from the numerous and useful applications of its wood. Wherever it abounds, and throughout the greater part of the United States, it is called *Poplar*. In Connecticut, New York and New Jersey, it is known by the name of *White Wood*, and of *Canoe Wood*, and more rarely by that of *Tulip Tree*. This

last denomination we have thought most proper to adopt, from the resemblance of its flowers to the tulip. The southern extremity of Lake Champlain, in latitude 45° , may be considered as the northern limit, and the river Connecticut, in the longitude of 72° , as the eastern limit of the tulip tree. It is only beyond the Hudson, which flows two degrees farther west, and below the 43° of latitude, that it is frequently met with and fully developed. It is multiplied in the Middle States, in the upper parts of the Carolinas and of Georgia, and still more abundantly in the Western Country, particularly in Kentucky. Its comparative rareness in the maritime parts of the Carolinas and of Georgia, in the Floridas and in Lower Louisiana, is owing less to the heat of the summer, than to the nature of the soil, which in some parts is too dry, as in the *pine-barrens*, and in others too

wet, as in the swamps which border the rivers. This tree attains the greatest dimensions in a deep, loamy, and extremely fertile soil, such as is found in the rich bottoms which lie along the rivers, and on the borders of the great swamps that are inclosed in the forests.

In the Atlantic States, especially at a considerable distance from the sea, tulip trees are often seen 70, 80 and 100 feet in height, with a diameter of 18 inches to 3 feet. But the Western States appear to be the natural soil of this magnificent tree, and here it displays its most powerful vegetation. M. Michaux mentions a tulip tree, near Louisville, on the Ohio, which at five feet from the ground was 22 feet six inches in circumference, and whose elevation he judged to be from 120 to 140 feet. Of all the trees of North America with deciduous leaves, the tulip tree, next to the button wood, attains the amplest dimensions; while the perfect straightness and uniform diameter of the trunk for upwards of 40 feet, the more regular disposition of its branches, and the greater richness of its foliage, give it a decided superiority over the button wood, and entitle it to be considered as one of the most magnificent vegetables of the temperate zones. In the spring, when the weather is warm and humid, the growth of the leaves is very rapid: they are six or eight inches broad, borne on long petioles, alternate, somewhat fleshy, smooth and of a pleasing green color. They are divided into three lobes, of which the middle one is horizontally notched at the summit, and the two lower ones are rounded at the base. The flowers bloom in June or July. They are large, brilliant, and on detached trees very numerous, variegated with different colors, among which yellow predominates: they have an agreeable odor, and, surrounded by luxuriant foliage, they produce a fine effect. The fruit is composed of a great number of thin, narrow scales, attached to a common axis, and forming a cone two or three inches in length. Each cone consists of sixty or seventy seeds, of which never more than a third part are productive. For ten years before the tree begins to yield fruit, almost all the seeds are unproductive, and on large trees, those from the highest branches are the best.

The bark of this tree, till the trunk exceeds seven or eight inches in diameter, is smooth and even : it afterwards begins to crack, and the furrow and the thickness of the bark are proportioned to the size and to the age of the tree. The heart of the perfect wood is yellow, approaching to a lemon color, and its alburnum is white. Though this tree is classed as a light wood, it is much heavier than the poplars ; its grain is equally fine and more compact, and the wood is easily wrought and polishes well. It is found strong and stiff enough for uses that require great solidity. The heart, when separated from the sap and perfectly seasoned, long resists the influence of the air, and is said to be rarely attacked by worms. Its greatest defect, when employed in wide boards and exposed to the weather, is its liability to shrink and warp by the alternations of dryness and moisture : but this defect is in a great measure compensated by its other properties. The nature of the soil has so striking an influence upon the color and upon the quality of this tree, that the mechanics who employ it, distinguish it by the names of *White Poplar* and *Yellow Poplar*. The external appearance which mark these varieties are so equivocal, that it can be ascertained to which a tree belongs only by cutting it. It is known in general that the white poplar grows in dry, gravelly and elevated places : it is recognized too by its branchy summit, and by the small proportion which the light yellow heart bears to the sap. The grain also is coarser and harder, and the wood decays more speedily ; hence it is always selected when the other variety can be obtained. The yellow poplar possesses every quality requisite to fit it for a great variety of uses, but we shall mention only some of the most common. In many parts of the United States it is employed for constructing the frames of houses and for shingles, and is considered as the best substitute for the pine, red cedar and the cypress. It is also sawn into boards, of which are made the panels of doors and of wainscots, and the mouldings of chimney pieces ; they are exclusively used for the panels of coaches and chaises. When perfectly dry, they receive paint well, and admit of a brilliant polish. A large quantity of this wood is likewise employed in the manufacture of trunks

which are covered with skins, and of bedsteads ; as it is easily wrought in the lathe, and is very light, it is much used for wooden bowls. It is also employed for the rails of rural fence; for the construction of bridges, and for the felloes of large mill wheels. In fine, it affords excellent charcoal, which is employed by smiths in districts that furnish no fossile coal. The cellular integument of the bark of this tree, the bark of the branches, and still more the bark of the roots, has an agreeable smell and a very bitter taste, and is very pungent : when powdered it is employed as a tonic, stimulant in intermittents and chronic rheumatism : given in substance to horses, appear to be a pretty certain remedy for worms.

MAGNOLIA.

Polyandria Polygynia. LINN. Magnoliaceæ. JUSS. *Tonic, aperient.*

CUCUMBER TREE. *Magnolia acuminata.*

In all parts of the United States where this tree is found, it is known only by the name of *Cucumber Tree*. It is a beautiful vegetable, equal in height and in diameter to the big laurel. The most northern point, at which this tree grows is near the falls of Niagara, in latitude 43°. It abounds along the whole tract of the Alleghanies, to their termination in Georgia, over a distance of 900 miles. It is also found on the Cumberland Mountains. The situations pecu-

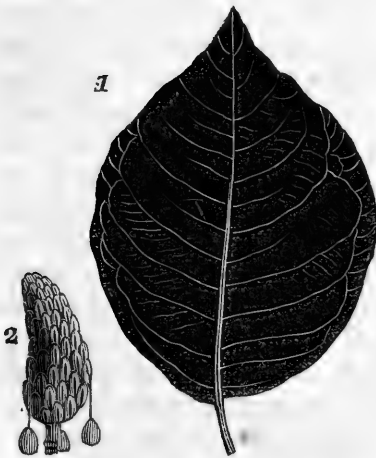


PLATE LIII.

Fig. 1. A leaf. Fig. 2. A cone with seeds.

liarily adapted to its growth are the declivities of mountains, narrow valleys and the banks of torrents, where the air is

constantly moist, and where the soil is deep and fertile. At the distance of forty or fifty miles from the mountains, either way, this tree is met with only accidentally upon the steep banks of rivers, where the atmosphere is constantly refreshed by the evaporation from their surface. We may conclude then that this tree is a stranger to all parts north of the river Hudson, and to all the Atlantic parts of the United States, to the distance of 100, 150 and 200 miles from the sea ; the nature of the soil, and the extreme heat of the climate in summer being utterly uncongenial to its growth. It is also rare in the parts of Kentucky and West Tennessee which are most remote from the mountains, where the face of the country is less uneven.

The cucumber tree sometimes exceeds 80 feet in height, with a diameter of three or four feet. The trunk is perfectly straight, of an uniform size and often destitute of branches for two-thirds of its length. The summit is ample and regularly shaped, and the tree is one of the finest in the American forests. The leaves are six or seven inches long, and three or four inches broad, upon old trees ; upon saplings growing in moist places, they are, sometimes twice as large. Their form is oval, entire and very acuminate ; they fall in the autumn and are renewed in the spring. The flowers open in May and are five or six inches in diameter, bluish and sometimes white with a tint of yellow. They have a feeble odor, but as they are large and numerous, they have a fine effect in the midst of the superb foliage. The cones or fruit are about three inches long, and eight or ten lines in diameter, of nearly a cylindrical shape, and often a little larger at the summit than at the base. They are convex on one side and concave on the other, and when green they nearly resemble a young cucumber, whence the tree has derived its name. The cells are arranged as in the other species of the genus, and each of them contains one rose-colored seed, which, before it escapes, remains suspended like those of the great and small laurels.

On old stocks the bark of this tree is grayish and deeply furrowed. The perfect wood is soft and of a yellowish brown color : it is fine-grained and susceptible of a brilliant polish.

Being a rare tree, it is only accidentally employed in the arts. Sawn into boards, it serves in joinery for the interior of wooden houses, and, for its size and lightness, it is selected for large canoes. Most of the inhabitants of the country bordering on the Alleghanies gather the cones of this tree about midsummer, when they are half ripe, and steep them in whiskey : a glass or two of this liquor, which is extremely bitter, they habitually take in the morning, as a preservative against autumnal fevers.

LONG-LEAVED CUCUMBER TREE. *Magnolia auriculata.*

This species of *Magnolia* is remarkable for the beauty of its foliage and for the size of its flowers and the fragrance of their odor. It appears to be particularly confined to that tract of the Alleghanies which traverse the Southern States, at the distance of nearly 300 miles from the sea. It is however sometimes found on the steep banks of the rivers which rise in these lofty mountains, and which on one side roll their waters to the sea, and on the other flow to meet the Ohio, after traversing Kentucky and Tennessee. It is profusely multiplied on the steepest part of the Great Father Mountains, Black and Iron Mountains of North Carolina. It is designated by the names of *Long-Leaved Cucumber Tree*, and of *Indian Physic*. The soil of these mountains, which is brown, deep and of an excellent quality, is peculiarly favorable to its growth, and it multiplies spontaneously with the greatest facility.

This tree grows to the height of 40 or 45 feet, with a diameter of 12 or 15 inches. Its trunk is straight and well shaped, and often undivided for half of its length ; its limbs, widely spread and sparingly ramified, give to this tree, when stript of its leaves, so peculiar an air, that it is readily distinguished. The leaves are of a light-green color, of a fine texture, eight or nine inches long, and from four to six inches broad ; on young and vigorous trees they are often one third or even one half longer. They are smooth on both surfaces, acuminate at the summit, widest near the top and narrowest towards the bottom. The base is

divided into rounded lobes, whence is derived the specific name of *auriculata*. The flowers are three or four inches in diameter, of a fine white color, of an agreeable odor, and situated at the extremity of the young shoots, which are of a purplish red dotted with white. The flowers open in April or May, and are succeeded by oval cones, three or four inches long, and, like those of the umbrella tree, of a beautiful rose color when ripe. Each cell contains one or two red seeds.

The wood is soft, spongy, very light, and unfit for use. The bark is gray, and always smooth even on the oldest trees. When the epidermis is removed, the cellular integument, by contact with the air, instantly changes from white to yellow. The bark has an agreeable aromatic odor, and an infusion of it in some spirituous liquor is employed as an excellent sudorific in rheumatic affections.

HEART-LEAVED CUCUMBER TREE. *Magnolia cordata*.

This species of *Magnolia*, which in its general appearance and in the form of its fruit, very nearly resembles the cucumber tree, has been confounded with it by the inhabitants of the regions in which it grows; from the cordiform shape of its leaves we have adopted the name of *Heart-Leaved Cucumber Tree*. The banks of the river Savannah in Upper Georgia, and those of the streams which traverse the back parts of South Carolina, are the native places of this tree. The soil in which it generally grows is a sandy loam.

This tree is 40 or 50 feet in height, and 12 or 15 inches in diameter. Its trunk is straight and covered with a rough and deeply-furrowed bark, very much resembling that of the sweet gum and of the young white oak. Its leaves which are borne upon long petioles, are from four to six inches in length, from three to five inches wide, smooth and entire. The flowers which appear in April, are yellow, with the interior of the petal longitudinally marked with several reddish lines. The flowers though somewhat smaller than those of the cucumber tree, are nearly four inches in diameter. The cones are about three

inches long, and ten or twelve lines in thickness, of a cylindrical form, and of a similar construction to those of the other magnolias. The seeds also are similar in color and arrangement.

The wood of this tree resembles, in every respect, that of the cucumber tree, from its softness and readiness to decay, it is not employed for any determinate use.

SMALL MAGNOLIA OR WHITE BAY. *Magnolia glauca.*

This tree, though inferior in size to the big laurel, and less regularly formed, is interesting on account of its beautiful foliage and flowers. It is common in Gloucester, Massachusetts, and in Lower Jersey and becomes more so in proceeding towards the south. In the maritime part of the Southern States, in the Floridas and in Lower Louisiana, it is one of the most abundant among the trees which grow in wet grounds. It is found not far in the interior of the country, and in New York, Pennsylvania and Maryland, it disappears thirty or forty miles north of the capitals of these states. In the Carolinas and Georgia, it grows only within the limits of the *pine-barrens*. In Philadelphia and New York and in their vicinity, this tree is called *Magnolia*, which denomination has entirely superseded those of *Swamp Sassafras* and *Beaver Wood*, which were in use among the Swedish settlers who first fixed themselves in the country. In the Southern States it is generally called *White Bay* or *Sweet Bay*. It grows most abundantly in swamps and marshes composed of a black and miry soil.

This tree sometimes rises to the height of 40 feet, with a diameter of 12 or 14 inches; but it does not ordinarily exceed 25 or 30 feet, and it often fructifies at the height of five or six feet. The bark of this tree is smooth and grayish, and its trunk is always crooked and divided into a great number of divaricating branches. The leaves are five or six inches long, petiolated, alternate, oblong-oval and entire. They are of a dark, shining green above, and glaucous beneath, thus presenting an agreeable contrast in the color of the two surfaces. The leaves fall in autumn and are renewed early in the following spring. The

flowers, which are single and situated at the extremity of the branches, are two or three inches broad, white, and composed of several concave, oval petals. Near Charleston in South Carolina, this tree blossoms in May and a month later in the neighborhood of Philadelphia and New York. The fruit is small, green and conical, composed of a great number of cellules, and varying in length from an inch to an inch and a half. When ripe, the seeds, which are of a scarlet color, burst their cells, and remain some days suspended without, by white, lax, slender filaments.

The wood of this tree, which is of a white color and very light, is employed for no use in the arts. The bark of the roots has an aromatic odor and a bitter taste. Some of the inhabitants drink an infusion of it in brandy, as a slight sudorific for rheumatic affections. They also steep the cones in spirituous liquor, which renders it very bitter; they regard it as a preservative against autumnal fevers.

BIG LAUREL. *Magnolia grandiflora*.

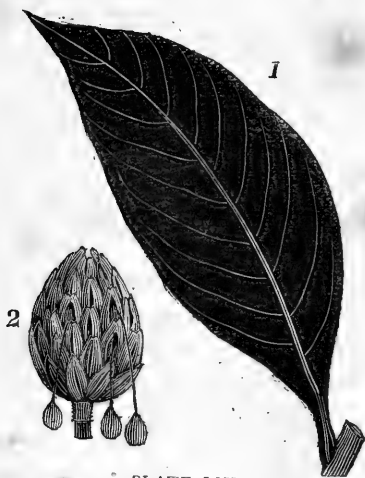


PLATE LIV.
Fig. 1. A leaf. Fig. 2. A conc.

Of all the trees of North America, east of the Mississippi, the Big Laurel is the most remarkable for the majesty of its form, the magnificence of its foliage and the beauty of its flowers. It is first seen in the lower part of North Carolina, near the river Neuse, in the latitude of 35° ; proceeding from this point it is found in the maritime parts of the Southern States and of the Floridas, and as far up the Mississippi as Natches, 300 miles above New Orleans,

which embraces an extent of 2000 miles. At Charleston, in South Carolina, and in its vicinity, this tree is commonly called *Large Magnolia*; but it is more generally known in the country by the name of *Big Laurel*. The French of Louisiana call it *Laurier Tulipier*. It grows only in cool and shady places, where the soil, composed of brown mould, is loose, deep and fertile. These tracts lie contiguous to the great swamps, which are found on the borders of the rivers and in the midst of the *pine-barrens*, or form themselves a part of these swamps; but they are never seen in the long and narrow marshes, called *branch swamps*, which traverse the barrens in every direction, and in which the miry soil is shallow, with a bed of white, quartzous sand beneath.

The big laurel claims a place among the largest trees of the United States. It sometimes, though rarely, reaches 90 feet in height, and two or three feet in diameter; but its ordinary stature is from 60 to 70 feet. Its trunk is nearly straight, covered with a smooth grayish bark, resembling that of the beech, and its summit nearly in the shape of a regular pyramid. Its leaves are entire, oval, sometimes acuminate and at others obtuse at the summit, six or eight inches long, and borne by short petioles. They are evergreen, thick, coriaceous, and very brilliant on the upper surface. The flowers are white, of an agreeable odor, and from seven to twelve inches broad. They are larger than those of any other tree of the American forests, and on detached trees they are commonly very numerous. Blooming in the midst of rich foliage, they produce so fine an effect, that those who have seen the tree on its native soil agree in considering it as one of the most beautiful productions of the vegetable kingdom. In Carolina, its flowers put forth in the month of May, and are succeeded by fleshy, oval cones, about four inches in length, which are composed of a great number of cells. At the age of maturity, which is about the first of October, they open longitudinally, showing two or three seeds of a vivid red. The seeds soon after quit their cells, and for some days remain suspended without, each by a white filament attached to the bottom of the cell. The red, pulpy substance, which surrounds

the stone, decays and leaves it naked. The stone contains a white milky kernel.

The wood of the big laurel is soft, and remarkable for its whiteness, which it preserves even after it is seasoned. It is said to be easily wrought and not liable to warp, but not durable when exposed to the weather : for this reason the boards are used only in joinery in the interior of buildings. In trees from fifteen to eighteen inches in diameter, there can be discerned no mark of distinction between the sap and the heart of this wood, except a deep, brown point, six or eight lines in diameter, in the centre of the trunk.

LARGE-LEAVED UMBRELLA TREE. *Magnolia macrophylla.*

This *Magnolia* is the least multiplied of the American species, and is rarely met with in the forests. On account of the resemblance of its leaves to those of the umbrella tree, the two species have hitherto been confounded by the inhabitants of the districts in which they grow : we have, therefore given it the specific name of *Large-Leaved Umbrella Tree*, which is sufficiently characteristic. It is found in small quantities on the mountains of North Carolina. West of the range, in Tennessee, it is more common, but even here only a few trees are found together, at intervals of forty or fifty miles. It delights in cool situations sheltered from the wind, where the soil is deep and fertile.

The large-leaved umbrella tree arrives at the height of 30 or 35 feet, with a diameter of four or five inches. The trunk is covered with a very smooth white bark, by which in the winter, when stript of its leaves, it is readily distinguished from the umbrella tree. At this season it differs also from the umbrella tree in its buds, which are compressed instead of being rounded at the end, and which are covered with a soft and silvery down. Of all this genus, this tree bears the largest leaves : some of them are 35 inches long and 9 or 10 inches broad. They are borne on petioles, short in comparison with the size of the leaves, and are of an oblong shape, pointed at the extremity, and cordiform

at the base : the color is light-green above, and glaucous beneath ; they fall in the autumn and reappear early in the spring. The flowers are white, and when full-blown are sometimes eight or nine inches in diameter : they are composed of six petals longer and broader than those of the umbrella tree. Within the flower, near the bottom of the petals, is a purple spot seven or eight lines in diameter. The flowers diffuse a fragrant odor, and their beauty is heightened by the luxuriant foliage which surrounds them. They bloom in June or July, and are succeeded by cones about four inches long, nearly cylindrical, and of a vivid rose color when arrived at maturity. In the arrangement of the cells and of the seeds, they resemble those of the umbrella tree and of the long-leaved cucumber tree..

The wood of this tree is softer and more porous than that of the umbrella tree, and is of no value in the arts.

UMBRELLA TREE. *Magnolia tripetala.*

The Umbrella Tree is first seen in the southern part of the state of New York ; but it is more multiplied farther south, and is common on some of the islands in the river Susquehannah, and still more so in the Southern and Western States. It is found in the maritime parts of the Carolinas and of Georgia, and 300 miles from the sea, on that part of the Alleghanies which traverse these states. The forests which cover the banks of the river Notahacky, in East Tennessee, may be particularly mentioned as abounding in the umbrella tree. It appears only in situations perfectly adapted to its growth, which are always shady, and where the soil is deep, strong and fertile.

The dimensions of the umbrella tree are such as to form a connecting link between the large shrubs and trees of the third order ; for though it sometimes rises to the height of 30 or 35 feet, with a diameter of five or six inches, it rarely attains this size. Its leaves, which are thin, oval, entire and acuminate at both extremities, are eighteen or twenty inches long, and seven or eight inches broad ; they are often disposed in rays at the

extremity of vigorous shoots, and thus display a surface of thirty inches in diameter: whence is derived the name of *Umbrella Tree*. The flowers open in May or June, and are seven or eight inches in diameter, white, composed of several oblong, concave petals, and situated at the extremity of the branches; they are beautiful, though less regularly shaped and of a less agreeable odor than those of the other species of magnolia. The conical fruit is four or five inches long, and about two inches in diameter; it ripens about the first of October, and is of a beautiful rose color, with seeds of a pale red.

The wood of this tree is soft, porous and unfit for use. The bark on the trunk is gray, smooth and polished: if cut while green, it exhales a disagreeable odor.

MALUS.

Icosandria Pentagynia. LINN. ROSACEÆ. JUSS. *Refrigerant, tonic, astringent.*

CRAB APPLE. *Malus coronaria.*



PLATE LV.

Fig. 1. A leaf. Fig. 2. The fruit.

The Crab Apple is found on both sides of the mountains, except in the state of Maine, Vermont and the upper part of New Hampshire. It appears to be most multiplied in the Middle States, and especially in the back parts of Pennsylvania and of Virginia. It abounds above all, in the *glades*, which is the name of a tract of land fifteen or eighteen miles, on the summit of the Alleghanies. It grows most favorably in cool and moist places, and on fertile soils.

The ordinary height of the crab apple tree is 15 or 18 feet, with a diameter of 5 or 6 inches; but it is sometimes found 25 or 30 feet high, and 12 or 15 inches in diameter. The leaves of this tree are oval, smooth on the upper surface, and when fully developed, very distinctly toothed: some of them are imperfectly trilobed. While young they have a bitter and slightly aromatic taste. Like the common apple tree, this species blooms very early in the spring. Its flowers are white, mingled with rose color, and are collected in corymbs; they produce a beautiful effect, and diffuse a delicious odor, by which, in the glades where the tree is abundant, the air is perfumed at a great distance. The apples, which are suspended by short peduncles, are small, green, intensely acid, and very odoriferous.

The wood of this tree is very compact, fine-grained and when dry is excellent fuel. Some farmers make cider of the fruit of this tree, which is said to be of a good quality: it also makes very fine sweetmeats, by the addition of a large portion of sugar. Successful experiments have been made of uniting this tree, by grafting, with the European species; but the time is so long in bringing it to as high state of improvement that it cannot be done to much advantage. Perhaps it might be profitably cultivated for cider, but, aside from its utility in this way, it must be regarded only as a tree highly agreeable for the beauty of its flowers and for the sweetness of its perfume.

MESPILOS.

Icosandria Pentagynia. LINN. Rosacæ. JUSS. *Refrigerant, tonic, astringent.*

JUNE BERRY. *Mespilus arborea.*

PLATE LVI.

Fig. 1. A leaf. Fig. 2. The fruit.

With the exception of the maritime parts of the Carolinas and of Georgia, this tree is spread over the whole extent of the United States and of Canada; but it is most multiplied upon the Alleghany Mountains, and upon the elevated banks of the rivers which flow from them. In the northern section of the Union, it is called *Wild Pear Tree* and *Sugar Plum*, and in the Middle States, *June Berry*. In the vicinity of New York and Philadelphia, it appears

to grow in preference in moist and shady situations, and along the margin of brooks and rivulets. In the Western Country, it is found in the midst of the forests among other trees.

The greatest height of this tree does not exceed 35 or 40 feet, with a diameter of ten or twelve inches. Its trunk is covered with a bark resembling that of the cherry tree. The leaves are two or three inches long, and alternately arranged. When beginning to open they are covered with a thick, silvery down, which disappears with their growth, and leaves them perfectly smooth on both sides. They are of a lengthened oval shape, of a delicate texture, and finely denticulated. The flowers, which are white and pretty large, are disposed in long panicles at the summit of the branches; they blow in the beginning of April, and are succeeded by small fruit of a purplish color and of an

agreeable, sweet taste. This fruit is ripe in the beginning of June, before that of any other tree or shrub.

The wood of the June berry is of a pure white, and exhibits no difference between the heart and the sap; it is longitudinally traversed by small, bright, red vessels, which intersect each other and run together. This wood is applied to no particular use in the arts.

MORUS.

Monœcia Tetrandria. LINN. Urticæ. JUSS. *Tonic, anodyne.*

RED MULBERRY. *Morus rubra.*



PLATE LVII.

Fig. 1. A leaf. Fig. 2. The fruit.

The northern extremity of Lake Champlain and the banks of the river Connecticut, may be assumed as the northern limits of this tree. As a temperate climate is favorable to its increase, it is more multiplied farther south; but in the Atlantic States it is proportionably less common than many other trees which still do not constitute the mass of the forests. In the lower part of the Southern States, it is much less frequently seen than at a distance from

the sea, where the soil and vegetable productions wear a different character. It is most abundant in Pennsylvania, Virginia, Ohio, Kentucky and Tennessee, particularly on the banks of the Wabash, the Illinois and Missouri, which is attributable to the superior fertility of the soil.

In situations favorable to the growth of the red mulberry, it attains the elevation of 60 or 70 feet, with a diameter of two

feet. Its leaves are large, and sometimes entire, and at others divided into two or three lobes, rounded, cordiform and denticulated, of a dark green color, a thick texture and a rough, uneven surface. The sexes are usually separate, though they are sometimes found upon the same tree. The male flowers form pendulous, cylindrical aments, about an inch in length; the female blossoms are small and scarcely apparent; the fruit is of a deep red color, an oblong form and an agreeable, acidulous, sugary taste: it is composed by the union of a great number of small berries, each of which contains a minute seed.

The trunk of the red mulberry is covered with a grayish bark more furrowed than that of the oaks and the hickories. The perfect wood is of a yellowish hue, approaching to lemon color. The concentric circles are distant and distinct; the wood is, nevertheless, fine-grained and compact, though lighter than that of the white oak. It possesses strength and solidity, and, when perfectly seasoned, it is almost as durable as the locust, to which, by many persons, it is esteemed perfectly equal. At Philadelphia, Baltimore and in the more southern ports, as much of it as can be procured is employed for the upper and lower parts of the frame of vessels, for the knees, the floor timbers, and, in preference to every other wood, except locust, for trunnels. In South Carolina it is selected for the ribs of large boats. For posts it is almost as durable and as much esteemed as the locust. As the leaves of this species are thick, rough and hairy while young, they are improper for the food of silk worms, which feed with advantage only on the smooth, thin and tender foliage of the white and Chinese mulberry.

NYSSA.

Polygonia Diœcia. LINN. Santalacæ. JUSS. *Sudorific, purgative, astringent.*

TUPELO. *Nyssa aquatica.*

PLATE LVIII.

Fig. 1. A leaf. Fig. 2. The fruit.

The Tupelo begins to appear in the lower part of New Hampshire, where the climate is tempered by the vicinity of the sea, but it is most abundant in the southern parts of New York, New Jersey and Pennsylvania. It is called indiscriminately *Tupelo*, *Gum Tree*, *Sour Gum* and *Pipperidge*. The first of these denominations is the most common, the second is wholly misapplied, as no self-condensing fluid distils from the tree, and the third is used only by the

descendants of the Dutch settlers of New York. The tupelo grows only in wet grounds on the borders of swamps and on the banks of rivulets and other waters.

This tree seldom rises above 40 or 45 feet in height, with a diameter of 15 or 20 inches. Its limbs, which spring five or six feet from the ground, affect a horizontal direction: the shoots of the two preceding years are commonly simple, and widely divergent from the branches. The trunk is of an uniform size from its base: while it is less than ten inches in diameter the bark is not remarkable, but on full-grown and vigorous stocks it is thick, deeply furrowed, and, unlike the bark of any other tree, divided into hexigons, which are sometimes very regular. The leaves are three inches long, oboval, smooth, slightly glaucous

beneath, alternate, and often united in bunches at the extremity of the young lateral shoots. The flowers are small, scarcely apparent, collected in bunches and supported by petioles one or two inches in length. They open in April or May. The fruit which is always abundant, is of a deep blue color, about the size of a pea, and attached in pairs. It is ripe in October, and persisting after the fall of the leaves, it serves for a part of the food of the red breasts in their autumnal migration to the south. The stone is compressed on one side, a little convex on the other, and longitudinally situated.

The tupelo holds a middle place between trees with soft and those with hard wood. When perfectly seasoned the sap is of a slight reddish tint, and the heart of a deep brown. Of trees exceeding fifteen inches in diameter, more than half the trunk is hollow. The ligneous fibres which compose the body of trees in general are closely united, and usually ascend in a perpendicular direction. But the genus, which we are now considering, exhibits, on the contrary, a constant peculiarity of organization; the fibres are united in bundles, and are interwoven like a braided cord; hence the wood is extremely difficult to split, unless cut into short billets. This property gives it a decided superiority for certain uses; in New York, New Jersey and particularly at Philadelphia, it is exclusively employed for the naves of wheels destined for heavy burthens. Wooden bowls are made of it which are heavier than those of poplar, but less liable to split. As a combustible it is esteemed for consuming slowly and diffusing a great heat.

SOUR TUPELO. *Nyssa capitata*.

The Sour Tupelo first makes its appearance on the river Ogeechee, near the road from Savannah to Sudbury, and in going southward it is seen in every favorable situation. It is said that it exists in Lower Louisiana, which is probable from the analogy in soil and climate between the ancient Southern States and the country watered by the lower part of the Mississippi. In Georgia

this tree is known by the name of *Sour Tupelo* and *Wild Lime*, the first of which we have preferred, though the last is more common, because this vegetable bears no resemblance to the lime tree in the form of its leaves or flowers.

This tree rarely exceeds 30 feet in height and a diameter of seven or eight inches. The leaves are five or six inches long, oval, rarely denticulated, of a light green above and glaucous beneath. The flowers are similar to those of the large tupelo, but the sexes are borne by separate stocks, and what is peculiarly remarkable, the male and female trees are easily distinguished by their general appearance when the leaves are fallen. The branches of the male are more compressed about the trunk, and rise in a direction more nearly perpendicular; those of the female diffuse themselves horizontally and form a larger and rounder summit. The flowers open in April or May. The fruit is supported by long petioles, and is from fifteen to eighteen lines in length, of a light red color and of an oval shape. It is thick-skinned, intensely acid, and contains, like that of the large tupelo, a large oblong stone deeply channelled on both sides. An agreeable acidulous beverage might be made of it; but the lime tree which is found in the same country, is superior in the size and abundance of its fruit, and has, besides, the advantage of flourishing on barren, sunbeaten land.

The wood of this tree is soft and unfit for any particular use in the arts.

LARGE TUPELO. *Nyssa grandidentata.*

PLATE LIX.

Fig. 1. A leaf. Fig. 2. The fruit.

This tree is the most remarkable of its genus for height and diameter. It is a stranger to the Northern and Middle States, and is found only in the lower part of the Carolinas, of Georgia and of East Florida, where it is designated by the name of *Large Tupelo*. It is said to abound also in Lower Louisiana on the banks of the Mississippi, where it is called *Wild Olive*. In fine, it exists in all parts of the United States which produce the long-leaved pine.

It grows most luxuriantly on the banks of rivers that are frequently inundated, and in swamps where the soil is deep and fertile.

The large tupelo, in favorable situations attains the elevation of 70 or 80 feet, with a diameter of 15 or 20 inches immediately above its conical base and six or seven feet from the ground. This size continues uniform to the height of 25 or 30 feet: at the surface the trunk is eight or nine feet thick, which is a greater disproportion than is observed in the other species. The leaves are commonly five or six inches long and two or three inches broad: on young and thriving stocks they are of twice these dimensions. They are of an oval shape, and are garnished with two or three large teeth irregularly placed, and not opposite, like those of other leaves. At their unfolding in the spring they are downy, but they become smooth on both sides as they expand. The flowers are disposed in bunches, are of a greenish color and open in April or May. They are succeeded by a fruit of considerable size and of a deep blue complexion, of which the stone is depressed and very distinctly striated.

The wood of the large tupelo is extremely light and softer than that of any other tree of the United States. In the arrangement of its fibres it resembles the other species of the genus. The only use to which it is applied is for bowls and trays, for which it is well adapted, as it is wrought with great facility. Its roots, also, are tender and light, and are sometimes employed by fishermen to buoy up their nets. Bruised in water its fruit yields a fine purple juice whose color is tenacious; but the quantity is too minute to afford resources in dyeing.

BLACK GUM. *Nyssa sylvatica.*



PLATE LX.

Fig. 1. A leaf. Fig. 2. The fruit.

On the banks of the Schuylkill and in the vicinity of Philadelphia may be assumed as the northern boundary of this tree; though it is common in the woods on the road from Philadelphia to Baltimore. In all the more southern states, both east and west of the Alleghanies, it is more or less multiplied, as the soil is more or less favorable to its growth. It is designated by the name of *Black Gum*, *Yellow Gum* and *Sour Gum*, none of which is founded

upon any of its characteristic properties; but as they have become sanctioned by use, however ill-chosen, we have adopted the first, which is the most common. The vegetation of this tree exhibits a remarkable singularity: in Maryland, Virginia and the Western States, where it grows on high level grounds, with the oaks and walnuts, it is distinguished by no peculiarity of form: in the lower part of the Carolinas and of Georgia, where it is found only in wet places with the small magnolia, the red bay, the

loblolly bay and the water oak, it has a pyramidal base resembling a sugar loaf. A trunk 18 or 20 feet high and seven or eight inches in diameter at the surface, is only two or three inches thick a foot from the ground ; these proportions, however, vary in different individuals.

The black gum is much superior in size to the tupelo, being frequently 60 or 70 feet in height and 18 or 20 inches in diameter. The bark of the trunk is whitish and similar to that of the white oak. The leaves are five or six inches long, alternate, entire, of an elongated, oval form, and borne by short and downy petioles. The flowers open in April or May, are small, not conspicuous, and collected in bunches. The fruit is of a deep blue color, and of a lengthened oval shape, and contains a slightly convex stone, longitudinally striated on both sides.

The wood of this tree is fine-grained but tender, and its fibres are interwoven and collected in bundles, an arrangement characteristic of the genus. The alburnum of stocks growing upon dry and elevated lands is yellow. Throughout the greater part of Virginia this wood is employed for the naves of coach and waggon wheels : at Richmond, Baltimore, Philadelphia, etc. it is preferred for hatters' blocks, as being less liable to split : in the Southern States it is used in the rice mills for the cylinder which receives the cogs : it is also chosen by shipwrights for the cap, or the piece which receives the topmast.

OLEA.

Diandria Monogynia. LINN. Jasmineæ. JUSS. Tonic, secernant, stimulant.

DEVIL WOOD. *Olea americana*.

PLATE LXI.

Fig. 1. A leaf. Fig. 2. The fruit.

laurel, the umbrella tree, the sweet gum, etc., in cool, fertile and shaded situations.

This tree, or to speak more accurately, this large shrub, is sometimes 30 or 35 feet high, and 10 or 12 inches in diameter : but this size is extraordinary ; it commonly fructifies at the height of 8, 10 or 12 feet. The bark which covers the trunk is smooth and grayish. The leaves are four or five inches long, opposite and lanceolate, entire at the edge, smooth and brilliant on the upper surface, and of an agreeable light green. They are evergreen, or at least are partially renewed once in four or five years. The fertile and barren flowers are on separate trees : they are very small, strongly scented, of a pale yellow, and axillary, or situated between the petiole and the leaves and branches. The season of flowering in the neighborhood of

Charleston, South Carolina, is about the end of April. The fruit is round, and about twice as large as a common pea. When ripe, it is of a purple color, approaching to blue, and consists of a hard stone thinly coated with pulp. As it remains attached to the branches during a part of the winter, its color forms, at this season, an agreeable contrast with the foliage.

The wood of this tree has a fine and compact grain, and when perfectly dry it is excessively hard and very difficult to cut and split: hence is derived the name of *Devil Wood*. It is, notwithstanding, neglected in use. On laying bare the cellular integument of the bark, its natural yellow hue changes instantaneously to a deep red, and the wood by contact with the air, assumes a rosy complexion.

PAVIA.

Hexandria Monogynia. LINN. Hippocastaneæ. JUSS. *Astringent.*

LARGE BUCKEYE. *Pavia lutea.*

The Yellow *Pavia*, or Large Buckeye is first observed on the Alleghany Mountains in Virginia near the 39th degree of latitude; it becomes more frequent by following the chain towards the south-west, and is most profusely multiplied in the mountainous districts of the Carolinas and of Georgia. It abounds also upon the rivers that rise beyond the mountains and flow through the western parts of Virginia, Kentucky and Tennessee to meet the Ohio. It is much less common along the streams which have their source east of the Alleghanies, and which, after watering the Carolinas and Georgia, discharge themselves into the Ocean. This species may be considered then as a stranger to the Atlantic States, with the exception of a tract thirty or forty miles wide in the Southern States, as it were beneath the shadow of the mountains. It is here called *Big Buckeye*, to distinguish it from the *Pavia rubra*, which does not exceed eight or ten feet in height, and which is called *Small Buckeye*. The situations most favorable to the growth of this tree are the declivities of mountains where the soil is generally loose, deep and fertile.

The large buckeye attains the height of 60 or 70 feet, with a diameter of three or four feet. The leaves are united to the number of five, at the end of a common petiole of considerable length. They are lanceolate, pointed at the summit, serrate and slightly furrowed. The flowers, of a light, agreeable yellow, are upright and disposed in bunches at the end of the shoots of the same season. They open in June. The numerous bunches of flowers contrasted with the fine foliage, lend a highly ornamental appearance to the tree. The fruit is contained in a fleshy, oval capsule, which is often gibbous, and whose surface, unlike that of the horse chesnut of Asia and of the American horse chesnut, is smooth. Each capsule contains two seeds, or nuts, of an equal size, flat upon one side and convex on the other. They are larger and lighter colored than those of the common horse chesnut, and, like them are not eatable.

The wood of this tree, from its softness and want of durability, can subserve to no useful purpose.

OHIO BUCKEYE OR
AMERICAN HORSE CHESNUT. *Pavia ohioensis.*

This species of Horse Chesnut is unknown in the Atlantic parts of the United States. It is found only beyond the mountains, and particularly on the banks of the Ohio, where it is very common. It is called *Buckeye* by the inhabitants, but as this name has been given to the *Pavia lutea*, we have denominated it *Ohio Buckeye*, because it is most abundant on the banks of this river, and have prefixed the synonyme of *American Horse Chesnut*, because it is proved to be a proper horse chesnut by its fruit, which is prickly like that of the Asiatic species, instead of being smooth like that of the *Pavia*.

The ordinary stature of this tree is 10 or 12 feet, but it sometimes equals 30 or 35 feet in height, and 12 or 15 inches in diameter. The leaves are palmated, and consist of five leaflets parting from a common centre, unequal in size, oval-acuminate, and irregularly toothed. The entire length of the leaf is nine or ten inches, and its breadth six or eight inches. The bloom of this tree is brilliant: its flowers appear early

in the spring, and are collected in numerous white bunches. The fruit is of the same color with that of the common horse chesnut and of the large buckeye, and of about half the size: it is contained in fleshy, prickly capsules, and is ripe in the beginning of autumn.

On the trunk of the largest trees the bark is blackish, and the cellular integument is impregnated with a venomous and disagreeable odor. The wood is white, soft, and wholly useless,

PINCKNEYA.

Pentandria Monogynia. LINN. Rubiacæ. JUSS. *Weak tonic, aperient.*

GEORGIA BARK. *Pinckneya pubens.*

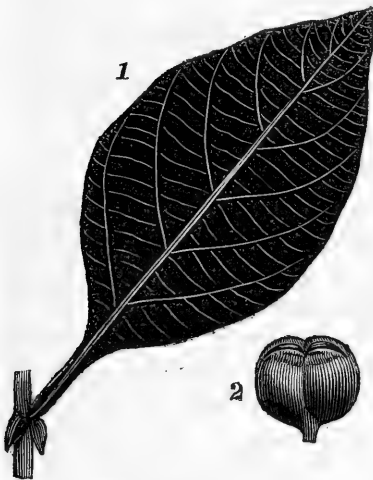


PLATE LXII.

Fig. 1. A leaf. Fig. 2. A seed vessel.

This tree, still more interesting by the properties of its bark, than by the elegance of its flowers and of its foliage, is indigenous to the most southern parts of the United States. The situation most favorable to its growth is a cool, shady exposure with a rich and fertile soil.

The Georgia bark is a low tree, dividing itself into numerous branches, and rarely exceeding the height of 25 feet, and a diameter of five or six inches at the base. Its leaves are opposite,

four or five inches long, of a light green color, and downy beneath, as are also the shoots to which they are attached. The flowers which are white with longitudinal, rose-colored stripes, are pretty large, and are collected in beautiful panicles at the extremity of the branches. Each flower is accompanied by a floral leaf, bordered with rose color near the upper edge. The capsules

are round, compressed in the middle, and stored with a great number of small winged seeds.

The wood of this tree is soft, and unfit for use in the arts; but its inner bark is extremely bitter, and appears to partake of the febrifuge virtues of the *Cinchona*, for the inhabitants of the southern parts of Georgia employ it successfully in the intermitting fevers, which, during the latter part of summer and the autumn, prevail in the Southern States. A handful of the bark is boiled in a quart of water till the liquid is reduced one half and the infusion is administered to the patient. From the properties of the bark the *Pinckneya* has taken the name of *Georgia Bark*. This tree so nearly resembles that which produces the Peruvian vegetable, that some botanists have included them in the same genus.

PINUS.

Monœcia Monadelphia. LINN. Coniferæ. JUSS. *Expectorant, secernant, stimulant.*

LONG-LEAVED PINE. *Pinus australis.*

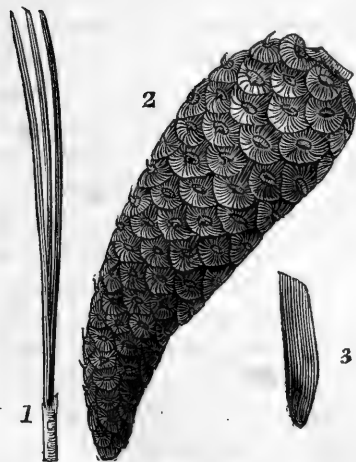


PLATE LXIII.

Fig. 1. A leaf. Fig. 2. A cone. Fig. 3. A seed.

This invaluable tree is known both in the countries which produce it, and in those to which it is exported, by different names: in the first it is called *Long-Leaved Pine*, *Yellow Pine*, *Pitch Pine* and *Broom Pine*; in the Northern States, *Southern Pine* and *Red Pine*; and in England and the West Indies, *Georgia Pitch Pine*. We have preferred the first denomination, because this species has longer leaves than any other eastward of the Mississippi, and

because the names of *Yellow Pine* and *Pitch Pine*, which are more commonly employed, serve in the Middle States to designate two species entirely distinct and extensively diffused. Towards the north this tree first makes its appearance near Norfolk in Virginia, where the *pine-barrens* begin. It seems to be especially assigned to dry, sandy soils, and it is found without interruption in the lower parts of the Carolinas, Georgia and the Floridas, over a tract of more than 600 miles long from north-east to south-west, and more than 100 miles broad from the sea towards the mountains of the Carolinas and Georgia.

The mean stature of the long-leaved pine, is 60 or 70 feet with an uniform diameter of 15 or 20 inches for two-thirds of this height. Some stocks, favored by local circumstances, attain much larger dimensions, particularly in East Florida. The bark is somewhat furrowed, and the epidermis detaches itself in thin transparent sheets. The leaves are about a foot long, of a beautiful brilliant green, united to the number of three in the same sheath, and collected in bunches at the extremity of the branches: they are longer and more numerous on the young stocks. The buds are very large, white, fringed, and not resinous. The bloom takes place in April; the male flowers form masses of divergent violet-colored aments about two inches long; in drying they shed great quantities of yellowish pollen, which is diffused by the wind and forms a momentary covering on the surface of the land and water. The cones are very large, being seven or eight inches long, and four inches thick when open, and are armed with small, retorted spines. In the fruitful year they are ripe about the middle of October, and shed their seeds the same month. The kernel is of an agreeable taste, and is contained in a thin, white shell, surmounted by a membrane; in every other species of American pine the shell is black.

The wood of this tree contains but little sap; trees fifteen inches in diameter three feet from the ground frequently have ten inches of heart. Many stocks of this size are felled for commerce, and none are received for exportation of which the heart is not ten inches in diameter when squared. The concentric circles in a trunk fully developed are close and at equal distances,

and the resinous matter, which is abundant, is more uniformly distributed than in the other species; hence the wood is stronger, more compact and more durable: it is, besides, fine-grained, and susceptible of a bright polish. These advantages give it a preference to every other pine; but its quality is modified by the nature of the soil in which it grows. In the vicinity of the sea, where only a thin layer of mould reposes upon the sand, it is more resinous than where the mould is five or six inches thick; the stocks that grow upon the first-mentioned soil are called *Pitch Pine*, and the others *Yellow Pine*, as if they were distinct species. This wood subserves a great variety of uses in the Carolinas, Georgia and the Floridas: four-fifths of the houses are built of it, except of the roof, which is covered with the shingles of the cypress; but in the country the roof is also of pine, and is renewed after fifteen or eighteen years. A vast consumption takes place for the inclosure of cultivated fields. In naval architecture this is the most esteemed of the pines: in the Southern States, the keel, the beams, the side planks and the pins by which they are attached to the ribs, are of this tree. For the deck it is preferred to the true yellow pine. In certain soils this wood contracts a reddish hue, and it is for that reason known in the dock yards of the Northern States by the name of *Red Pine*. Wood of this tint is considered best, and in the opinion of some shipwrights it is more durable on the sides of vessels, and less liable to injury from worms, than the oak. The value of this tree does not reside exclusively in its wood: it supplies nearly all the resinous matter used in the United States in ship building, and a large residue for exportation to the West Indies and Europe.

The resinous product of the pine is of six sorts, namely, turpentine, scrapings, spirit of turpentine, rosin, tar and pitch. The last two are delivered in their natural state; the others are modified by the agency of fire in certain modes of preparation. More particularly, turpentine is the sap of the tree obtained by making incisions in its trunk. It begins to distil about the middle of March, when the circulation commences, and flows with increasing abundance as the weather becomes warmer, so that July and

August are the most productive months. When the circulation is abated by the chills of autumn, the operation is discontinued, and the remainder of the year is occupied in preparatory labors for the following season, which consist, first, in making the *boxes*. This is done in January and February : in the base of each tree, about three or four inches from the ground, and of preference on the south side, a cavity is formed, commonly of the capacity of three pints, but proportioned to the size of the trunk, of which it should occupy one fourth of the diameter ; on stocks of more than six feet in circumference, two, and sometimes four, *boxes* are made on opposite sides. Next comes the *raking*, or the clearing the ground at the foot of the trees from leaves and herbage, by which means they are secured from the fires that are often kindled in the woods by the carelessness of travellers and waggoners. If the flames gain the *boxes* already impregnated with turpentine, they are rendered useless, and others must be made. *Notching* is merely making at the sides of the box two oblique gutters, about three inches long, to conduct into it the sap that exudes from the edges of the wound. In the interval of a fortnight, which is employed in this operation, the first boxes become filled with sap. A wooden shovel is used to transfer it to pails, which in turn are emptied into casks at convenient distances. To increase the product, the upper edge of the box is chipped once a week, the bark and a portion of the alburnum being removed to the depth of four concentric circles. The turpentine thus procured is the best, and is called *pure dipping*. The *chippings* extend the first year a foot above the box, and as the distance increases, the operation is more frequently repeated, to remove the sap coagulated on the surface of the wound. The closing of the pores, occasioned by continued rains, exacts the same remedy ; and it is remarked that the produce is less abundant in moist and cool seasons. After five or six years the tree is abandoned ; the upper edge of the wound becomes cicatrized, but the bark is never restored sufficiently for the renewal of the process. The *scraping* is a coating of sap which becomes solid before it reaches the boxes, and which is taken off in the fall and added to the last runnings. Large quantities of

spirits of turpentine are made in North Carolina : it is obtained by distilling the turpentine in large copper retorts, which are of an imperfect shape, being so narrow at the mouth as to retard the operation. Six barrels of turpentine are said to afford thirty gallons of the spirit. All the tar of the Southern States is made from dead wood of the long-leaved pine, consisting of trees prostrated by time or by the fire, of the summits of those that are felled for timber, and of limbs broken off by the ice which sometimes overloads the leaves. It is worthy of remark that the branches of resinous trees consist almost wholly of *wood*, of which the organization is even more perfect than in the body of the tree. As soon as vegetation ceases in any part of the tree, its consistence speedily changes ; the sap decays and the heart, already impregnated with resinous juice, becomes surcharged to such a degree as to double its weight in a year : the accumulation is said to be much greater after four or five years. To procure the tar, a *kiln* is formed in a part of the forest abounding in dead wood : this is first collected, deprived of the sap, and cut into billets two or three feet long and about three inches thick. The next step is to prepare a place for piling it : for this purpose a circular mound is raised, slightly declining from the circumference to the centre, and surrounded with a shallow ditch. The diameter of the pile is proportioned to the quantity of wood which it is to receive : to obtain one hundred barrels of tar, it should be eighteen or twenty feet wide. In the middle is a hole with a conduit leading to the ditch, in which is formed a receptacle for the resin as it flows out. Upon the surface of the mound, beaten hard and coated with clay, the wood is laid round in a circle like rays. The pile, when finished, may be compared to a cone truncated at two-thirds of its height and reversed, being twenty feet in diameter below, twenty-five or thirty feet above, and ten or twelve feet high. It is then strewed with pine leaves, covered with earth, and contained at the sides with a slight cincture of wood. This covering is necessary in order that the fire kindled at the top may penetrate to the bottom with a slow and gradual combustion : if the whole mass was rapidly inflamed, the operation would fail and the labor in

part be lost : in fine, nearly the same precautions are exacted in the process as are observed in making charcoal. A kiln which is to afford one hundred or one hundred and thirty barrels of tar, is eight or nine days in burning. As the tar flows off into the ditch, it is emptied into casks of thirty gallons, which are made of the same species of wood. *Pitch* is tar reduced by evaporation : it should not be diminished beyond half its bulk to be of a good quality.

NEW JERSEY PINE. *Pinus inops.*

The Jersey Pine has probably been so named from its abounding in the lower part of New Jersey, where the soil is meagre and sandy, and where it is often accompanied by the yellow pine. It is not, however, confined to this state, but it grows in Maryland, Virginia, Kentucky and Pennsylvania. In the last-mentioned state it is called *Scrub Pine*, and is seen wherever the soil is composed of argillaceous schistus, and is consequently poor. This tree is not found north of the river Hudson, nor in the Carolinas and Georgia.

The Jersey pine is sometimes 30 or 40 feet high and 12 or 15 inches in diameter, but it rarely attains these dimensions. The trunk, which is clad in a blackish bark, tapers sensibly from the base to the summit, and half its length is occupied by limbs remote from each other. The leaves are united in pairs and are of a dark green, one or two inches long, flat on the inner face, stiff and scattered over the young branches, which are very flexible and smooth, while those of the other species are scaly. The wood of the annual shoots is observed to be of a violet tint, which is a character peculiar to this species and the yellow pine. The cones are about two inches long and an inch in diameter at the base : they are attached by short, thick peduncles, and are armed with long, firm spines, pointed and bent backwards ; they are usually single and directed towards the earth. The seeds are shed the first year of their maturity.

The size of this tree forbids the useful employment of its wood, not to mention the disadvantage under which it exists of

containing a large proportion of sap. In Kentucky a small quantity of tar is obtained from the heart and is consumed in the vicinity. Next to gray pine, this is the most uninteresting species of the United States.

YELLOW PINE. *Pinus mitis*.

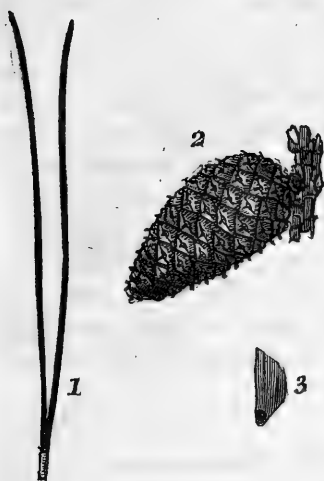


PLATE LXIV.

Fig. 1. A leaf. Fig. 2. A cone. Fig. 3. A seed.

This tree is widely diffused in North America, and is known in different places by different names: in the Middle States, where it is abundant and in common use, it is called *Yellow Pine*, in the Carolinas and Georgia, *Spruce Pine*, and more frequently *Short-Leaved Pine*. Towards the north, this species is not found beyond certain districts of Connecticut, Massachusetts and New Hampshire. It is multiplied in the lower part of New Jersey, and still more so on the eastern shore of Maryland and in the lower parts of Virginia, where it is seen only upon arid soils. It is also met with in New York, Pennsylvania, Kentucky, the Carolinas, Georgia, East Tennessee, the Floridas and probably in Louisiana. In these regions it generally grows on spots consisting of beds of clay mingled with gravel.

In New Jersey and in Maryland this tree is 50 or 60 feet high, and is commonly of an uniform diameter of 15 or 18 inches for two-thirds of this distance; in Virginia and the upper part of the Carolinas there are stocks of nearly the same height and of twice this diameter. The leaves are four or five inches long, fine, flexible, hollowed on the inner face, of a dark green, and united in pairs; sometimes, from luxuriancy of vegetation,

three are found together on the shoots of the same season, but never upon the older branches. The cones are oval, armed with fine spines, and smaller than those of any other American pine, since they scarcely exceed an inch and a half in length upon old trees. The seeds are cast the first year.

The concentric circles of the wood are six times as numerous in a given space as those of the pitch and loblolly pines. In trunks fifteen or eighteen inches in diameter, there are only two inches, or two and a half, of sap, and still less in such as exceed this size. The heart is fine-grained and moderately resinous, which renders it compact without great weight. Long experience has proved its excellence and durability. It is employed for floors of houses, for the casings of doors and wainscots and for window sashes. Immense quantities are used in the dockyards of New York, Philadelphia, Baltimore, etc., for the decks, masts, yards, beams and cabins of vessels, and it is considered as next in durability to the long-leaved pine. The wood from New Jersey and Maryland is fine-grained, more compact, and stronger than that from the river Delaware, which grows upon richer lands.

TABLE MOUNTAIN PINE. *Pinus pungens.*

Table Mountain, in North Carolina, one of the highest points of the Alleghanies, at the distance of nearly 300 miles from the sea, has given its name to this species of pine, which covers it almost exclusively, though it is rare on the neighboring summits. Nor is it found in any other part of the United States.

The Table Mountain pine is 40 or 50 feet in height with a proportional diameter. The buds are resinous, and the leaves, which grow in pairs, are thick, stiff and about two inches and a half in length. The cones are about three inches long and two inches in diameter at the base, of a regular form and a light yellow color: they are sessile, and often united to the number of four. Each scale is armed with a strong, ligneous spine, two lines in length, widened at the base, and bent towards the summit of the cone.

This tree divides itself into numerous ramifications. It is appropriated to no particular use, but in the mountains of North Carolina its turpentine is preferred to every other as a dressing for wounds.

PITCH PINE. *Pinus rigida.*

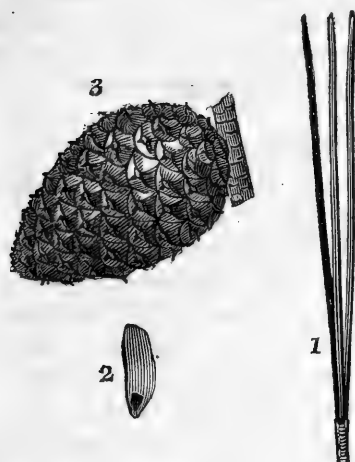


PLATE LXV.

Fig. 1. A leaf. Fig. 2. A seed. Fig. 3. A cone.

This species is known in all the United States by the name of *Pitch Pine*, and sometimes in Virginia by that of *Black Pine*. Except the maritime parts of the Atlantic States, and the fertile regions west of the Alleghany Mountains, it is found throughout the United States, but most abundantly upon the Atlantic coast, where the soil is diversified but generally meagre. In Maine, New Hampshire and Vermont it grows almost exclusively in light, even, pliable, sandy soils.

In the lower part of New Jersey, Pennsylvania and Maryland, it is frequently seen in the large swamps filled with the red cedar, which are constantly miry or covered with water. In such situations it is 70 or 80 feet high and from 20 to 28 inches in diameter, and exceeds the surrounding trees both in bulk and elevation. In Pennsylvania and Virginia, on the Alleghanies, it grows to the height of 35 or 40 feet with a diameter of 12 or 15 inches. And in Maine and Vermont, it seldom grows more than 20 or 25 feet in height, and its slender branches, laden with puny cones, evince the feebleness of its vegetation. The buds of this tree are always resinous, and its triple leaves vary in length from an inch and a half to seven inches, according to the de-

gree of moisture of the soil. The aments are an inch long, straight and winged like those of the pond pine. The size of the cones depend upon the nature of the soil, and varies from less than an inch to more than three inches in length; they are of a pyramidal shape, and each scale is pointed with an acute spine about two inches long. Wherever these trees grow in masses the cones are dispersed singly over the branches, and they release the seeds the first autumn after their maturity; but on solitary stocks, exposed to the buffeting of the winds, the cones are collected in groups of four, five or even a larger number, and remain closed for several years.

The pitch pine has a thick, blackish, deeply-furrowed bark. It is remarkable for the number of its branches, which occupy two-thirds of its trunk and render the wood extremely knotty. The concentric circles are widely distant, and three fourths of the larger stocks consist of sap. On mountains and gravelly lands, the wood is compact, heavy and surcharged with resin, whence is derived the name *Pitch Pine*: in swamps, on the contrary, it is light, soft, and composed almost wholly of sap; it is then called *Sap Pine*. These essential defects place it below the yellow pine, but as that species is constantly diminishing by the vast consumption in civil and naval architecture, it is partially replaced by the pitch pine, the poorer variety of which is used for the boxes employed in packing certain sorts of merchandize, such as soap, candles, etc. On some parts of the Alleghanies, houses are built of it, and the wood if not covered with paint, is recognized by its numerous knots. It is thought better than the yellow pine for floors that are frequently washed, as the resin with which it is impregnated renders it firmer and more durable. It serves perfectly well for ship pumps, for which purpose trees with very little heart are preferred. It is much esteemed for fuel by bakers and brick makers. From the most resinous stocks is procured the lamp black of commerce.

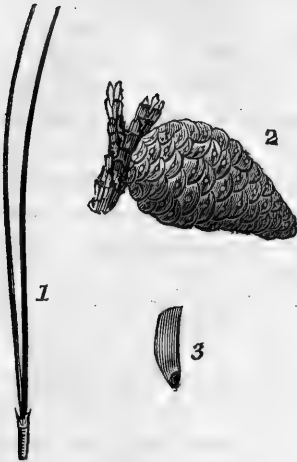
RED OR NORWAY PINE. *Pinus rubra.*

PLATE LXVI.

Fig. 1. A leaf. Fig. 2. A cone. Fig. 3. A seed.

This tree is called by the French inhabitants of Canada *Pin rouge*, red pine, and the name has been preserved in the United States. In the Northern States it is called *Norway Pine*, though differing totally from that tree, which is a species of spruce. The first of these denominations should be adopted by the Americans, especially as it is founded on a distinguishing character of the species, which will be hereafter noticed. The most north-

ern points at which this vegetable grows, is near Lake St. John in Canada in the 48th degree of latitude. Towards the south it is not seen beyond Pennsylvania, in latitude $41^{\circ} 30'$; and it is rare in all the country south of the river Hudson. It is found in Nova Scotia, where it bears the same name as in Canada, and also that of *Yellow Pine*. It is said likewise to exist beyond Lake Superior. Like most species of this genus, it grows in dry and sandy soils.

When the luxuriance of this tree is not checked, it attains the height of 70 or 80 feet with a diameter of two feet. It is chiefly remarkable for the uniform size of its trunk for two-thirds of its length. The bark upon the body of the tree is of a clearer red than upon that of any other species in the United States; hence is derived its popular name, *Red Pine*. The leaves are of a dark green, five or six inches long, united in pairs and collected in bunches like those of the long-leaved pine, instead of being dispersed like those of the Jersey pine. The female flowers are

bluish during the first months after their appearance, and the cones, which are destitute of thorns and which shed their seeds the first year, are about two inches long, rounded at the base and abruptly pointed.

The concentric circles are crowded in the red pine, and the wood, when wrought, exhibits a fine, compact grain. It is rendered heavy by the resinous matter with which it is impregnated, and in Canada, Nova Scotia and the state of Maine, it is highly esteemed for strength and durability, and is frequently employed in naval architecture, especially for the deck of vessels, for which it furnishes planks forty feet long without knots. Stript of the sap it makes very lasting pumps.

GRAY PINE. *Pinus rupestris*.

This species is found farther northward than any other American pine. In Nova Scotia and the state of Maine, where it is rare, it is called *Scrub Pine*, and in Canada, *Gray Pine*.

In the vicinity of Hudson's Bay and a few degrees farther south this tree disappears almost entirely. Here and there, in the intervals of the rocks, are seen a few individuals of this species of pine, which fructify and even exhibit the appearances of decrepitude at the height of three feet. One hundred and fifty miles farther south its vegetation is more vigorous, but it is still not more than eight or ten feet high, and in Nova Scotia, where it is confined to the summit of the rocks, it rarely exceeds this stature. The leaves of this tree are united in pairs in the same sheath, but they are disseminated over the branches instead of being collected at the extremity, and are about an inch long, flat on the interior and rounded on the exterior face. The cones are commonly in pairs and are of a gray or ashy color, which has probably lent its name to the tree; they are about two inches long, and have the peculiarity of always pointing in the same direction with the branches: they are besides remarkable for naturally assuming an arching shape, which gives them the appearance of small horns. They are extremely hard, and do

not open to release the seeds before the second year. The Canadians find a speedy cure for obstinate colds in a diet drink made by boiling these cones in water. The wood of this tree is not used in any respect in the arts.

POND PINE. *Pinus serotina*.

The Pond Pine frequently recurs in the maritime parts of the Southern States, but it is lost as it were among the long-leaved pines which cover these regions. It receives its specific name on account of its growing principally on the borders of ponds, and in swamps where the soil is black and miry. It sometimes grows in abandoned fields on the borders of swamps in dry, sandy soils.

The ordinary size of this tree is 35 or 40 feet with a diameter of 15 or 18 inches. The leaves, united to the number of three, are five or six inches in length and a little more upon young stocks. The aments are straight, and six or eight lines long; the cones are commonly opposite and in pairs two inches and a half in length, five inches and a half in circumference, and in form like an egg; their scales are rounded at the extremity, and armed with fine, short spines which are easily broken off, so that in some instances no vestige is left of their existence. The cones arrive at maturity the second year, but do not release their seeds before the third or fourth.

This tree is remarkable for the remoteness of its branches, which begin to spring upon the lower half of the stock; and more than half of the largest trunk consists of sap; for these reasons the species is useless in the arts.

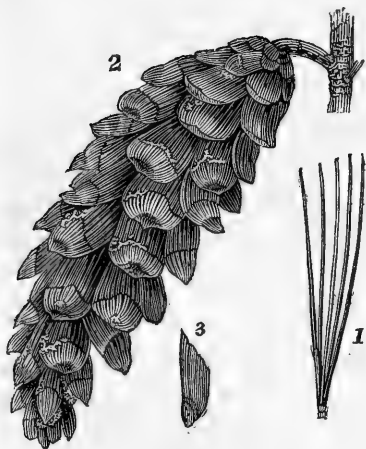
WHITE PINE. *Pinus strobus*.

PLATE LXVII.

Fig. 1. A leaf. Fig. 2. A cone. Fig. 3. A seed.

This species, one of the most interesting of the American pines, is known in Canada and the United States by the name of *White Pine*, from the perfect whiteness of its wood when freshly exposed, and in New Hampshire and Maine by the secondary denominations of *Pumpkin Pine*, *Apple Pine* and *Sapling Pine*, which are derived from certain accidental peculiarities. This tree is diffused, though not uniformly, over a vast extent of country; it is incapable

of supporting intense cold, and still less extreme heat. It is first observed in the north about 40 leagues from the mouth of the river Mistassin, which discharges itself into Lake St. John in Canada, in the latitude of $48^{\circ} 50'$. It appears to be most abundant between the 43d and 47th degrees of latitude; farther south it is found in the valleys and on the declivities of the Alleghanies to their termination, but at a distance from the mountains on either side its growth is forbidden by the warmth of the climate. It is said with great probability to be multiplied near the source of the Mississippi which is in the same latitude with the state of Maine, the upper part of New Hampshire, Vermont, and the commencement of the St. Lawrence, where it attains its greatest dimensions. In these countries it is seen in very different situations, and it seems to accommodate itself to all varieties of soil except such as consist wholly of sand, and such are almost wholly submerged. The largest stocks are found in the bottom of soft, pliable and fertile valleys, on the

banks of rivers composed of deep, cool, black sand, and in swamps covered with a thick and constantly humid carpet of *sphagnum*.

Near Norridgewock on the river Kennebeck, in one of the swamps, which is accessible only in midsummer, M. Michaux measured two trunks felled for canoes, of which one was 154 feet long and 54 inches in diameter, and the other 142 feet long and 44 inches in diameter, at three feet from the ground. Mention is made in Belknap's History of New Hampshire of a white pine felled near the river Merimack, 7 feet 8 inches in diameter. M. Michaux likewise measured a stump near Hallowell, Maine, exceeding 6 feet in diameter : these enormous trees had probably reached the greatest height attained by the species, which is about 180 feet. But this ancient and majestic inhabitant of the North American forests is still the loftiest and most valuable of their productions, and its summit is seen at an immense distance aspiring towards heaven, far above the heads of the surrounding trees. The trunk is simple for two-thirds or three-fourths of its height, and the limbs are short and verticillate, or disposed in stages one above another to the top of the tree, which is formed of three or four upright branches seemingly detached and unsupported. In forests composed of other trees, where the soil is strong and proper for the culture of corn, as for example on the shores of Lake Champlain, it is arrested at a lower height and diffused into a spacious summit ; but it is still taller and more vigorous than the neighboring trees. On young stocks not exceeding 40 feet in height the bark of the trunk and branches is smooth and even polished ; as the tree advances in age it splits and becomes rugged and gray, but does not fall off in scales like that of the other pines. The white pine is also distinguished by the sensible diminution of its trunk from the base to the summit, in consequence of which it is more difficult to procure sticks of great length and uniform diameter : this disadvantage, however, is compensated by its bulk and by the small proportion of alburnum. The leaves are five-fold, four inches long, numerous, slender, and of a bluish green : to the lightness and delicacy of the foliage is owing the elegant appear-

ance of the young trees. The male aments are four or five lines long, united to the number of five or six, and arranged like those of the loblolly and long-leaved pines: they bloom in the month of May, and turn reddish before they are cast. The cones are four or five inches long, ten lines in diameter in the middle, pedunculated, pendulous, somewhat arched, and composed of thin, smooth scales, rounded at the base. They open about the first of October to release their seeds, of which a part are left adhering to the turpentine that exudes from the scales.

The wood of this species is employed in greater quantities and far more diversified uses than that of any other American pine; yet it is not without essential defects; it has little strength, gives a feeble hold to nails and sometimes swells by the humidity of the atmosphere. These properties are compensated however by others which give it a decided superiority; it is soft, light, free of knots and easily wrought, is more durable, and less liable to split when exposed to the sun, furnishes boards of a great width, and timber of large dimensions, in fine, it is still abundant and cheap. It is observed that the influence of soil is greater upon resinous than upon leafy trees. The qualities of the white pine, in particular, are strikingly affected by it. In loose, deep, humid soils, it unites in the highest degree all the valuable properties by which it is characterized, especially lightness and firmness of texture, so that it may be smoothly cut in every direction; hence the name *Pumpkin Pine*. On dry, elevated lands, its wood is firmer and more resinous, with a coarser grain and more distant concentric circles, and it is then called *Sapling Pine*. The wood of this tree is used for every species of ornamental work about building, for *clap boards*, and shingles, for looking glass and picture frames, for images in sculpture, the inside of mahogany furniture and of trunks, in cooperage and an endless variety of other purposes. It serves exclusively for the masts of the numerous vessels constructed in the Northern and Middle States. The principal superiority of these masts over those exported to England from Riga is their lightness; but they have less strength, and are said to decay more rapidly between decks and at the point of intersection of the yards: this

renders the long-leaved pine superior to the white pine in the opinion of the greater part of American ship builders. The bowsprits and yards are also made of white pine. The wood is not resinous enough to furnish turpentine for commerce, nor would the labour of extracting it be easy, since this tree occupies exclusively tracts of only a few hundred acres, and is usually mingled in different proportions with the leafy trees.

LOBLOLLY PINE. *Pinus taeda*.

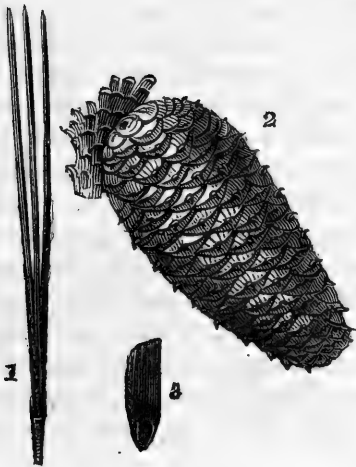


PLATE LXVIII.

Fig. 1. A leaf. Fig. 2. A cone. Fig. 3. A seed.

Throughout the lower parts of the Southern States this species is called *Loblolly Pine*, and sometimes *White Pine* in Virginia. Its most northern limit is at Fredericksburgh, 230 miles south of Philadelphia. In the lower part of Virginia and in the districts of North Carolina situated north-east of the river Cape Fear, over an extent of nearly 200 miles, it grows wherever the soil is dry and sandy. In the same parts of Virginia, it exclusively occupies lands

that have been exhausted by cultivation, and forests of oak tracts of 100 or 200 acres are not unfrequently seen covered with thriving young pines. In the more Southern States it is the most common species after the long-leaved pine, but it grows only in *branch swamps*, or long, narrow marshes that intersect the *pine-barrens*, and near the creeks and rivers, where the soil is of middling fertility and susceptible of improvement.

The loblolly pine sometimes exceeds 80 feet in height, with a diameter of two or three feet with a wide-spreading summit.

The leaves are fine, of a light green, six inches long, and united to the number of three and sometimes of four on young and vigorous stocks. The bloom takes place in the beginning of April; the aments are nearly an inch long, and are bent and intermingled like those of the long-leaved pine. The cones are about four inches in length, and armed with strong spines; while closed they have the form of an elongated pyramid, and when open of a rhombus more or less perfect: the seeds are cast the first year.

The wood of this tree has a still greater proportion of sap than that of the pond and pitch pines: in trunks three feet in diameter, there are thirty inches of alburnum, and those of a foot in diameter and thirty or thirty-five feet in height, not more than an inch of heart. The concentric circles are widely distant, as might be supposed from the rapidity of its growth in the more Southern States; in Virginia, where it vegetates more slowly, its texture is closer and the proportion of sap less considerable. This wood is much used for building houses in Virginia. In the ports of the Southern States it is used, like the pitch pine in those of the north, for the pumps of ships; at Charleston the wharves are built with logs of the loblolly pine, consolidated with earth; it is much esteemed by bakers to heat their ovens. It affords turpentine in abundance, but in a less fluid state than that of the long-leaved pine; as it contains more alburnum, from which the turpentine distils, perhaps by making deeper incisions it would yield a greater product.

PLANERA.

Tetrandria Tetragynia. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

PLANER TREE. *Planera ulmifolia.*

Kentucky, Tennessee, the banks of the Mississippi and the Southern States are the native places of this tree. It generally grows on the borders of rivers or in swamps.

The planer tree is of the second order, and is rarely more than 35 or 40 feet high and 12 or 15 inches in diameter. The leaves are about an inch and a half long, oval-acuminate, denticulated, of a lively green color. Its bloom is early and not conspicuous. Its minute seeds are contained in small, oval, inflated, uneven capsules.

The wood of this tree is hard, strong, and seemingly proper for various uses : but it is rare and the wood is neglected.

PLATANUS.

Monœcia Polyandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

BUTTONWOOD OR SYCAMORE. *Platanus occidentalis.*



PLATE LXIX.

Fig. 1. A leaf. Fig. 2. The fruit.

Among trees with deciduous leaves, none in the temperate zones, either in the Old or New Continent, equal the dimensions of the planes. The species which we are about to describe is not less remarkable for its amplitude, and for its magnificent appearance than the plane of Asia, whose majestic form and extraordinary size were so much celebrated by the ancients. In the Atlantic States this tree is commonly known by the name of *Buttonwood*,

and sometimes in Virginia, by that of *Water Beach*. On the banks of the Ohio, and in the state of Kentucky and Tennessee, it is most frequently called *Sycamore*, and by some persons *Plane Tree*. The French of Canada and of Upper Louisiana give it the name of *Cotton Tree*. The first of these denomina-

tions appear to be the most widely diffused, and not to be entirely unknown in those districts where the others are habitually employed ; for this reason we have adopted it, though a less appropriate appellation than that of *Plane Tree*. The buttonwood does not grow towards the north-east, beyond Portland in the state of Maine ; but it is found farther west at the extremity of Lake Champlain and at Montreal. Proceeding from Boston and the shores of Lake Champlain towards the west and the south-west, this tree is continually met with over a vast tract, comprising the Atlantic and Western States, and extending beyond the Mississippi. The nature of the buttonwood confines it to moist and cool grounds, where the soil is loose, deep and fertile : the luxuriance of its vegetation depends upon the union of these circumstances. It is never found upon dry lands of an irregular surface among the white and red oaks and the walnuts : it is also more rare in all the mountainous tracts of the Alleghanies than in the flat country. In the swamps of Virginia its growth is stunted and in general it does not exceed eight or ten inches in diameter. Farther south, in the lower parts of the Carolinas and Georgia, it is not abundant even on the sides of the rivers, and is not seen in the *branch swamps*. The cause of its not being found in these small marshes is, perhaps, that the layer of vegetable mould, which is black and always miry, is not sufficiently thick and substantial to support its growth, and that the heat, in this part of the Southern States, is long continued and excessive. This tree in no part of the United States is more abundant and more vigorous than along the rivers of Pennsylvania and Virginia ; though in the more fertile valleys of the west, its vegetation is still more luxuriant, especially on the banks of the Ohio and of the rivers which flow into it. The bottoms which are watered by these rivers are covered with dark forests, composed of trees of an extraordinary size. The soil is very deep, loose, of a brown color and unctuous to the touch : it appears to have been formed by the slime deposited in the course of ages, at the annual overflowing of the rivers.

On the margin of the great rivers of the west, the buttonwood is constantly found to be the loftiest and largest tree of the

United States. Often with a trunk of several feet in diameter, it begins to ramify at the height of 60 or 70 feet, near the summit of other trees; and often the base divides itself into several trunks equally vigorous and superior in diameter to any of the surrounding trees. On a little island in the Ohio, fifteen miles above the mouth of the Muskingum, M. Michaux mentions a buttonwood which, at five feet from the ground, was 40 feet and 4 inches in circumference, and consequently more than 13 feet in diameter. He mentions another on the right bank of the Ohio, thirty-six miles above Marietta, whose base was swollen in an extraordinary manner; at four feet from the ground it was 47 feet in circumference. This tree, which still exhibited the appearance of vigorous vegetation, ramified at 20 feet from the ground. A buttonwood of equal size is mentioned as existing in Genessee. The astonishing dimensions of these trees recall the famous plane tree of Lycia spoken of by Pliny, whose trunk, hollowed by time, afforded a retreat for the night to the Roman Consul Licinius Mutianus, with eighteen persons of his retinue. The interior of this grotto was 75 feet in circumference, and the summit of the tree resembled a small forest. The most striking resemblance, in the majesty of their form and in the enormous size of their trunk, thus appears to exist between the only two species of plane that have hitherto been discovered. The American species is generally thought, in Europe, to possess a richer foliage, and to afford a deeper shade than the Asiatic plane: its leaves are of a beautiful green, alternate, from five to fifteen inches broad, less deeply lobed, and formed with more open angles than those of the plane of the Eastern Continent. In the spring the lower surface of these leaves is covered with a thick down, which disappears towards summer. The sexes are separate, but the male and female flowers are attached to the peduncle, instead of being placed on different branches. The flowers are in the form of small balls: the fertile ones grow to the diameter of an inch, and are supported by peduncles two or three inches long. These balls fall in the course of the autumn and winter, and, parting asunder, the seeds which compose them

are scattered in the wind, by means of the plummy tuft by which they are surmounted.

The trunk and branches of the buttonwood are covered with a smooth, pale green bark, of which the epidermis detaches itself every year in portions: a sufficiently obvious character is thus afforded, by which to distinguish the tree when deprived of its leaves. The roots, when taken from the earth, are of a beautiful red color; but they lose this tint upon being split and exposed to the light in a dry place. The concentric layers, and the medullary rays are also observed to be much more distinct in the roots than in the body of the tree. This wood, in seasoning, becomes of a dull red: its grain is fine and close, and it is susceptible of a brighter polish than the wood of the beech, to which it bears some resemblance. Its concentric circles are divided into numerous sections, by fine, medullary rays extending from the centre to the circumference. When a trunk is sawn in a direction parallel to these rays, they appear larger than when it is cut parallel to the concentric circles. It would seem then that the division should be made in the intermediate direction, so that the spots may be of a proper size and at equal distances, which gives an elegant surface to the wood. Cabinet makers rarely make use of this wood, on account of its liability to warp, except for bedsteads, which retain the color of the wood and are coated with varnish. This wood speedily decays when exposed to the atmosphere, hence it is only proper for work that is sheltered from the weather; when thoroughly seasoned, it may be usefully employed in the interior of houses for joists, and for sheathing the frame. It never is used in naval architecture.

POPULUS.

Diœcia Octandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

CAROLINIAN POPLAR. *Populus angulata.*

The lower part of Virginia is the most northern point at which this species of poplar is found, and here it is less common than in the Carolinas, in Georgia and in Lower Louisiana. It grows of preference on the marshy banks of the great rivers which traverse these states, and is peculiarly abundant on the Mississippi, from the ocean to the mouth of the Missouri, and along the Missouri for 100 miles from the junction of these streams, which, in following their windings, is a distance of 1500 miles.

Among the numerous species of poplar of the United States, this is one of the most remarkable for its size, being sometimes 60 feet in height with a proportional diameter and an expansive summit garnished with beautiful foliage. The leaves, from the moment of their unfolding, are smooth and brilliant, but they differ widely in conformation, at different ages of the plant; on sprouts and young stocks they are seven or eight inches long and as much in breadth in the widest part, heart-shaped and rounded at the base, with the principal ribs of a reddish color; on trees five or six inches in diameter, and thirty or forty feet in height, they are only one-fourth as large, particularly on the higher branches, and their base is nearly straight, and at right angles with a petiole. These leaves are thin, smooth, of a fine green tint, marked with yellowish nerves and edged with obtuse teeth, which are fine towards the summit and coarser near the base. The long petiole compressed in the upper part renders them easy to be agitated by the wind. On sprouts and young stocks the annual shoots are very thick, distinctly striated and of a green complexion spotted with white; on branches of the second, third and even to the eighth year, the traces of the furrows are still observable: they are indicated by prominent, red lines in the bark terminating at the insertion of young shoots, which ultimately disappear with the growth of the branches

This character also belongs to the cotton tree, but, besides the difference of their general appearance, the two species are distinguished by their buds; those of the Carolinian poplar are short, of a deep green, and destitute of the resinous, aromatic substance, which covers those of the cotton wood, and of which the vestiges remain till late in the season. The Carolinian poplar blooms in March or April.

The wood of this tree is white, soft and considered unfit for use either for fuel or in the arts.

COTTON TREE. *Populus argentea.*

This species is scattered over a great extent of country, comprising the Middle, Western and Southern States. But it is so rare as to escape the notice of their inhabitants, and it has received a specific name only on the banks of the river Savannah, in Georgia, where it is called *Cotton Wood*. The same denomination is applied also to the Carolinian poplar which grows in the same place. In New Jersey, not far from the city of New York may be considered the most northern point at which this tree grows. It is also found in Virginia, but less commonly than on the banks of some of the rivers which traverse the maritime parts of the more Southern States. It is still more abundant in the Western Country. Near the junction of the Ohio with the Mississippi, M. Michaux mentions a swamp six miles in diameter, which is entirely covered with these trees.

The cotton tree is sometimes 70 or 80 feet in height and 2 or 3 feet in diameter. On trunks of these dimensions the bark is very thick and deeply furrowed. The young branches and annual shoots are round, instead of being angular like those of the Carolinian poplar and of the cotton wood. The leaves while very young, are covered with a thick, white down, which gradually disappears, leaving them perfectly smooth above and slightly downy beneath. They are borne by long petioles, are often six inches in length and as much in breadth, of a thick texture, denticulated and heart-shaped, with the lobes of the base lapped

so as to conceal the junction of the petiole. The aments are drooping and about three inches long as those of the Carolinian poplar. They put forth in the month of April.

The wood of the cotton tree is soft, light, unfit for use, and inferior to that of the white, the Virginian and the Lombardy poplar. The heart is yellowish, inclining to red, and the young branches are filled with a pith of the same color. It is appropriated to no particular use in the arts or for fuel.

COTTON WOOD. *Populus canadensis*.



PLATE LXX.
Figure 1. A leaf.

This species, like the Virginian poplar, has long been known in Europe. It was probably introduced into France from Canada; such at least is its origin indicated by the name of *Canadian Poplar*. This tree grows in the upper part of the state of New York on the banks of the river Genessee which empties into Lake Ontario, in some parts of Virginia and on several islands of the Ohio. It is generally found on the margin of rivers in a fat, unctuous soil, exposed

to inundation at their overflowing in the spring.

On the banks of the Genessee, where the winter is rigorous, the cotton wood is 70 or 80 feet in height and three or four feet in diameter. The leaves are deltoid, or trowel-shaped, approaching to cordiform, always longer than they are broad, glabrous and equally toothed: the petioles are compressed and of a yellowish green, with two glands of the same color at the base: the branches are angular, and the angles form whitish lines, which persist even the adult age of the tree. The female

aments are six or eight inches long, flexible and pendulous. The seeds are surrounded with a beautiful plume which has the whiteness of cotton, and the young buds are coated with a resinous, aromatic substance of an agreeable odor.

The cotton wood is a more picturesque tree than the Virginian poplar, particularly when growing on the sides of rivers. Its trunk is very plainly sulcated even in its old age. It is less so than the Carolinian poplar, but far more so than the Virginian poplar, whose trunk is rounder and its summit more spherical. Hence the two species are easily distinguished. The cotton wood, also, acquires a larger bulk. This wood is assigned to no particular use in the arts or for fuel.

HEART-LEAVED BALSAM POPLAR. *Populus canadensis*.



PLATE LXXI.
Figure 1. A leaf.

In the state of Rhode Island, Massachusetts and New Hampshire, this tree, which is a genuine *Balsam Poplar*, is commonly seen growing before the houses, less as an ornament than as a shelter from the sun. It is not found in the forests of these states.

This tree attains the height of 40 or 50 feet, with a diameter of 18 or 20 inches. The trunk is clad in a smooth, greenish bark. The foliage is tufted and of a dark green tint, but the

irregular disposition of the branches gives an elegant appearance to the tree. The buds, like those of the balsam poplar, are covered, in the spring, with a resinous, balsamic substance of an agreeable odor.

The wood of this tree is soft, light and is appropriated to no use in the arts and is little esteemed for fuel.

AMERICAN LARGE ASPEN. *Populus grandidentata.*

The American Large Aspen belongs rather to the Northern and Middle, than to the Southern States, in the upper parts only of which it is found. North of the United States, this poplar, though not one of the most rare, is not one of the most common trees, and it is so thinly scattered over the face of the country, that sometimes not a single stock is met with by the traveller for several days. For this reason, probably it has been confounded by the inhabitants with the American aspen, which is more multiplied: as it surpasses the aspen in height, we have given it the name of *Large Aspen*. It grows as favorably on uplands as on the borders of swamps.

This tree attains the height of about 40 feet with a diameter of 10 or 12 inches. The trunk is straight and covered with a smooth, greenish bark which is rarely cracked. Its branches are few and scattered; they ramify and become charged with leaves only at their extremity, so that the interior of the summit is void and of an ungrateful appearance. At their unfolding in the spring the leaves are covered with a thick, white down, which disappears with their growth, so that at the beginning of summer they are perfectly smooth. The full-formed leaf is nearly round, two or three inches in width, smooth on both sides, and bordered with large teeth, from which is derived the latin specific name of *grandidentata*. The flowers, which put forth in April, compose aments about two inches long that appear in the infancy of the leaves, and that, at this period, are thickly coated with down.

The wood is light, soft, and unequal to that of the Virginian and Lombardy poplars, and of little use.

AMERICAN BLACK POPLAR. *Populus hudsonica.*

This poplar is found principally on the banks of the river Hudson, above Albany and in the Canadas, and is a stranger to the other parts of the United States.

This tree seldom surpasses the height of 30 or 40 feet and a diameter of 12 or 15 inches. The bark of the young branches is of a grayish white, and the buds, which spring from the bosom of the leaves, are of a dark brown. One of the distinctive characters of this species is the hairiness of the young shoots and of the petioles in the spring, which is perceptible, also, on the back of the young leaves. The leaves are smooth, of a beautiful green color, denticulated, rounded in the middle, and acutely tapering towards the summit. When fully developed they are a little more than three inches long, about two inches broad, and, unlike the leaves of trees in general, they exhibit nearly the same shape from the moment of their unfolding. The aments are four or five inches long and destitute of the hairs which surround those of several other species.

The wood of the American black poplar is inferior to that of the Virginian and Lombardy poplars and consequently of little use.

VIRGINIAN POPLAR. *Populus monilifera*.

This poplar is indigenous to North America, though very rare, and is called *Virginian Poplar* and *Swiss Poplar*; the last of which denominations is owing only to its being abundantly multiplied in Switzerland.

This tree is 60 or 70 feet high with a proportional diameter. Its trunk is cylindrical, and not sulcated like that of the Lombardy poplar, and the bark upon old stocks is blackish. The leaves are nearly as long as they are broad, slightly heart-shaped, compressed towards the summit, obtusely denticulated and borne by long petioles. On large trees their mean length is from two and a half to three inches, but they vary in size, being twice as large on the lower limbs, and on young stocks growing in moist places. On trees equally vigorous and nourished by the same soil, the leaves of this species are observed to be only half as large as those of the cotton wood and Carolinian poplar. This tree has been and is still confounded with the cotton wood; but the principal difference between them is that the leaves of the

Virginian poplar are much smaller and less distinctly heart-shaped; the young shoots are smaller and less angular, and on high grounds those of the third year are even cylindrical; the limbs also diverge less widely from the trunk.

The wood of this tree is softer than that of the cotton wood, but its growth is more rapid and it prospers in a less humid soil. It is appropriated to no particular use in the arts.

AMERICAN ASPEN. *Populus tremuloides*.

This species of Poplar is common in the Northern and Middle sections of the United States, and is profusely multiplied in Lower Canada: in the vicinity of New York and Philadelphia, it prefers open lands of a middling quality.

The American aspen is ordinarily about 30 feet in height and five or six inches in diameter. The bark of the trunk is greenish and smooth, except on the base of the oldest trees, where it becomes furrowed. The leaves are about two inches broad, narrowed at the summit, and supported by long petioles; they are of a dark green color, and in the spring, their nerves are reddish: on stocks seven or eight feet in height, they are nearly round, and are bordered with obtuse, irregular teeth; on young shoots, they are of twice this size, heart-shaped, and acuminate at the summit. Of all the American poplars, this species has the most tremulous leaves, the gentlest air suffices to throw them into agitation. This tree blooms about the middle of April, about a fortnight before the birth of the leaves. The aments, which spring from the extremity of the branches, are composed of silky plumes, and are of an oval form and about two inches in length.

The wood of this tree is light, soft, destitute of strength and utility for timber or fuel. The wood is sometimes divided into *laminæ* for the fabrication of hats, which are much worn in the summer season.

QUERCUS.

Monœcia Polyandria. LINN. Amentaceæ. Juss. *Astringent, tonic, emollient.*

WHITE OAK. *Quercus alba.*

PLATE LXXI.

Fig. 1. A leaf. Fig. 2. The fruit.

Throughout the United States and Canada this tree is known by the name of *White Oak*. The environs of a small town of *Trois Rivières* in Canada, latitude $46^{\circ} 20'$, and the lower part of the river Kennebeck in the state of Maine are the most northern points at which this tree grows. Thence we trace it along the sea shore to a distance beyond Cape Canaveral, latitude 28 degrees, and westward from the ocean to Illinois, an extent of more

than 1200 miles from north-east to south-west. It is, however, by no means equally diffused over this vast tract; in the state of Maine, Vermont and Lower Canada, it is little multiplied, and its vegetation is repressed by the severity of the winter. In the lower part of the Southern States, in the Floridas and Lower Louisiana, it is found only on the borders of the swamps with a few other trees which likewise shun a dry and barren soil. The white oak is observed also to be uncommon on lands of extraordinary fertility, like those of Kentucky and Tennessee, and of all the spacious valleys watered by the western rivers. It abounds chiefly in the Middle States, particularly in that part of Pennsylvania and Virginia which lie between the Alleghanies and the Ohio, a distance of about 150 miles, where nine-tenths of the forests are

frequently composed of these trees, whose heathful appearance evinces the favorable nature of the soil. East of the mountains this tree is found in every exposure, and in every soil which is not extremely dry or subject to long inundations ; but the largest stocks grow in humid places. In the western districts, where it composes entire forests, the face of the country is undulated, and the yellow soil, consisting partly of clay with calcareous stones, yields abundant crops of wheat.

The white oak attains the elevation of 70 or 80 feet with a diameter of 6 or 7 feet ; but its proportions vary with the soil and climate. The leaves are regularly and obliquely divided into oblong, rounded lobes, destitute of points : the sections are deepest in the most humid soils. Soon after their unfolding they are reddish above and white and downy beneath ; when fully grown they are smooth and of a light green on the upper surface and glaucous beneath. In autumn they change to a bright violet color, and form an agreeable contrast with the surrounding foliage which has not yet suffered by the frost. This is the only oak on which a few of the dried leaves persist till the circulation is renewed in the spring. By this peculiarity and by the whiteness of the bark, from which it derives its name, it is easily distinguishable in the winter. This tree puts forth flowers in May which are succeeded by acorns of an oval form, large, very sweet, contained in rough, shallow, grayish cups, and borne singly or in pairs, by peduncles eight or ten lines in length, attached as in all species of annual fructification, to the shoots of the season. The fruit of the white oak is rarely abundant and frequently for several years in succession a few handfuls of acorns could hardly be collected in a large forest where the tree is multiplied. Some stocks produce acorns of a deep blue color.

The bark of the trunk of the white oak is often variegated with large, black spots. On stocks of less than sixteen inches in diameter the epidermis is divided into squares ; on old trees, growing in moist grounds, it is in the form of plates laterally attached. The wood is reddish, and very similar to that of the European oak, though lighter and less compact : in the American

species the vessels which occupy the intervals of the concentric circles are visibly less replete. But of all the American oaks, this is the best and the most generally used, being strong, durable, and of large dimensions. It is less employed than formerly in building, only because it is scarcer and more costly. The excellent properties of this wood cause it to be preferred for a great variety of uses, among which are many articles manufactured by the wheelwrights. White oak perfectly seasoned is employed for the frames of coaches, waggons and sledges, for the mould boards of ploughs, the felloes, spokes and naves of wheels. The wood of the young stocks is very elastic and is susceptible of minute division, hence it is preferred for large baskets used in harvesting, for the hoops of sieves, the bottoms of riddles and the handles of coach whips; for pail handles and axe helms. In many parts of the Middle States, the white oak is selected for the posts of rural fence. The bark is considered by many tanners as the best for preparing leather for saddles and other similar objects; it is little employed however, because the bark of the trunk and large limbs only is employed, and on these the cellular integument is much thinner in the white, than in the red and black oaks. The white oak furnishes staves of the best quality, of which are made casks for wine and spirituous liquors. The domestic consumption for this purpose is immense, and vast quantities are exported to the West Indies, Great Britain, and the islands of Madeira and Teneriffe. The young stocks are very elastic and are used for hoops. Among the uses of this wood, the most important is in ship building. In all the dock yards of the Northern and Middle States, except Maine, it is almost exclusively employed for the keel and always for the lower part of the frame and the sides: it is preferred for the knees when sticks of a proper form can be found. In the smaller ports south of New York, the upper part of the frame is also made of white oak; but such vessels are less esteemed than those constructed of more durable wood. The medicinal properties of oak bark depend on its astringency, and that again on its tannin. The inner bark of the small branches is the strongest, the middle bark next, and the outer bark is almost useless.

Internally it may be given in form of decoction, of infusion, or powder, as a tonic and astringent in leucorrhœa, menorrhagia, etc., and also in intermittents. Externally, as a styptic, astringent, and antiseptic, when sprinkled in form of a powder over gangrenous and ichorous ulcers. Inhaled in the form of impalpable powder it has been known to cure phthisic, even in its advanced stages.

GRAY OAK. *Quercus ambigua.*



PLATE LXXIII.

Fig. 1. A leaf. Fig. 2. The fruit.

The Gray Oak is found farther north than any other species in America; on the river St. Lawrence, between Quebec and Malabaie, in latitude $47^{\circ} 50'$ may be considered as its northern limit. Three degrees farther south in Maine and New Hampshire, and on the shores of Lake Champlain in Vermont, it is more multiplied. It is called by the inhabitants *Gray Oak*, but it has been confounded by botanists with the red oak, to which it bears a close

analogy in its foliage as it does to the scarlet oak in its fruit. On these resemblances is founded the latin specific name of *ambigua*.

In favorable situations it attains the height of 50 or 60 feet with a diameter of 15 or 18 inches. The leaves are large, smooth, and deeply sinuated at right angles to the main rib. The flowers put forth in the month of May, which are succeeded by acorns of a middling size, rounded at the end, and contained in scaly cups.

The wood of the gray oak is similar to that of the other species included under the common name of *Red Oak*. Its coarse and

open texture renders it unfit for any use except to contain dry wares ; but in districts where oak wood is rare, recourse is had for other purposes, to several species of inferior quality, which are still preferred to the birch, the beech and the pine. Thus the gray oak is employed for the knees of vessels and for cartwrights' work ; it is even preferred to that of the red oak, as being stronger and more durable.

WATER OAK. *Quercus aquatica.*

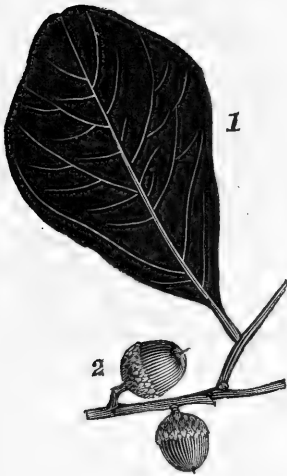


PLATE LXXIV.

Fig. 1. A leaf. Fig. 2. The fruit.

The Water Oak abounds in Virginia, the lower part of the Carolinas and Georgia and in East Florida. Under the name of *Water Oak* it is sometimes confounded with *Willow Oak*, by which it is always accompanied in the ponds and narrow swamps inclosed in the *pine-barrens*.

This tree is inferior in size to the willow oak, and rarely exceeds 40 or 45 feet in height, and 12 or 18 inches in diameter. On full-grown trees the leaves are smooth, shining, and heart-shaped or

broad and rounded at the summit and terminated in an acute angle at the base. In the severe climate of Virginia they fall with the first frost, but on the sea-shore of the Carolinas, Georgia, and Florida, they persist during two or three years. There is no oak in the United States of which the foliage is so variable and so different from that of the tree, on the young stocks and on the sprouts from an old trunk or from the base of a limb that has been lopped : the leaves are commonly oval and deeply and irregularly toothed. The flowers appear in the month of May,

and are followed by acorns, which are contained in shallow, slightly scaly cups; they are brown, small and extremely bitter. This tree fructifies once in two years.

The bark upon the oldest trunks of the water oak is smooth and very slightly furrowed; it is little used in tanning, either because it is inferior to that of the Spanish oak, or because the tree is less abundant. The wood is very tough, but less durable and less esteemed by carpenters and wheelwrights than that of the white oak and chesnut white oak.

BEAR OAK. *Quercus banisteri*.

This diminutive species is known in the Northern and Middle States by the name of *Bear Oak*, *Black Scrub Oak* and *Dwarf Oak*, of which the first is most common in New Jersey, where it is abundant. This shrub is common in New York, New Jersey, Pennsylvania, particularly on that part of the Alleghanies which is crossed by the road to Pittsburgh. It is seldom found insulated or mingled with other trees in the forests, but always in tracts of many acres, which it covers almost exclusively.

The ordinary height of the bear oak is 3 or 4 feet; but when accidentally insulated and nourished by a vein of more fertile soil, it sometimes equals eight or ten feet. It usually grows in compact masses, which are traversed with difficulty, though no higher than the waist. As the individuals which compose them are of an uniform height, they form so even a surface that at a distance the ground appears to be covered with grass instead of shrubs. The stem, which is numerously ramified, is covered, like the branches, with a polished bark. It has more strength than would be supposed from its size, which is rarely more than an inch in diameter. The leaves are of a dark green color on the upper surface, whitish beneath, and regularly divided into three or five lobes. The flowers appear in May, and it fructifies once in two years. The acorns are small, blackish, and longitudinally marked with a few reddish lines: they are so abundant as sometimes to cover the branches; the lowly stature of the

shrub renders it easy for bears, deer and swine to reach them by lifting their heads or rising on their hinder feet.

The presence of this oak is considered as an infallible index of a barren soil, and it is usually found on dry, sandy land mingled with gravel. It is too small to be adapted to any use in the arts or for fuel. It might probably be usefully adopted in the Northern States for hedges, which might be formed by sowing the acorns in furrows from twenty to twenty-four inches thick, which in a few years would be sufficient to prevent the passage of horses and cattle.

UPLAND WILLOW OAK. *Quercus cinera*.

The Upland Willow Oak is confined to the maritime parts of the Southern States. It is little multiplied in comparison with many other species, and is dispersed in small groups in the forests of white pine. It is found also upon the sea shore, and upon the islands where it covers tracts of several acres still more barren than the main. But the stocks which grow in these different situations are so different in appearance that they might easily be mistaken for distinct species.

In the *pine-barrens* this tree is 18 or 20 feet high, and 4 or 5 inches in diameter. The leaves are two inches and a half long, entire and whitish beneath; on the islands and on the shore of the continent, where the soil is extremely dry, they are only three or four feet in height, and the leaves are denticulated, are an inch in length, and persist for two years. Its fructification is biennial and it flowers in the month of May. The acorns, which are contained in shallow cups, are round and blackish with the base of a bright rose color when freshly exposed.

The upland willow oak is one of those object trees that succeed the pines on lands which have been cleared for cultivation and abandoned on account of their sterility. In these places as in the *pine-barrens*, it is 20 feet in stature, and its trunk, which is covered with a thick bark, begins at a third of this height to divide itself by numerous ramifications. In the spring it is

distinguished at a distance by the reddish color of its leaves and male aments.

The bark of this species, like that of the black oak, affords a beautiful yellow dye; but the tree is so small and so little multiplied that it is of no utility in this respect, not even for fuel.

BARENS SCRUB OAK. *Quercus catesbæi*.

This species is principally confined to the lower part of the Carolinas and Georgia. It grows in soils too meagre to sustain any other vegetation, such as the vicinity of Wilmington in North Carolina, where the light, moveable sand is wholly destitute of vegetable mould. It is the only species multiplied in the *pine-barrens*, and from this circumstance it seems to have derived its name.

The ordinary height of this tree is 20 or 25 feet with a diameter of six or eight inches. Its foliage is open, and its leaves are large, smooth, thick and coriaceous towards the close of summer, deeply and irregularly lacinated, and supported by short petioles. With the first frost they change to a dull red, and fall the ensuing month. It blooms in May and fructifies once in two years. The acorns are pretty large, of a blackish color, and partly covered with a fine, gray dust, which is easily rubbed off between the fingers: they are contained in thick cups, swollen towards the edge, with the upper scales bent inwards.

In the winter it is difficult to distinguish the scrub oak from the black jack oak, which it nearly resembles. Like that, it is crooked, ramified at the height of two or three feet, and covered with a thick, blackish, deeply-furrowed bark: it is, besides, perfectly similar in the color, texture and weight of the wood. This tree is considered as the best of fuel, and its size alone would exclude it from use in the arts.

SCARLET OAK. *Quercus coccinea*.

PLATE LXXV.

Fig. 1. A leaf. Fig. 2. The fruit.

The Scarlet Oak is first seen in the vicinity of Boston, but it is less multiplied than in New Jersey, Pennsylvania, Virginia, and the upper part of the Carolinas and Georgia, where it forms a part of the forests that are still standing. It is a stranger to Maine, New Hampshire and Vermont. In the Northern States it is confounded with the red oak, and in those of the south, with the Spanish oak.

This is a vegetable of more than 80 feet in height and of three or four feet in diameter. The leaves, which are supported by long petioles, are of a beautiful green, shining on both sides, and lacinated in a remarkable manner, having usually four deep sinuses very broad at the bottom. They begin to change with the first cold, and, after several successive frosts, turn to a bright scarlet color, instead of a dull hue like those of the red oak. At this season the singular color of the foliage forms a striking contrast with that of the surrounding trees, and is itself a sufficient inducement to cultivate the tree for ornament. It flowers in May, and fructifies once in two years. The acorns are large, somewhat enongated, similarly rounded at both ends, and half covered with scaly cups. As this fruit varies in size with the quality of the soil, it is difficult to distinguish it from the black oak; the only constant difference is in the kernel, which is yellowish in the black oak and white in the species which we are considering.

The bark of the scarlet oak is very thick and generally

employed in tanning, though it is in no respect preferable to that of the gray and red oaks. The wood of this tree is reddish and coarse-grained, with open pores. As it decays much more rapidly than the white oak, it is employed by the builder and wheelwright only for necessity or economy. It is poor fuel, and is used principally for staves. In the Middle States, a large part of the *red oak staves* are furnished by this species. From this tree is obtained those excrescences which afford the galls of commerce.

SPANISH OAK. *Quercus falcata*.



PLATE LXXVI.
Fig. 1. A leaf. Fig. 2. The fruit.

This species first makes its appearance in New Jersey near Allentown, about sixty miles from Philadelphia. Farther south it is constantly found among the most common trees in the forests. It is less multiplied near the mountains, and in the country beyond them. In Delaware, Maryland and Virginia, it is known only by the name of *Spanish Oak*, and in the Carolinas and Georgia by that of *Red Oak*. It is said to have been called *Spanish Oak* by the first settlers,

from the resemblance of its leaves to those of the *Quercus velani* which grows in Spain. The denomination of *Red Oak* which is used only in the more Southern States, was probably given on account of the great analogy between its wood and that of the species thus called in the Northern and Middle States, where the Spanish oak is much less common than in the south.

This tree is more than 80 feet in height, and 4 or 5 feet in diameter. Its leaves are very different on different individuals ;

thus in New Jersey, where the tree is only thirty feet high and four or five inches thick, they are three lobed, except a few on the summit, and not falcated as on the large stocks in the Southern States. On young plants, and on the lower branches of the most vigorous stocks growing in moist and shaded situations, they are also trilobed; and on the upper limbs they are more acutely lacinated, with the sections more arching than those represented in the figure. One of their constant characters is a thick down upon the lower side of the leaves and upon the young shoots to which they are attached. This tree fructifies once in two years. Its flowers put forth in May and are succeeded by small, round acorns, of a brown color, and contained in slightly scaly, shallow cups supported by peduncles one or two lines in length. They resemble those of the bear oak, and, like them, preserve for a long time the capability of germination.

The bark upon the trunk of the Spanish oak is blackish and deeply furrowed, with a cellular integument of middling thickness. The wood is reddish and coarse-grained, with empty pores, and all the characteristic properties of the species known in commerce by the general name of *Red Oak*: hence its staves are fit only to contain molasses, salted provisions and dry goods. From its want of durability, this oak is less esteemed than the white oak, the post oak and other species of annual fructification. It is rarely employed in building, and is used by cartwrights in preference to white oak for the felloes of large wheels. Its bark is preferred to that of most other species of oak for tanning coarse leather, which it renders whiter and more supple; the leather is said to be improved by the addition of a small quantity of the bark of the hemlock spruce.

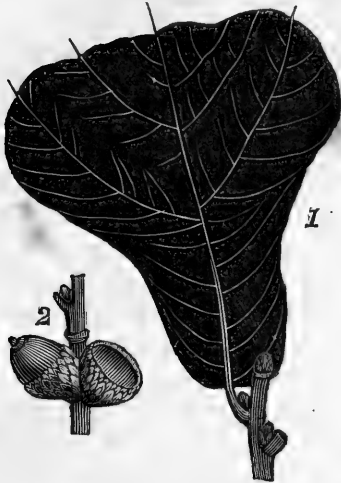
BLACK JACK OAK. *Quercus ferruginea.*

PLATE LXXVII.

Fig. 1. A leaf. Fig. 2. The fruit.

The Black Jack Oak is first seen near Allentown in New Jersey; but it is smaller and less multiplied in this place than farther south. In New Jersey and Pennsylvania it is called *Barrens Oak*, and *Black Jack Oak* in Maryland and the more Southern States. This species is commonly found upon soils composed of red, argillaceous sand mingled with gravel, and so meagre as to be totally exhausted by five or six crops, when they are thought worthy of cultivation.

The black jack oak is sometimes 30 feet high and 8 or 10 inches in diameter, but commonly does not exceed half these dimensions. Its trunk is generally crooked, and is covered with a very hard, thick and deeply-furrowed bark, of which the epidermis is nearly black, and the cellular integument of a dull red. The summit is spacious even in the midst of the woods. The leaves are yellowish, and somewhat downy at their unfolding in the spring; when fully expanded, they are of a dark green above, rusty beneath, thick, coriaceous, and dilated towards the summit like a pear. In autumn they turn reddish, and fall with the earliest frost. This tree fructifies once in two years. The flowers are put forth in the month of May and are succeeded by large acorns, half covered with scaly cups.

When the stock of this tree is more than eight inches in diameter, the wood is heavy and compact; but coarse-grained and porous before it has reached this size. As it speedily decays when exposed to the weather, it is not used in the arts, but it forms excellent fuel.

BARTRAM OAK. *Quercus heterophylla*.

Every botanist who has visited the different regions of the globe must have remarked certain species of vegetables which are so little multiplied that they seem likely at no distant period to disappear from the earth. To this class belongs the Bartram oak. Several foreign and American naturalists have spent years in exploring the United States, and have found no traces of this species except a single stock in a field belonging to M. Bartram, on the banks of the Schuylkill, four miles from Philadelphia. This is a flourishing tree upwards of 30 feet in height and a foot in diameter, and seems formed to attain a much greater developement. Its leaves are of an elongated, oval form, coarsely and irregularly toothed, smooth above, and of a dark green beneath. The acorns are round, of a middling size, and contained in shallow cups slightly covered with scales. This tree bears a great affinity to the laurel oak ; but the leaves of that species are never indented, like those of the Bartram oak. Several young plants have been generated from the original stock which are now growing in the gardens of Europe and this country which will insure the preservation of the species.

LAUREL OAK. *Quercus imbricaria*.

PLATE LXXVIII.

Fig. 1. A leaf. Fig. 2. The fruit.

East of the Alleghanies this species is rare, and has received no specific name; west of the mountains, where it is more multiplied and has attracted more attention, it is called *Jack Oak*, *Black Jack Oak*, and sometimes from the form of the leaves, *Laurel Oak*. The last denomination we have preserved as the most appropriate, though perhaps it is less common than the first. This tree is a stranger north of Pennsylvania and is rare in the more Southern States.

It is found abundantly only beyond the mountains in some parts of Kentucky and Tennessee and in the country of Illinois where it is profusely multiplied, and it is called by the French of that country *Chene a lattes*, lath oak. In the western parts of Pennsylvania and Virginia, small lawns, covered only with tall grass, are frequently seen in the forests, around which the laurel oak forms entire groves: insulated stocks are also found in cool, humid situations. It is probably from its flourishing in open exposures that it is most abundant in the country of the Illinois, which consists of immeasurable *savannas* stretching in every direction, to which the forests bear no sensible proportion.

The laurel oak is 40 or 50 feet high, and 12 or 15 inches in diameter. Its trunk even when old, is clad in a smooth bark, and, for three-fourths of its height, is laden with branches. It has an uncouth form when bared in the winter, but is beautiful in the summer when clad with its thick, tufted foliage. The leaves are long, lanceolate, entire, of a light, shining green and

pubescent beneath. It flowers in the month of May, and is succeeded by acorns of a sub-globose form. It fructifies once in two years.

The wood is hard and heavy, though its pores are open. As the trunk is branchy and often crooked, it is considered as fit only for fuel on the eastern side of the mountains. In the country of Illinois where it attains much greater dimensions, it is employed for shingles, probably for the want of a better species, for the wood is inferior to that of the willow oak, which it nearly resembles.

OVER-CUP OAK. *Quercus lyrata*.

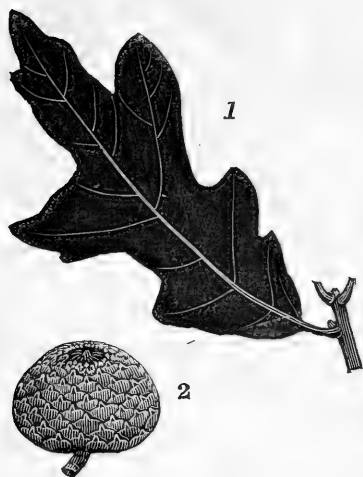


PLATE LXXIX.
Fig. 1. A leaf. Fig 2. The fruit.

This interesting species exists in the lower part of the Carolinas and Georgia, on the banks of the Mississippi in Lower Louisiana and in East Florida. In Georgia and the Carolinas it is not extensively multiplied, and has been distinguished only by the inhabitants of the places where it grows. It is called *Swamp Post Oak*, *Over-Cup Oak* and *Water White Oak*. The name of *Over-Cup Oak* is the most common in South Carolina, and that of *Swamp Post Oak*

on the Savannah in Georgia. This tree grows in more humid situations than any other species of this genus in the United States. It is never seen in the long, narrow marshes which intersect the *pine-barrens*, but is found exclusively in the great swamps on the borders of the rivers, which are often overflowed at the rising of the waters, and are inaccessible during three-fourths of the year.

This oak expands to a majestic size, and the influence of a deep and constantly humid soil is shown in the luxuriancy of its vegetation. On the banks of the Savannah it attains the elevation of 80 feet with a circumference of 8 to 12 feet. The leaves are six or eight inches long, smooth, narrow, lyre-shaped, deeply sinuated, and borne by short petioles. The lobes, particularly the two upper ones, are truncated, and from their resemblance in this respect to those of the post oak, is derived the name of *Swamp Post Oak*. The foliage is thick and of a light, agreeable tint. It fructifies annually and flowers in the month of May. The acorns, unlike those of the oaks in general which are of an elongated, oval shape, are broad, round and depressed at the summit: they are sometimes from 12 to 18 lines from the base to the summit. The cup, which is nearly closed, is thin, and its scales are terminated by short, firm points.

The bark upon the trunk is white, and the wood, though inferior to that of the white oak and the post oak, is more compact than would be supposed from the soil in which it grows; the pores are observable only between the concentric circles, and are more regularly disposed than in other trees.

OVER-CUP WHITE OAK. *Quercus macrocarpa*.

PLATE LXXX.

Fig. 1. A leaf. Fig. 2. The fruit.

This interesting species is most multiplied beyond the Alleghanies, in the fertile districts of Kentucky and West Tennessee, and in Upper Louisiana near the Missouri. It is called by the Americans *Bar Oak* and *Over-Cup White Oak*, and by the French of Illinois, *Chene a gros gland*.

This is a beautiful tree, more than 60 feet in height, laden with a dark, tufted foliage. The leaves are larger than those of any other oak in the United

States, being frequently fifteen inches long and eight broad : they are notched near the summit, and deeply lacinated below. It fructifies annually and flowers in May. The acorns, which are also larger than those of any other American species, are oval and inclosed for two-thirds of their length in a thick, rugged cup, bordered with fine, flexible filaments. Sometimes, however, in compact forests, or in very temperate seasons, the filaments do not appear, and the edge of the cup is smooth and bent inwards.

The fructification of this tree is not abundant, and as its wood is inferior to that of the white oak, it is little esteemed in the United States.

POST OAK. *Quercus obtusiloba*.

PLATE LXXXI.

Fig. 1. A leaf. Fig. 2 The fruit.

In New Jersey near the sea, and in the vicinity of Philadelphia, this species is thinly disseminated in the forests, and was formerly considered as a variety of the white oak. In Maryland and a great part of Virginia, where it abounds, and where its properties are better understood, it is called *Box White Oak*, and sometimes *Iron Oak* and *Post Oak*. The last denomination only is used in the Carolinas, Georgia and East Tennessee. The steep banks of the

Hudson in the vicinity of New York are the most northern points where it grows. Even here its existence seems to be secured only by the influence of the sea air, which tempers to a certain degree the severity of the winter. A little farther inward it is not found in the forests. In the vicinity of South Amboy, thirty miles nearer the sea, where the soil is dry and sandy, it is more multiplied, and it still becomes more vigorous and more common in advancing towards the south. Near Baltimore, it abounds in the woods and attains its utmost expansion. In Kentucky and Tennessee it is rare, except on the edges of the swamps inclosed in the forests, about which it is multiplied though not fully developed. It is likewise found in Lower Louisiana and East Florida. But it is nowhere more abundant than in Maryland and in Virginia, between the Alleghanies and the sea. Wherever the soil is dry, gravelly and unsubstantial, it forms a considerable portion of the forests. The upper part of the Carolinas and Georgia, particularly where the pine and oak forests unite, is

analogous in soil, and abounds in the post oak ; but nearer the sea the oak becomes rare and is only seen in the lowest parts of the swamps, about the plantations, and on tracts that have been exhausted by cultivation and abandoned.

The height of the post oak rarely exceeds 40 or 50 feet, with a diameter of 15 inches. Its summit, even when compressed in the forests, is disproportionably large, owing probably to an early division of the trunk into several limbs, with which the secondary branches form more open angles than is common on other trees. The branches are also bent into elbows at certain distances, which give so peculiar an appearance to the tree that it is easily distinguished when the leaves are fallen. The bark upon the trunk is thin and of a grayish white. The leaves are borne by short petioles, and are divided into four or five rounded lobes, of which the two nearest the summit are the broadest ; they are coriaceous, of a dusky green above and grayish beneath. Toward autumn the ribs are of a rosy tint, instead of a purplish red like those of the scarlet oak. The fructification is annual and seldom fails. It puts forth flowers in May, which are followed by small, oval acorns, covered for a third of their length, with a slightly rugged, grayish cup. They are very sweet, and form a delicious food for squirrels and wild turkeys ; hence the tree is sometimes called *Turkey Oak*.

The wood of this tree is yellowish, with no tint of red. Growing upon a less humid soil it is less elastic, but finer-grained, stronger and more durable, than the white oak : hence it is preferred for posts, and it is used with advantage by wheelwrights and coopers. In ship building it is used principally for the knees, and is admitted into the lower part of the frame. It rarely furnishes side planks or timber of considerable length, for this reason it is less esteemed than the white oak. The staves made of this tree are preferable to those of the white oak.

MOSSY-CUP OAK. *Quercus olivæformis*.

PLATE LXXXII.

Fig. 1. A leaf. Fig. 2. The fruit.

This species is very rare and little known except in the state of New York on the banks of the Hudson above Albany, in Genessee, and in the northern part of Pennsylvania.

This tree is 60 or 70 feet in height, with a spacious summit and an imposing aspect. The bark is white and laminated; but the tree is chiefly remarkable for the form and disposition of its secondary branches, which are slender, flexible, and always inclined towards the

earth. Its leaves are of a light green above and whitish beneath; they resemble those of the white oak in color, but differ from them in form, being larger, and very deeply and irregularly lacinated, with rounded lobes so various in shape that it is impossible to find two leaves that are alike. Its fructification is annual. The flowers appear in May and are succeeded by acorns of an elongated, oval form, and are inclosed in cups of nearly the same configuration, of which the scales are prominent and recurved, except near the edge, where they terminate in slender, flexible filaments: from this peculiarity is derived the name of *Mossy-Cup Oak*.

The wood of this tree is not better than that of the white oak, though far superior to that of the red oak.

PIN OAK. *Quercus palustris*.

PLATE LXXXIII.

Fig. 1. A leaf. Fig. 2. The fruit.

This species is found in Massachusetts, but is less common than in the vicinity of New York, in New Jersey, Pennsylvania and Maryland. It is abundant beyond the mountains, in Ohio, East Tennessee and the country of the Illinois. It is said not to exist in Maine, Vermont and the Southern States. It is called *Pin Oak* in the lower part of New York, and in New Jersey, and *Swamp Spanish Oak*, in Pennsylvania, Delaware and Maryland. The last of these

denominations is sufficiently appropriate; but we have preferred the second, because it is less liable to mistake, and is indicative of a characteristic arrangement of the branches.

The pin oak is a tall tree, which grows constantly in moist places, and of preference about the swamps inclosed in the forests. In these situations it is frequently more than 80 feet high and 3 or 4 feet in diameter. Its secondary branches are more slender and more numerous than is common in so large a tree, and are intermingled so as to give it at a distance the appearance of being stuffed. This singular disposition renders it distinguishable at first sight in the winter. These small limbs die as the tree advances, which gives the tree the appearance of having pins or trunnels driven into it: whence the name of *Pin Oak*. The leaves are smooth, of a pleasing green, supported by long petioles, deeply lacinated and very similar to those of the scarlet oak, from which they differ principally in their proportions. This tree fructifies once in two years. The flowers put forth in

the month of May and are succeeded by small, round acorns, contained in flat, shallow cups, of which the scales are closely applied one upon another.

The bark upon the oldest trunk is scarcely cracked, and consists almost wholly of a very thick, cellular integument. The wood is coarse-grained, with the pores open and larger than those of the scarlet and red oaks: though stronger and more tenacious than those species, it is little esteemed for durability. It is used for the axletrees of mill wheels when white oak of sufficient dimensions cannot be procured; it is also sometimes, though rarely, made into staves, as the species is little multiplied compared with the scarlet, red and black oaks.

WILLOW OAK. *Quercus phellos.*

This species which is remarkable for its foliage, makes its first appearance in the environs of Philadelphia; but it is more common and of a larger size in Virginia, the Carolinas and Georgia, where the milder temperature of the winter is evidently favorable to its growth. It is seen, however, only in the maritime parts of those states, where the surface is mountainous and the climate more severe. From the analogy of soil and climate, it is probably found in Lower



PLATE LXXXIV.
Fig. 1. A leaf. Fig. 2. The fruit.

Louisiana. It commonly grows in cool, moist places on the borders of swamps.

The willow oak, in favorable situations, attains the height of 50 or 60 feet with a diameter of 20 or 24 inches. The trunk, even

at an advanced age, is covered with a smooth bark, remarkable for the thickness of its cellular integument. The leaves are two or three inches long, of a light green, smooth, narrow, entire, and similar to those of the willow, whence is derived the name of *Willow Oak*, which is used in every part of North America where the tree is known. This tree fructifies once in two years. It flowers in May and bears acorns of a dark brown color, which are small, bitter and contained in shallow cups slightly coated with scales.

The wood is reddish and coarse-grained. It is too porous to contain wine or spirituous liquor, and its staves are classed with those of red oak. The quantity, however, is small, as the tree is so little multiplied that alone it would not supply the consumption for two years. It possesses great strength and tenacity, and splits more readily than the white oak; hence after being thoroughly seasoned, it is employed for the felloes of wheels. These are the principal uses to which it seems adapted, and for these it is less proper than the post oak and white oak. It is sometimes employed in Georgia for fencing the plantations, and lasts only eight or nine years. As fuel, it is very little esteemed.

YELLOW OAK. *Quercus prinus acuminata.*

PLATE LXXXV.

Fig. 1. A leaf. Fig. 2. The fruit.

The banks of the Delaware may be assumed as the northern limit of the Yellow Oak. It scarcely exists in the maritime parts of the Southern States. In the Middle and Western States, though more common, it is still rare in comparison with many other trees, and is sometimes lost sight of by the traveller for several days in succession. It is also found in the country of the Illinois. It is invariably found in valleys where the soil is loose, deep and fertile.

The Yellow Oak is a fine tree 70 or 80 feet high and 2 feet in diameter, with branches tending rather to close round the trunk than to diffuse themselves horizontally. The bark upon the trunk is whitish, very slightly furrowed, and sometimes divided into plates, like that of the swamp white oak. The leaves are lanceolate, regularly toothed, of a light green above and whitish beneath. It fructifies annually and blooms in the month of May. The acorns are contained in scaly cups and are sweeter than those of any other species in the United States.

The wood of this tree is yellowish, though the tint is not bright enough to fit it for peculiar uses. Its pores are partly obliterated, irregularly disposed, and more numerous than those of any other American oak: this organization must impair the strength and render it less durable than the chesnut white oak, and the rock chesnut oak. As this tree is so thinly disseminated it has not been appropriated to any particular use in the arts.

SMALL CHESNUT OAK. *Quercus prinus chinquapin.*

In the Northern and Middle States this pretty little species is called *Small* or *Dwarf Chesnut Oak*, from the resemblance of its leaves to those of the rock chesnut oak ; as there is also a likeness between its foliage and that of the chinquapin, it is known in East Tennessee and in the upper part of the Carolinas by the name of *Chinquapin Oak*. This tree is not generally diffused, but is rare in many places adapted to its constitution, and is usually found in particular districts, where, alone, or mingled with the bear oak, it sometimes covers tracts of more than 100 acres. The presence of these species is a certain proof of the barrenness of the soil. It is found in Rhode Island, New York, Pennsylvania and in Virginia on the Alleghanies.

This species and another which is found in the pine forests of the Southern States rarely exceeds 30 inches in height : they are the most diminutive of the American oaks. The leaves are oval-acuminate, regularly but not deeply denticulated, of a light green above and whitish beneath. Its fructification is annual, and its flowers put forth in May and are followed by acorns of a middling size, somewhat elongated, similarly rounded at both ends, inclosed for one-third of their length in scaly, sessile, cups : they are very sweet.

Nature seems to have sought a compensation for the diminutive size of this shrub in the abundance of its fruit : the stem which is sometimes no bigger than a quill, is stretched at full length upon the ground by the weight of the thickly-clustering acorns. United with the bear oak, which is of the same size and equally prolific, perhaps it might be cultivated with advantage for its fruit.

SWAMP WHITE OAK. *Quercus prinus discolor*.

PLATE LXXXVI.

Fig. 1. A leaf. Fig. 2. The fruit.

This species is known in the United States only by the name of *Swamp White Oak*, which indicates at once the soil which it prefers and its analogy to the white oak. Except the state of Maine and the maritime parts of the Southern States, it is diffused throughout the Union: in comparison, however, with some other species, it is not common.

The swamp white oak is a beautiful tree more than 70 feet in height, of which the vegetation is vigorous and the foliage luxuriant. The leaves are six or eight inches long and four inches broad, smooth and of a dark green above, downy and lighter colored beneath; they are entire towards the base, which is cuneiform, but are widened and coarsely toothed for two-thirds of their length towards the summit. The tree is distinguished, when young, by the form of its base and by the down upon the leaves, which is more sensible to the touch than on any analogous species. At a riper age the lower side of the leaf is of a silvery white, which is strikingly contrasted with the bright green of the upper surface; hence the specific name of *discolor*. This tree is of annual fructification and flowers in the month of May. The acorns are sweet, but seldom abundant; they are rather large, of a brown complexion, and contained in a spreading cup edged by short, slender filaments, more downy within than those of any other oak, and supported by peduncles one or two inches in length.

The trunk of this tree is clad in a scaly, grayish-white bark. The wood is strong, elastic and heavier than that of the white oak. In stocks more than a foot in diameter the grain is fine and close, and the pores are nearly obliterated. It splits easily and in a straight line, and is esteemed next in quality to the white oak, though from its rareness it is but accidentally employed in the arts.

ROCK CHESNUT OAK. *Quercus prinus monticola*.



PLATE LXXXVII.

Fig. 1. A leaf. Fig. 2. The fruit.

This oak is among the species which are not scattered promiscuously in the forests, but which grow only in particular situations and easily escape observation; hence it is difficult to assign its limits with precision. It probably does not extend north beyond Vermont, nor eastward beyond New Hampshire; it is likewise a stranger to the maritime parts of the Southern States. It is most frequently met with in the Middle and in some parts of the Northern

States; but it is rarely mingled with other trees in the forests, and is found only on high grounds thickly strewed with stones or covered with rocks. In Pennsylvania, Virginia and Maryland, it is known by the name of *Chesnut Oak*, and by that of *Rock Oak* on the banks of the Hudson and the shores of Lake Champlain. Both are significant; the first, of a remarkable resemblance of the bark to that of the chesnut; and the second, of the situations, in which the tree is exclusively found. For this reason and to avoid confounding it with the chesnut oak and the yellow oak, we have blended the two denominations.

The rock chesnut oak is sometimes 3 feet in diameter, and more than 60 feet high ; but as its growth is usually repressed by the poverty of the soil, it rarely attains these dimensions. In open, elevated situations it spreads widely, and forms a head like that of the apple tree. The beautiful appearance of this tree when growing in a fertile soil, is owing equally to the symmetry of its form and to the luxuriance of its foliage. The leaves are five or six inches long, and three or four broad, oval and uniformly denticulated, with the teeth more regular but less acute than those of the chesnut oak. When beginning to open in the spring, they are covered with a thick down ; but, when fully expanded, they are perfectly smooth, whitish beneath, and of a delicate texture. The petiole is of a yellow color, which becomes lighter towards autumn. The fructification of this tree is annual. The flowers appear in the month of May, and are succeeded by brown acorns of an oblong-oval shape, and sometimes an inch in length, a third part of which is contained in a spreading cup covered with loose scales : they are sweet-tasted and are a favorite nourishment of wild and domesticated animals.

When the trunk of this tree exceeds a foot in diameter, it is covered with a thick, hard, deeply-furrowed bark, which is esteemed in some parts of the United States for tanning. That of the secondary branches and of stocks of less than six inches thick is commonly employed. The epidermis is strongly impregnated with the tanning principle, which in other species resides only in the cellular integument. The wood is reddish like that of the white oak, but its pores are more open, though its specific gravity is greater : pieces of both species being thrown into water, the white oak remains on the surface and the other at the bottom. Its staves are not used to contain spirituous liquors. At New York and on the banks of the Hudson, it holds the next place to the white oak in the construction of vessels. It is employed for the lower part of the frame, and oftener for the knees and the ribs. For fuel this wood is next in price to the hickory.

CHESNUT WHITE OAK. *Quercus prinus palustris*.

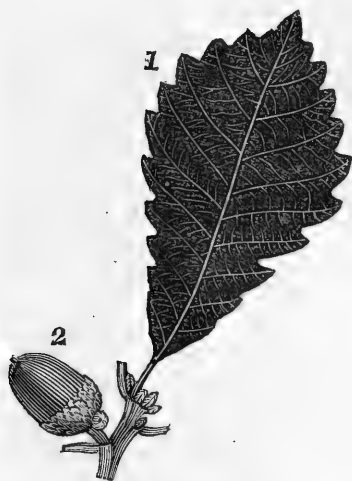


PLATE LXXXVIII.

Fig. 1. A leaf. Fig. 2. The fruit.

The Chesnut White Oak is first seen in the vicinity of Philadelphia; but it is less multiplied and less amply developed than farther south. It is most abundant in the maritime parts of the Carolinas, Georgia and East Florida, and is probably found on the banks of the Mississippi, which are analogous to those of many rivers of the Southern States. In Pennsylvania this species is confounded with the rock chesnut oak, which it strikingly resembles; farther

south, where the rock chesnut oak is unknown, it is called *Chesnut White Oak*, *Swamp Chesnut Oak*, and generally on the Savannah *White Oak*. This tree grows only in large swamps that border the rivers or are inclosed in the forests; but it always prefers spots that are rarely inundated, where the soil is loose, deep, constantly cool and luxuriantly fertile.

Under favorable circumstances the chesnut oak arrives at the height of 90 feet with a proportional diameter. Its straight trunk, undivided and of an uniform size to the height of 50 feet, and its expansive tufted summit, form one of the most beautiful and majestic trees of the North American forests. Its leaves are eight or nine inches long, four or five inches broad, obovate, deeply toothed, of a light, shining green above and whitish beneath. Its fructification is annual. The flowers make their appearance in May and are followed by brown, oval acorns, larger than those of any other species except the over-cup white oak, and are contained in shallow, scaly cups. Being sweet-flavored,

and sometimes abundant, they are sought with avidity by wild and domesticated animals.

The wood, which is affected by the richness of the soil, is inferior to that of the post oak, the white oak and even that of the over-cup oak; and its pores, though nearly obliterated, are more open. But it is superior to many other species, and is employed for wheelwrights' works and for other objects which require strength and durability. As it splits in a straight line, and may be divided into fine shreds it is chosen by the Negroes for baskets and brooms. Its pores are too open to contain wine or spirituous liquors. In the form of rails it lasts twelve or fifteen years, or a third longer than the willow oak. It is highly esteemed as fuel.

RUNNING OAK. *Quercus pumila*.

This species is the smallest oak hitherto discovered in the known world. Like the upland willow oak, it is confined to the maritime parts of the Carolinas, Georgia and the Floridas, where it is called *Running Oak*. It springs with that species in the *pine-barrens*, amidst the numerous varieties of whortleberry and other plants which overspread the ground wherever there is a little moisture in the soil and the layer of vegetable mould is a few inches thick.

The running oak rarely rises more than 20 inches in height and 2 lines in diameter. The leaves are of a reddish tint in the spring, and turn green as the season advances. When fully developed they are entire, smooth, of an elongated, oval shape, and about two inches in length. It fructifies once in two years and flowers in the month of May. The acorns are small, round and similar to those of the willow and water oaks; they are few in number, and seldom arrive at maturity. No particular use is made of this shrub either in the mechanic arts or for medicine.

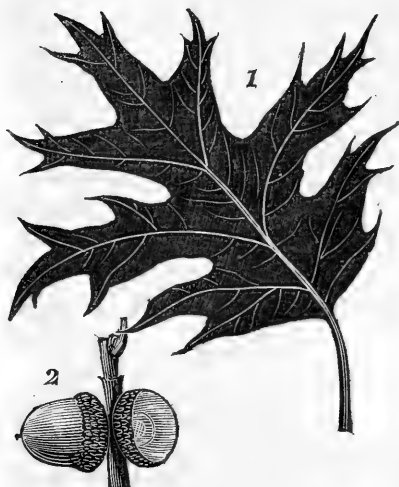
RED OAK. *Quercus rubra*.

PLATE LXXXIX.

Fig. 1. A leaf. Fig. 2. The fruit.

Next to the gray oak this species is found in the highest latitude of all the American oaks, and is one of the most common species in the Northern States and Canada. Farther south, particularly in the lower part of New York, New Jersey, the upper districts of Pennsylvania, and along the whole range of the Alleghanies, it is nearly as abundant as the scarlet and black oaks; but it is much less common in Maryland, the lower part of Virginia, and the maritime

parts of the Carolinas and Georgia. Its perfect developement requires a cool climate and a fertile soil. It is universally known by the name of *Red Oak*, except in some parts of Pennsylvania, where it is sometimes confounded with the Spanish oak.

The red oak is a tall, wide-spreading tree, frequently more than 80 feet high, and 3 or 4 feet in diameter. Its leaves are smooth and shining on both sides, large and deeply lacinated, and rounded at the base; they are larger and have deeper and narrower sections on the young stocks than on the middle or the summit of the full-grown tree; these last resemble the leaves of the Spanish oak, which, however, are always downy beneath, while those of the red oak are perfectly smooth. In autumn they change to a dull red, and turn yellow before they fall. The fructification is biennial and it flowers in May. The acorns are very large and abundant, rounded at the summit, compressed at the base, and contained in flat cups covered with narrow, compact scales. They are voraciously eaten by wild and domesticated animals.

The bark of this tree consists of a very thin epidermis with a thick cellular integument. It is extensively used in tanning, but is less esteemed than that of the Spanish, black and rock chesnut oaks. The wood is reddish and coarse-grained, and the pores are often large enough for the passage of a hair: it is strong but not durable, and is the last among the oaks to be employed in building. Its principal use is for staves, which, at home, are used to contain salt provisions, flour, and other dry wares. It is little esteemed for fuel.

BLACK OR QUERCITRON OAK. *Quercus tinctoria*.



PLATE XC.

Fig. 1. A leaf. Fig. 2. The fruit.

Except the state of Maine, the northern part of New Hampshire, Vermont and Tennessee, this species is found throughout the United States on both sides of the Alleghanies and is every where called *Black Oak*, except in some parts of New England, where it is called *Yellow Oak*. It is more abundant in the Middle States, and in the upper parts of the Carolinas and Georgia, than on the southern coast. It flourishes in a poorer soil than the white

oak. In Maryland and certain districts of Virginia, where the soil is lean, gravelly and uneven, it is constantly united in the forests with the scarlet, Spanish and post oaks, and mockernut hickory, with which the yellow pine is also frequently mingled. There are several varieties of this species of oak, all of which afford the quercitron bark, so highly esteemed in dyeing, staining, tanning, etc.

This oak is one of the loftiest trees of the American forests, being 80 or 90 feet high and 4 or 5 feet in diameter. The trunk is covered with a deeply furrowed bark of middling thickness, and generally of a black or very deep-brown color, whence probably is derived the name of *Black Oak*. North-east of Pennsylvania the complexion of the bark is the only character by which it can be distinguished from the red, scarlet and gray oaks, when the leaves are fallen. Farther south this character is not sufficient to distinguish it from the Spanish oak, whose bark is of the same color, and recourse must be had to the buds, which on the black oak are longer, more acuminate, and more scaly. All doubt may be removed by chewing a bit of the cellular integument of each : that of the black oak is very bitter and gives a yellow tinge to the saliva, which is not the case with the other. The leaves are large, deeply lacinated, and divided into four or five lobes : they resemble those of the scarlet oak, but have less deep and open sinuses, are less shining, of a duller green, and in the spring and during a part of the summer have their surface roughened with small glands which are sensible to the eye and to the touch. The same appearance is observed on the young shoots, the leaves which change in the autumn to a dull red, and those of the old trees to yellow, beginning with the petiole. This tree fructifies once in two years and its flowers put forth in May. The acorns generally grow in clusters, are of a brown color, sub-sessile and about half buried in a thick, scaly cup. This species is more remarkable than any other for producing the oak apple.

The wood is reddish and coarse-grained, with empty pores ; it is, however, more esteemed for strength and durability than that of any other oak of biennial fructification. As it is abundant in the Middle and Northern States, it furnishes a large proportion of the *red oak staves* exported to the West Indies, or employed at home to contain flour, salted provisions and molasses. It is said to furnish the best of fuel except the hickories. The bark is extensively used in tanning, as it is easily procured and is rich in tannin. The only inconvenience which attends it is imparting a yellow color to the leather, which must be discharged by a

particular process, to prevent its staining the stockings : it is a great error to assert that this color augments its value. From the cellular integument of the black oak is obtained the *quercitron*, of which great use is made in dyeing wool, silk and paper hangings. This substance was first prepared as a dye by Dr. Bancroft ; he has given it the name of *quercitron*, by which it is now universally recognized.

Before extracting the color from the bark, the epidermis, or external covering, ought to be removed by shaving. The remaining parts being then properly ground by mill stones, separate partly into a light, fine powder, and partly into stringy filaments or fibres, which last yield but about half as much color as the powder, and therefore care should be always taken to employ both together, and as nearly as possible in their natural proportions, otherwise the quantity of color produced may either greatly exceed or fall short of what may be expected. The *quercitron* thus prepared and proportioned, says Dr. Bancroft, will generally yield as much color as eight or ten times its weight of the weld plant, and about four times as much as its weight of the chipped fustic. The coloring matter, continues he, most nearly resembles that of the weld plant ; with this advantage, however, that it is capable alone of producing more cheaply all, or very nearly all, the effects of every other yellow dyeing drug ; and, moreover, some effects which are not attainable by any other means yet known. The coloring matter of *quercitron* readily dissolves in water, even at a blood heat. If the infusion be strained and left at rest, a quantity of resinous matter subsides in the form of a whitish powder, which produces the same effects in dyeing as the part remaining in solution. The clear effusion being evaporated and dried, affords an extract equal in weight to about one twelfth of the bark from which it is obtained. Much care, however, must be employed in procuring this extract, so as to make it produce colors equal in beauty to those obtained directly from the bark itself. If the evaporation be carried on rapidly, and the heat be too great, the color is tarnished, probably, as Dr. Bancroft conjectures, from the absorption of oxygen, the color thus undergoing a sort of semi-combustion. On the other

hand, if the evaporation be conducted too slowly, the coloring matter suffers another change, and soon spoils by keeping. The decoction of quercitron is of a yellowish-brown color, which is darkened by alkalies, and brightened by acids. A solution of alum being added to it, separates a small proportion of the coloring matter, which subsides in the form of a deep yellow precipitate. The solutions of tin produce a more copious precipitate, and of a beautiful, lively, yellow color. Sulphate of iron causes a copious olive precipitate; sulphate of copper, a yellow of an olive cast. To dye wool, it is sufficient to boil the quercitron with an equal weight of alum: in dipping the stuff the deepest shade is given first, and afterwards the straw color: enliven the tint the stuff may be passed, in coming out of the dye through water whitened with a small portion of chalk: but a brighter color is obtained by means of a solution of tin. Quercitron may be substituted for woad, in imparting all the shades of yellow to silk. It is highly valuable as an article of commerce, which has often been sold at \$40 or \$50 a ton. Large quantities are annually exported into Europe from the ports of the Middle States.

LIVE OAK. *Quercus virens*.

PLATE XCI.

Fig. 1. A leaf. Fig. 2. The fruit.

This species which is confined to the maritime parts of the Southern States, the Floridas and Louisiana, is known only by the name of *Live Oak*. The climate becomes mild enough for its growth near Norfolk in Virginia, though it is less multiplied and less vigorous than in a more southern latitude. From Norfolk it spreads along the coast for a distance of fifteen or eighteen hundred miles, extending beyond the mouth of the Mississippi. The sea

air seems essential to its existence, for it is rarely found in the forests upon the main land, and never more than fifteen or twenty miles from the shore. It is most abundant, the most fully developed, and of the best quality, about the bays and creeks, and on the fertile islands which in great numbers lie scattered for several hundred miles along the coast.

The live oak is commonly 40 or 50 feet in height, and from one to two feet in diameter; but it is sometimes much larger. Like most other trees, it has, when insulated, a wide and tufted summit. Its trunk is sometimes undivided for 18 or 20 feet, but often ramifies at half this height, and at a distance it has the appearance of an old apple tree or pear tree. The leaves are oval, coriaceous, of a dark green above and whitish beneath: they persist during several years, and are partially renewed every spring. On trees reared upon plantations, or growing in cool soils, they are one half larger, and are often denticulated: upon stocks of two or three years they are commonly very distinctly

toothed. It fructifies once in two years. The flowers make their appearance in the month of May, which are succeeded by acorns of a lengthened, oval form, nearly black, and contained in shallow, grayish, pedunculated cups.

The bark upon the trunk of this tree is blackish, hard and thick. The wood is heavy, compact, fine-grained, and of a yellowish color, which deepens as the tree advances in age. The number and closeness of the concentric circles evince the slowness of its growth. As it is very strong, and incomparably more durable than the best white oak, it is highly esteemed in ship building, and is consumed not only in the country which produces it, but still more extensively in the Northern States. From its great durability when perfectly seasoned it is almost exclusively employed for the upper part of the frames of vessels. To compensate its excessive weight it is joined with the red cedar, which is extremely light and equally lasting. This tree does not afford large timber; but its wide and branching summit makes amends for this disadvantage by furnishing a great number of knees, of which there is never a sufficient quantity in the dock yards. This wood is said to make the best of trunnels. It is also employed for the naves and felloes of heavy wheels, for which it is superior to the white oak: it is more proper, also, for screws and for the cogs of mill wheels. The bark is excellent for tanning, but is only accidentally employed, and its wood is highly esteemed for fuel.

RHODODENDRON.

Decandria Monogynia. LINN. Rhododendræ. JUSS. *Tonic, narcotic.*

DWARF ROSE BAY. *Rhododron maximum.*

The Dwarf Rose Bay is found on Long Island and the river Hudson below the *highlands*, in the state of New York and in Dedham, Massachusetts; but these places may be considered far beyond the limits where this shrub ceases to be found in the forests. It is abundant, on the contrary, in the Middle States,

and in the upper parts, particularly in the mountainous tracts of the Southern States. It is almost exclusively seen on the borders of creeks and rivers, and is observed to be more multiplied in approaching the Alleghanies, till, in the midst of these ranges, especially in Virginia, it becomes so abundant on the sides of the torrents, as to form impenetrable thickets, in which the bear finds a secure retreat from the pursuit of the dogs and the hunters. Deeply-shaded situations, in the vicinity of cool and crystal waters flowing among rocks, where the atmosphere is laden with vapor, are the most congenial to its growth. Shade and humidity seem indispensable to the growth of this shrub.

The dwarf rose bay generally presents itself in the form of a shrub, less than 10 feet in height; but it sometimes attains the height of 20 or 25 feet with a diameter of 4 or 5 inches. When the leaves are beginning to unfold themselves they are rose-colored, and covered with red down; when fully expanded they are smooth, five or six inches long, of an elongated-oval form, and of a thick, coriaceous texture. They are evergreen, and are partially renewed once in three or four years. It puts forth flowers in the month of June and July, which are commonly rose-colored, with yellow dots on the inside, and sometimes they are perfectly white. They are always collected at the extremity of the branches in beautiful groups, which derive additional lustre from the foliage which surrounds them. The seeds are extremely minute, and are contained in capsules that open in autumn, for their escape.

The wood is hard, compact and fine-grained; but it is inferior in these respects to that of the mountain laurel. This wood is appropriated to no particular use in the arts.

ROBINIA.

Diadelphia Decandria. LINN. Leguminosæ. JUSS. *Aperient, diuretic, emollient.*

LOCUST. *Robinia pseudo acacia.*

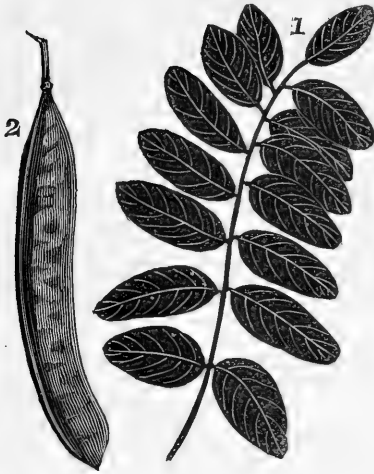


PLATE XCII.

Fig. 1. A leaf. Fig. 2. Apod.

From the excellent properties of its wood, and the beauty of its foliage and flowers, the Locust ranks in the first class of the trees of the American forests. In the Atlantic States, it begins to grow naturally in Pennsylvania, between Lancaster and Harrisburgh, in the latitude of $40^{\circ} 20'$. West of the mountains, it is found two or three degrees farther north; which is explained by an observation already repeated, that, in proceeding towards the west, the climate

becomes milder and the soil more fertile. But the locust is most multiplied in the south-west, and abounds in all the valleys between the chains of the Alleghany Mountains, particularly in *Lime Stone Valley*. It is also common in all the Western States, and in the territory comprised between the Ohio, the Illinois, the lakes and the Mississippi. It is not found in the states east of the river Delaware, nor does it grow spontaneously in the maritime parts of the Middle and Southern States, to the distance of from 50 to 100 miles from the sea, all the stocks that are seen in these parts having been planted at different periods. The soil in which it appears to thrive best, is a light and somewhat sandy loam in situations having a southern aspect.

The dimensions of the locust vary with the soil and climate : thus in Pennsylvania, between Harrisburgh and Carlisle, where it begins to appear, it is much smaller than in Virginia, and particularly in Kentucky and West Tennessee, which are situated two or three degrees farther south, and where the soil is more fertile. In these states it sometimes exceeds four feet in diameter, and 70 or 80 feet in height ; which is twice the size it attains east of the mountains. On the trunk and large limbs of the old locust, the bark is very thick and deeply furrowed. The young tree, till it attains the diameter of two or three inches, is armed with formidable thorns, which disappear in its mature age. The foliage is light and agreeable to the eye. Each leaf is composed of opposite leaflets, eight, ten, or twelve, and sometimes more in number, surmounted by an odd one. The leaflets are nearly sessile, oval, thin, of a fine texture, and of so smooth a surface that the dust is blown off from them as it alights. These leaves are rarely injured by insects. The flowers, which open in the month of May, are disposed in numerous, pendulous bunches : they are perfectly white, and diffuse the most delicious odor. Their fine effect, heightened by the fresh tint of the light green foliage, renders this tree one of the most admired in Europe among the ornamental trees. To the flower succeeds a narrow, flat pod, about three inches long, containing five or six small seeds, which are commonly brown, and sometimes black.

The wood of the locust, which is commonly of a greenish-yellow color, marked with brown veins, is very hard, compact, and susceptible of a brilliant polish ; it is possessed of great strength with but little elasticity. Its most valuable property is that of the power of resisting decay longer than almost any other species of wood. In naval architecture the shipwrights use as much locust wood as they can procure. It is as durable as the live oak and the red cedar, with the advantage of being stronger than the one and lighter than the other. It enters, with the live oak, the white oak and the red cedar, into the upper and the lower parts of the frame, though in a very small proportion. It is also used for the *trunnels*, or the pins destined to attach the *side planks* to the frame. Instead of decaying they acquire with

time an extreme hardness, and they are used, to the exclusion of all others, in the ports of the Middle and Northern States. In the construction of houses, even of such as are wholly of wood, the locust is not extensively employed in those parts of the country where it is the most multiplied : the use to which it is more particularly applied is to support the *sills* or the beams on which the frame rests. These sills are of oak, and if they were placed immediately on the ground, they would decay more rapidly than the locust. From the hardness of the wood when seasoned, from the fineness of its grain, and its lustre when polished, it has been extensively substituted by turners for the box wood in many species of light work, such as small domestic wares, toys, etc. It is highly esteemed for posts of fence and for fuel. This invaluable property of durability, which is possessed by this tree in a great degree far superior to that of any other except the red mulberry, sufficiently indicates the purposes to which it may be advantageously applied ; but its use is limited to the objects which we have enumerated.

There are said to be several varieties of the locust growing in the United States ; those trees are reputed the best whose heart is red ; the next in esteem are those with a greenish-yellow heart ; and the least valuable are those with a white heart. From this variety in the color of the wood, which probably arises from a difference of soil, are derived the names of *Red*, *Green* and *White Locust*. In the Western States there is a variety which is sometimes called *Black Locust*.

ROSE-FLOWERING LOCUST. *Robinia viscosa.*

PLATE XCIII.

Fig. 1. A leaf. Fig. 2. A pod.

This species of locust is found only on that part of the Alleghanies which traverses Georgia and the Carolinas in these states west of the mountains. It probably does not exist beyond the 35th degree of latitude, nor in any of the lower parts of the Southern States; hence it appears to be confined to a very small tract.

The rose-flowering locust is not so large as the preceding species; its ordinary stature does not exceed 40 feet, with a diameter of 10 or 12 inches. Its branches, like those of the locust, are garnished with thorns, which, however, are smaller and less numerous. The annual shoots are of a dull-red color, and are covered with a viscid, adhesive humour. The foliage is thick and of a dusky green. The leaves are five or six inches long, and are composed of opposite leaflets, ten, twelve, or more in number, with a terminal odd one. The leaflets are about an inch in length, oval, nearly sessile, smooth, and of a fine texture. The flowers are in open bunches, four or five inches long. They are numerous and of a beautiful rose color, but destitute of fragrance. This tree not unfrequently blooms twice in a year, and it would form one of the most brilliant ornaments of the park and of the garden. The seeds are small and contained in hairy pods two or three inches long, and three or four lines broad.

The wood of this tree is of a greenish color, like that of the common species, which it resembles also in its other properties: but the inferior size of the tree, notwithstanding its surprisingly rapid growth, renders it less interesting to the arts.

SALIX.

Diœcia Diandria. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

CHAMPLAIN WILLOW. *Salix ligustrina.*

This willow is found on the shores of Lake Champlain, particularly near the village of Skeensborough. It is about 25 feet high and 7 or 8 inches in diameter: its first aspect resembles that of the black willow, but its leaves are longer, narrower, and accompanied at the base by cordiform, serrate stipulæ. Its wood and branches are appropriated to no particular use.

SHINING WILLOW. *Salix lucida.*

This tree is found only in the Northern and Middle States. It is found in moist but open grounds, and is more common on the edges of the *salt meadows* than in the interior of the forests; it is also seen on the islands, not covered with woods, in the rivers and near the shores of the lakes.

The shining willow attains the height of 18 or 20 feet; but its ordinary elevation is 9 or 10 feet. This species is easily distinguished by the superior size of its leaves, which are oval-acuminate, denticulated, and sometimes four inches in length, brilliant and shining, hence its name.

Baskets are made of the branches of this tree, when those of the European willow, which are preferable, cannot be obtained; but it possesses no property that recommends it to attention.

BLACK WILLOW. *Salix nigra*.

PLATE XCIV.
Figure 1. The leaves.

This species is the most common of the American willows. It is less multiplied in the Northern and Southern than in the Middle and especially in the Western States. It is found on the banks of the great rivers, such as the Susquehannah and the Ohio, and is called *Black Willow* or simply *Willow*.

This tree is rarely more than 30 or 35 feet high and 12 or 15 inches in diameter. It divides at a small height into several divergent but

not pendant limbs, and forms a spacious summit. The leaves are long, narrow, finely denticulated, of a light green, and destitute of stipulæ. In the uniformity of its coloring the foliage of this species differs from that of the European willow, the lower surface of which is glaucous.

Upon the trunk the bark is grayish and finely chapped; upon the roots it is of a dark brown, whence may have been derived the specific name of the tree. The roots afford an intensely bitter decoction, which is considered in the country as a purifier of the blood, and as a preventative and a remedy for intermittent fevers.

THUJA.

Monœcia Monadelphia. LINN. Coniferæ. JUSS. *Expectorant, secernant, stimulant.*

AMERICAN ARBOR VITÆ. *Thuja occidentalis.*

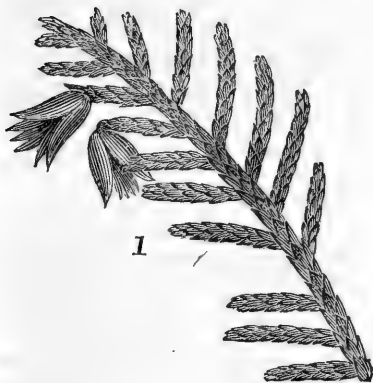


PLATE XCV.
Fig. 1. A leaf with cones.

This species of *Thuja*, the only one that has been discovered in America, is the most interesting of the genus for the properties of its wood. The shores of Lake St. John in Canada may be considered as its northern limit. It abounds in favorable situations between the parallels of $48^{\circ} 50'$ and 45° ; farther south it becomes rare, and solitary stocks are seen only on the sides of torrents and on the banks of certain rivers, as on the Hudson amidst the

highlands, along the Erie canal from Rome to Montezuma, and near the *rapids* of the Potomac in Virginia. Goat's Island, round which the Niagara divides itself to form the stupendous cataract which is one of the most wonderful spectacles of nature, is seen from the banks of the river to be bordered with the arbor vitæ. In Canada and the northern parts of the United States this tree is called *White Cedar*, but in the state of Maine it is frequently designated by the name of *Arbor Vita*, which we have preferred, though less common, because the other is appropriated to the *Cupressus thyoides*. In Lower Canada, New Brunswick, Vermont and the state of Maine, the arbor vitæ is the most multiplied of the resinous trees, after the black and hemlock spruces. A cool soil seems to be indispensable to

its growth. It is never seen upon the uplands, among the beeches, birches, etc., but is found on the rocky edges of the innumerable rivulets and small lakes which are scattered over these countries, and occupies in great part, or exclusively, swamps from 50 to 100 acres in extent, some of which are accessible only in the winter when they are frozen and covered with several feet of snow. It abounds exactly in proportion to the degrees of humidity, and in the driest marshes it is mingled with the black and hemlock spruces, the yellow birch, the black ash, and a few stocks of white pine. In all of them the surface is covered with a bed of *sphagnum* so thick and surcharged with moisture that the foot sinks half-leg deep while the water rises under its pressure.

The arbor vitæ is 45 or 50 feet in height and sometimes more than 10 feet in circumference; usually, however, it is not more than 10 or 15 inches in diameter at five feet from the ground. A full-grown tree is easily distinguished by its shape and foliage. The trunk tapers rapidly from a very large base to a very slender summit, and is laden with branches for four-fifths of its height. The principal limbs, widely distant and placed at right angles with the body, give birth to a great number of drooping, secondary branches, whose foliage resembles that of the white cedar. On the borders of the lakes, where it has room and enjoys the benefit of the light and air, it rises perpendicularly, grows more rapidly and attains a greater size than when crowded in the swamps, where its thick foliage intercepts the light and impedes the circulation of the air. In swamps its trunk is rarely straight, but forms the arc of an ellipse or less inclined. Its sides swell into two large ridges, which are a continuation of the principal roots. The foliage is evergreen, numerously ramified, and flattened or spread. The leaves are small, opposite, imbricated scales; when bruised they diffuse a strong, aromatic odor. The sexes are separate upon the same tree. The male flowers, which appear in the month of May, are in the form of small cones: to the female blossoms succeeds a yellowish fruit about four lines in length, composed of oblong scales, which open through their

whole length for the escape of several minute seeds surmounted by a short wing.

The bark upon the body is slightly furrowed, smooth to the touch and very white when the tree stands exposed. The wood is reddish, somewhat odorous, very light, soft and fine-grained : in the northern part of the United States and in Canada it holds the first place for durability. From the shape of the trunk it is difficult to procure sticks of considerable length and an uniform diameter ; hence in the state of Maine it is little employed for the frame of houses, though in other respects proper for this object, and still less for the covering. It is softer than white pine, and gives a weaker hold to nails, for which reason the Canadians always join it with some more solid wood. The most common use of this tree is for rural fence, for which it is highly esteemed. The posts last 35 or 40 years, and the rails 60, or three or four times as long as those of any other species. The posts subsist twice as long in argillaceous as in sandy lands. While the usage of such fences continue the utmost economy should be practised in cutting the arbor vitæ according to the rules prescribed for resinous trees. In Canada it is selected for the light frame of bark canoes. Its branches garnished with leaves are formed into brooms, which exhale an agreeable, aromatic odor. Kalm affirms that the leaves, pounded and moulded with hog's lard, form an excellent ointment for the rheumatism.

TILIA.

Polyandria Monogynia. LINN. Tiliaceæ. JUSS. *Aperient, emollient.*

WHITE LIME. *Tilia alba.*

The White Lime is not met with east of the river Delaware, but it is abundant in Pennsylvania, Maryland, Delaware and the Western States. It does not grow like the bass wood, in elevated places nor amidst the other trees of the forests, and is rarely seen except on the banks of rivers ; it is particularly observed on those of the Susquehannah, the Ohio, and the streams which flow into them.

The height of the white lime tree rarely exceeds 40 feet, and its diameter 12 or 18 inches. Its young branches are covered with a smooth, silver-gray bark, by which it is recognized in the winter. The leaves are very large, denticulated, obliquely heart-shaped and pointed, of a dark green on the upper surface and white beneath, with small, reddish tufts on the angles of the principal nerves. This whitish tint is most striking on solitary trees exposed to the sun. The flowers come out in June, and, as well as the floral leaf, are larger than those of any other lime tree. The petals are larger and whiter, and are impregnated with an agreeable odor. The seeds are round, or rather oval, and downy.

The wood of this tree is white and tender, and is seldom appropriated to any use in the arts.

AMERICAN LIME OR BASS WOOD. *Tilia Americana.*

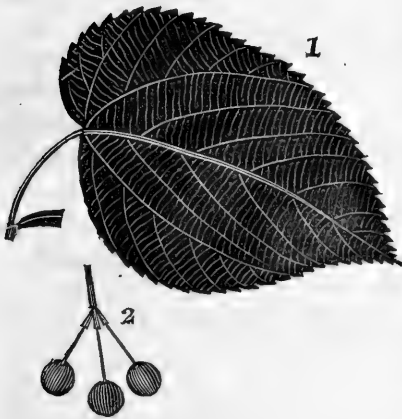


PLATE XCVI.

Fig. 1. A leaf. Fig. 2. The fruit.

Among the lime trees of North America east of the Mississippi, this species is the most multiplied. It exists in Canada, but is more common in the northern parts of the United States, where it is usually called *Bass Wood*; it becomes less frequent towards the south, and in Virginia, the Carolinas and Georgia, it is found only on the Alleghany Mountains. It is profusely multiplied in Genessee which borders on Lake Erie and Lake Ontario. It generally

grows on a loose, deep, fertile soil.

The lime tree, in situations favorable to its growth, sometimes attains the elevation of more than 80 feet with a proportional

diameter, and its straight, uniform trunk, crowned with an ample and tufted summit, forms a beautiful tree. In newly-cleared lands the remains of these trees are distinguished by the numerous sprouts which cover the stumps, and the large roots, whose growth can be prevented only by stripping off the bark or by the operation of fire. The leaves of this tree are alternate, large, nearly round, finely denticulated, heart-shaped at the base, and abruptly terminated in a point at the summit. The flowers put forth in the month of June, and are borne by long peduncles, are pendulous, subdivided at the extremity, and garnished with a long, narrow, floral leaf. The seeds, which are ripe about the first of October, are round and of a gray color.

The trunk is covered with a very thin bark; the cellular integument, separated from the epidermis and macerated in water, is formed into ropes; in Europe they are used for well cords. The wood of this tree is white and tender: in the Northern States, where the tulip tree does not grow, it is used for the panels of carriage bodies, and the seats of chairs; but as it is softer and splits more easily, it is less proper for these objects. On the Ohio the images affixed to the prow of vessels are made of this wood instead of the white pine. The flowers of this tree are probably endowed with the same antispasmodic and cephalic properties which are ascribed to those of the European species.

DOWNY LIME TREE. *Tilia pubescens.*

PLATE XCVII.

Fig. 1. A leaf. Fig. 2 The fruit.

The Downy Lime Tree belongs to the southern parts of the United States and the Floridas. It grows of preference on the borders of rivers and large marshes, where the soil is cool and fertile, but not exposed to inundation. It is little multiplied, and consequently, is not taken notice of by the inhabitants; for this reason, and because it is the only species of its kind in the maritime parts of the Carolinas and of Georgia, it has received no specific denom-

ination, and is simply called *Lime Tree*, to which we have added the epithet *Downy*, derived from a character of its foliage not observed in the preceding species.

This tree is 40 or 50 feet high with a proportionate diameter. In its general appearance it resembles the American lime tree, which grows farther north, more than the white lime tree, which belongs to the Middle and Western States. Its leaves differ widely in size according to the exposure in which they have grown; in dry and open places they are only two inches in diameter, and are twice as large in cool and shaded situations. They are rounded, pointed at the summit, very obliquely truncated at the base, edged with fewer and more remote teeth than those of the other lime trees, and very downy beneath. The flowers, which appear in June, also, are more numerous and form larger bunches, and the seeds are round and downy.

The wood is very similar to that of the other species, and is seldom appropriated to any use in the arts.

ULMUS.

Pentandria Digynia. LINN. Amentaceæ. JUSS. *Astringent, tonic, emollient.*

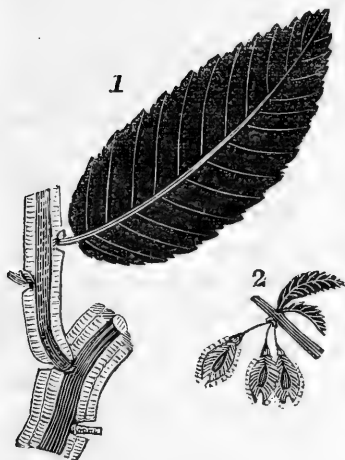
WAHOO. *Ulmus alata.*

PLATE XCVIII.

Fig. 1. A leaf. Fig. 2. The seed.

few exceptions, are the same. The name of *Wahoo*, given to this species of elm, in South Carolina and Georgia, is derived from the Indians. This tree grows of preference on the banks of rivers and in the great swamps inclosed in the *pine-barrens*.

The wahoo is of a middling stature, commonly not exceeding 30 feet, with a diameter of 9 or 10 inches. The branches are furnished throughout their whole length, on two opposite sides, with a fungous appendage, two or three lines wide, from which the name of *alata*, winged, has been given to the species. The leaves are borne by short petioles, and are oval, denticulated, and smaller than those of the white and red elms. The flowers, like those of other elms, open before the leaves. The seeds are fringed and differ from those of the white elm only by a little inferiority of size.

The Wahoo is a stranger to the Middle and Northern States, and to the mountainous regions of the Alleghanies; it is found only in the lower part of Virginia, in the maritime districts of the Carolinas and Georgia, in West Tennessee and in some parts of Kentucky. Probably it grows also in the Floridas and in Lower Louisiana, of which the soil and climate are analogous to those of the maritime parts of the Southern States, and of which the vegetable productions, with

The wood of this tree is fine-grained, more compact, heavier and stronger than that of the white elm. The heart is of a dull red approaching to chocolate color, and always bears a large proportion to the sap. In South Carolina, it is employed for the naves of coach wheels, and is preferred for this object, to the tupelo, as being harder and tougher; but it is appropriated to no other particular use.

WHITE ELM. *Ulmus americana.*



PLATE XCIX.

Fig. 1. A leaf. Fig. 2. The seed.

This tree which is known throughout the United States by the name of *White Elm*, is found over an extensive tract of North American continent. Towards the north it is first seen in about the latitude of $48^{\circ} 20'$, near the mouth of the river Mistassin, which empties into Lake St. John in Canada. It is abundantly multiplied from Nova Scotia to the extremity of Georgia, at a distance of 1200 miles. It is found also on banks of all the rivers of the Western

States. But it appears to be the most multiplied and of the loftiest height between the 42d and 46th degrees of latitude, which comprises the provinces of Lower Canada, New Brunswick and Nova Scotia, the New England States and Genessee in the state of New York. This tree delights in low, humid, substantial soils, such as in the Northern States are called *interval lands*. In the Middle States it grows in similar situations, and on the borders of swamps. West of the mountains it abounds in all the fertile bottoms watered by the great rivers that swell the Ohio and the Mississippi, where it attains superior dimensions.

In the Middle States, the white elm stretches to a great height, but does not approach the magnificence of vegetation which it displays in the countries peculiarly adapted to its growth. In clearing the primitive forests a few stocks are sometimes left standing; insulated in this manner, it appears in all its majesty, towering to the height of 80 or 100 feet, with a trunk 4 or 5 feet in diameter, regularly shaped, naked, and insensibly diminishing to the height of 60 or 70 feet, where it divides itself into two or three primary branches. The limbs, not widely divergent near the base, approach and cross each other eight or ten feet higher, and diffuse on all sides, long, flexible, pendulous branches, bending into regular arches and floating lightly in the air. A singularity in this tree which exists in no other; two small limbs four or five feet long grow in a reversed position near the first ramification, and descend along the trunk, which is covered with a white, tender bark very deeply furrowed. The leaves of this tree are four or five inches long, borne by short petioles, alternate, unequal at the base, oval-acuminate and doubly denticulated. They are generally smaller than those of the red elm, of a thinner texture and a smoother surface, with more regular and prominent ribs. It differs, also, essentially from the red and European elm in its flowers and seeds: it blooms in the month of April, previous to the unfolding of the leaves; the flowers are very small, of a purple color, supported by short, slender foot stalks, and united in bunches at the extremity of the branches. The seeds are contained in a flat, oval, fringed capsule, notched at the base: the season of their maturity is from the 15th of May to the first of June.

The wood of this tree, like that of the European elm, is of a dark brown, and, cut transversely or obliquely to the longitudinal fibres, it exhibits the same numerous and fine undulations; but it splits more easily, and has less compactness, hardness and strength. This wood is used at New York and farther north for the naves of coach wheels. It is not admitted into the construction of houses or of vessels, except occasionally in the state of Maine for keels, for which it is adapted only by its size. Its bark is easily detached during eight months of the year; soaked in water

and suppld by pounding, it is used in the Northern States for the bottoms of common chairs. The wood makes good fuel, and produces ashes strongly impregnated with the alkaline principle.

RED OR SLIPPERY ELM. *Ulmus rubra*.

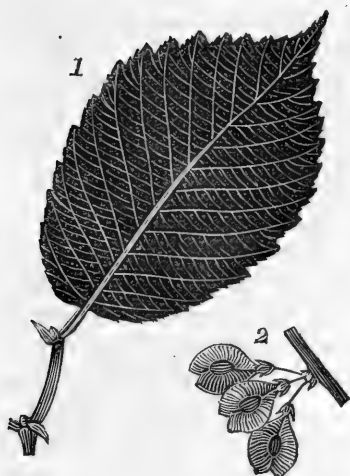


PLATE C.

Fig. 1. A leaf. Fig. 2. The seed.

Except the maritime districts of the Carolinas and Georgia, this species of elm is found in all parts of the United States and of Canada. It bears the names of *Red Elm*, *Slippery Elm* and *Moose Elm*, of which the two first are the most common. The French of Canada and Upper Louisiana call it *Orme gras*. This tree is less multiplied than the white elm, and the two species are rarely found together, as the red elm requires a substantial soil

free from moisture, and even delights in elevated and open situations, such as the steep banks of the Hudson and the Susquehannah. In Ohio, Kentucky and Tennessee it is more multiplied than east of the mountains, and grows on the richest lands of an uneven surface.

This tree is 50 or 60 feet high and one or two feet in diameter. In the winter it is distinguished from the white elm by its buds, which are larger and rounder, and which a fortnight before their developement, are covered with a russet down. The leaves are oval-acuminate, doubly denticulated and larger, thicker and rougher than those of the white elm, and emit an agreeable odor. It blooms in the month of April. The flowers are aggregated at

the extremity of the young shoots. The scales which surround the bunches of flowers are downy like the buds. The flowers and seeds differ from those of the wahoo; the calyx is downy and sessile, and the stamens are short and of a pale-rose color; the seeds are larger, destitute of fringe, round, and very similar to those of the European elms; they are ripe about the last of May.

The bark upon the trunk is brown; the heart is coarse-grained and less compact than that of the white elm, and of a dull-red tinge. The wood, even in branches of one or two inches in diameter, consists principally of alburnum or sap. This species is stronger, more durable, when exposed to the weather, and of a better quality than the white elm; hence in the Western States it is employed with greater advantage in the construction of houses, and sometimes of vessels on the banks of the Ohio. It is said to be the best wood in the United States for blocks, and its scarceness in the Atlantic States is the only cause of its limited consumption in the ports. It makes excellent rails, which are of long duration and are formed with little labor, as the trunk divides itself easily and regularly: this is probably the reason that it is never employed for the naves of wheels. This tree bears a strong resemblance to a species or a variety in Europe known by the name of *Dutch Elm*; the bark of which is very mucilaginous and also contains sugar, a little gallic acid and super tartrate of potass. Medicinally it is said to be alternative, tonic and diuretic, and to be useful for herpetic and leprous eruptions. If it ever do good in such cases, it must be from its mucilage sheathing the acid or acrid substances of the *primæ vitæ*, from which they arise. The leaves and the bark of the branches, macerated in water, yield a thick and abundant mucilage, which is used for a refreshing drink in colds. The bark, when reduced to flour, is said to make excellent puddings.

VIRGILIA.

Decandria Monogynia LINN. Leguminosæ. Juss. *Aperient, emollient.*

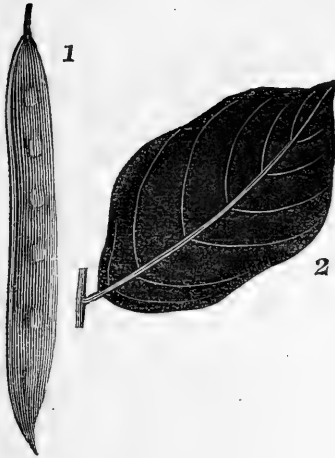
YELLOW WOOD. *Virgilia lutea.*

PLATE CI.

Fig. 1. A pod. Fig. 2. A leaflet.

The Yellow Wood is confined to that part of West Tennessee which lies between the 35th and the 37th degrees of latitude where it is commonly designated by the name which we have adopted. It grows of preference on gentle declivities, on a loose, deep and fertile soil.

This tree rarely exceeds 40 feet in height and one foot in diameter, and in general it does not exceed these dimensions. Its trunk is covered with a greenish bark, which is smooth instead

of being furrowed like that of most other trees. The leaves are six or eight inches long on old trees, and of twice this size on young and thrifty stocks. They are composed of two rows of leaflets, smooth, entire, nearly round and about an inch and a half in diameter. The leaflets are three, four or five on each side, borne by short petioles, and surmounted by an odd one which is supported by the common foot stalk. As in the button wood, the lower part of the foot stalk contains the bud, which becomes visible in plucking the leaf. The flowers form elegant, white, pendulous bunches, a little larger than those of the locust, but less odoriferous. The seeds also resemble those of the locust, and are contained in pods that differ only in being a little narrower. The seeds are ripe about the middle of August.

The wood of this tree is fine-grained and soft; it is principally remarkable for the yellow color of the heart, which speedily imparts this hue to cold water; but the color is fugitive even when the wood is boiled with alum. The inhabitants of the country were very desirous of finding some method of rendering it permanent. Aside from the fine vegetation of the yellow wood, the brilliant color of its heart appears to be a sufficient motive for multiplying it till we become able to appreciate its importance in dyeing.

SYLVA AMERICANA.

PART III.

ARBORICULTURE.

JUDICIOUS planting and the skilful culture of plantations combine national and private interests in an eminent degree; for, besides the real or intrinsic value of the timber or ostensible crop, with other produce of woods, available for the arts and comforts of life, judicious forest-tree planting improves the general climate of the neighborhood, the staple of the soil, as regards the gradual accumulation of vegetable matter, afford shelter to live stock, promotes the growth of pasture and of corn crops, beautifies the landscape, and thus greatly and permanently increases the value of the *fee simple* of the estate and adjoining lands.

If we turn to those soils emphatically termed wastes — exposed, elevated lands, moors, bogs, and sterile sands — composing so large a portion of the United States, and naturally clothed by the lowest and least valuable products of the vegetable kingdom, the inferior grasses, mosses, rushes, sedges, ferns, and heaths — we find that upon them the more valuable domestic animals cannot exist. If we consider the reason why they are so barren, waste, and unproductive, when compared with other lands not more favored by nature, and under similar circumstances of latitude

and elevation, the cause will, in many instances, be found in the want of the shelter and shade of trees, and of the ameliorating influence which plantations exercise on ungenial local climates.

The essential, permanent pasture grasses cannot be established on naked exposed situations ; but when assisted by the shelter of forest trees they become permanent and productive. Plantations supply us with fuel, with materials for fencing, inclosing, building ; corn crops, soiling plants, and root crops are obtained in succession under their genial protection. Many millions of acres now unprofitable to the owners and to the community, might, by judicious planting, be reclaimed, and rendered highly productive ; and it may be safely affirmed, that there is hardly a spot of waste land in the Union so barren, which by the exercise of skill in planting, and selection of proper species of forest trees adapted to the soil and exposure, might not be covered with profitable plantations.

Numerous instances might be cited from different parts of this Republic where exposed and sterile lands have, by planting, been made capable of producing valuable arable crops and the best pasture grasses, and of rearing and fattening stock of improved breeds. This, in effect, is adding to the territorial extent of a country, to its wealth and strength, by conquest over the natural defects of local climate, soil and exposure.

The subject of planting may, with propriety, be divided into three parts: useful or forest-tree planting, ornamental or gardening-planting, and orchard or fruit-tree planting. Each of these divisions of the subject, from its importance and interest, in a national point of view, as well as to individuals, seems to demand a distinct treatise.

The first of these, forest-tree planting, is proposed for the subject of the following pages ; and the details of the theory and practice of the art discussed under the following heads :—1st of earths and soils ; 2d of the different modes of rearing forest trees ; 3d of the soils and sites most profitably employed in the growth of timber ; 4th of the most approved modes of preparing different soils for the reception of the plants ; and 5th of the culture of plantations.

CHAP. I.

OF EARTHS AND SOILS.

Earths are the productions of the rocks which are exposed on the surface of the globe, and soils are earths mixed with more or less of the decomposed organized matter afforded by dead plants and animals. Earths and soils, therefore, must be as various as the rocks which produce them, and hence to understand their nature and formation it is necessary to begin by considering the geological structure of the territorial surface; next the manner in which earths and soils are produced; and lastly we shall consider in succession the nomenclature and qualities of soils.

OF THE GEOLOGICAL STRUCTURE OF THE GLOBE.

The materials of which the general mass of this earth is composed, are variously distributed in different parts. In some places they form irregular masses or blocks, either buried below the surface, or elevated to a greater or less height above it. In most places, however, the materials are arranged in a more regular manner; those of the same kind being collected into extensive masses, lying in layers or strata, above or below a similar mass of another kind, or these alternate with each other to a considerable depth. These strata are sometimes found arranged in a direction parallel to the horizon; at others they are vertical, or perpendicular to the horizon, appearing as if the horizontal strata had been lifted up, and laid upon their edges. More commonly the strata are arranged in a direction inclining to the horizon, when they are said *to dip*.

The uppermost stratum is in most places covered to a certain depth with mould that has evidently been formed from the decomposition of organized substances. In many parts of the earth this mould extends to a very considerable depth, and

constitutes the soil ; in other places it is barely sufficient to form a coating to the strata, and in others it is entirely wanting. Sometimes the strata are continued in a regular arrangement, preserving the same inclination to a very considerable extent ; but more commonly they appear in some parts separated, as if they had been broken asunder. These separations are usually in a perpendicular direction, and the cavities are found filled with various heterogeneous matters. Sometimes these are chiefly composed of fragments of the adjacent strata, but for the most part they consist of mineral or metallic substances of a different nature. When these fissures are filled with broken fragments or rubble, as it is called, it very commonly happens that they become the beds of brooks or rivers. When the fissure is filled with a solid stony matter, this forms what is called a *dyke*. If a mass of mineral or metallic matters fill the fissure, or be insinuated between the strata, it forms what is called a vein, and these veins sometimes branch between the strata in various directions. When a fracture has taken place in the stratified mass, one part of the mass sometimes preserves the same position as it had before, or still forms a continued line with the other parts of the mass, or is parallel to it ; but more frequently one part is thrown out of its original position, and becomes more inclined to the horizon than before. Sometimes one side of the mass is more depressed than the other ; at others the two parts of the mass are so distributed as to incline, towards each other, as if they had been broken upwards. When the edges of the strata on each side of the fissure are thus divided and disarranged, they are said by the miners *to trap*. If the country in which the strata lie runs in a waving direction of hill and dale, the strata usually preserves the same waving direction, keeping pretty nearly parallel to each other.

The general observation of all modern geologists proves, that all these materials may be distributed under four general classes ; the first, supposed to be coeval with the world, and are called *primitive*, and consist chiefly of granite and marble, below which man has not yet penetrated. The second series, called by the Wernerians *transition rocks*, are of more recent formation, and

seem to have resulted from some great catastrophe, (probably that to which history gives the name of deluge), tearing up and modifying the former order of things. Clay slate is one of the principal rocks of this class, and next limestone, sand stone, and trap or whin stone. The third series are called *secondary rocks*, and seem to owe their formation to partial or local revolutions, as indicated by their comparatively soft and fragile structure, superincumbent situation, and nearly horizontal position. They are chiefly lime stones, sand stones, and conglomerations of fragments of other rocks, as plum-pudding stone, etc., and appear rather as mechanical deposits from water than as chemical compounds from fusion or solution. A fourth stratum consists of *alluvial* or earthy depositions from water, in the form chiefly of immense beds of clays, marls, or sands. These strata are far from being regular in any one circumstance; sometimes one or more of the strata are wanting, at other times the order of their disposition seems partially inverted; their continuity of surface is continually interrupted, so that a section of the earth almost every where exhibits only confusion and disorder to persons who have not made geology more or less their study.

OF THE FORMATION OF EARTHS AND SOILS.

The surface earth, or that which forms the outer coating of the dry parts of the globe, is formed by the detrious or worn off parts of rocks and rocky substances. For in some places, as in chasms and vacuities between rocky layers or masses, earth occupies many feet in depth, and in others, as on the summit of chalk hills or granite mountains, it hardly covers the surface. Earths are, therefore, variously composed, according to the rocks or strata which have supplied their particles. Sometimes they are chiefly formed from slate rocks, as in blue clays; at other times from sand stone, as in siliceous soils; and mostly of a mixture of clayey, slaty and lime stone rocks, blended in proportions as various as their situations. Such we may suppose to have been the state of the surface of the dry part of the globe

immediately after the last disruption of the crust ; but in process of time the decay of vegetables and animals form additions to the outer surface of the earth, and constitute what are called *soils* ; the difference between which and earths is, that the former always contains a portion of vegetable or animal matter. The manner in which rocks are converted into soils, Sir H. Davy observes, may be easily conceived by referring to the instance of soft granite, or porcelain granite. This substance consists of three ingredients, quartz, feldspar and mica. The quartz is almost pure siliceous earth in a chrySTALLINE form. The feldspar and mica are very compounded substances ; both contain silica, alumina and oxide of iron ; in the feldspar there is usually lime and potassa ; in the mica, lime and magnesia. When a granite rock of this kind has been long exposed to the influence of the air and water, the lime and the potassa contained in its constituent parts are acted upon by water or carbonic acid ; and the oxide of iron, which is almost always in its least oxidized state, tends to combine with more oxygen ; the consequence is, that the feldspar decomposes, and likewise the mica ; but the first the most rapidly. The feldspar, which is as it were the cement of the stone, forms a fine clay : the mica partially decomposed mixes with it as sand ; and the undecomposed quartz appears as gravel, or sand of different degrees of fineness. As soon as the smallest layer of earth is formed on the surface of a rock, the seeds of lichens, mosses and other vegetables of the kind which are constantly floating in the atmosphere, and which have made it their resting place begin to vegetate ; their death, decomposition and decay afford a certain quantity of organizable matter, which mixes with the earthy materials of the rock ; in this improved soil more perfect plants are capable of subsisting ; these in their turn absorb nourishment by the agency of water and the atmosphere ; and after perishing, afford new materials to those already provided : the decomposition of the rock still continues ; and at length, by such slow and gradual processes, a soil is formed in which even forest trees can fix their roots, and which is fitted to reward the labors of the cultivator.

The formation of peaty soils is produced from very opposite causes, and it is interesting to contemplate how the same effect may be produced by different causes, and the earth which supplies almost all our wants may become barren alike from the excessive application of art, or the utter neglect of it. Continual pulverization and cropping, without manuring, will certainly produce a hungry, barren soil; and the total neglect of fertile tracts will, from their accumulated vegetable products, produce peaty soils, and bogs. Where successive generations of vegetables have grown upon a soil, Sir H. Davy observes, unless part of their produce has been carried off by man, or consumed by animals, the vegetable matter increases in such proportion, that the soil approaches to a peat in its nature; and if in a situation where it can receive water from a higher district, it becomes spongy, and permeated with that fluid, and is gradually rendered incapable of supporting the nobler classes of vegetables. Many peat mosses seem to have been formed by the destruction of forests, in consequence of the imprudent use of the hatchet by the early cultivators of the country in which they exist: when the trees are felled in the outskirts of a wood, those in the interior are exposed to the influence of the winds; having been exposed or accustomed to shelter, they become unhealthy, and die in their situation; and their leaves and branches gradually decomposing, produce a stratum of vegetable matter.

Lakes and pools of water are sometimes filled up by the accumulation of the remains of aquatic plants; and in this case a spurious peat is formed. The fermentation in these cases, however, seems to be of a different kind. Much more gaseous matter is evolved; and the neighborhood of morasses, in which aquatic vegetables decompose, is generally aguish and unhealthy; while that of the true peat, or peat formed on soils originally dry, is always salubrious.

Soils may generally be distinguished from mere masses of earth by their friable texture, dark color, and by the presence of some vegetable fibre or carbonaceous matter. In uncultivated grounds, soils occupy only a few inches in depth on the surface,

unless in crevices, where they have been washed in by rains ; and in cultivated soils their depth is generally the same as that to which the implements used in cultivation have penetrated.

CLASSIFICATION AND NOMENCLATURE OF SOILS.

Systematic order and an agreed nomenclature are as necessary in the study of soils as of plants or animals. The number of provincial terms for soils which have found their way into the books on cultivation, is one reason why so little use can be made of their directions. A correct classification of soils may be founded on the presence or absence of organic or inorganic matter in their basis. This will form two grand classes, viz. *primitive soils*, or those composed entirely of inorganic matter, and *secondary soils*, or those composed of organic and inorganic matter in mixtures. These classes may be subdivided into orders founded on the presence or absence of saline, metallic and carbonic matter. The orders may be subdivided into genera founded on the prevailing earths, salts, metals, or carbon ; the genera into species founded on their different mixtures ; the species into varieties founded on color, texture ; and sub-varieties founded on moisture, dryness, richness, lightness, etc.

In naming the genera of soils, the first thing is to discover the prevailing earth or earths ; either the simple earths as clay, lime, sand, or the particular rocks from which the soil has been produced, as granite, basalt, etc. When one earth prevails, the generic name should be taken from that earth, as clayey soil, calcareous soil, etc. ; when two prevail to all appearance equally, then their names must be conjoined in naming the genus, as clay and sand, lime and clay, basalt and sand, etc. The great thing is precision in applying the terms. Thus as Sir H. Davy has observed, the term sandy soil should never be applied to any soil that does not contain at least seven-eighths of sand ; sandy soils that effervesce with acids should be distinguished by the name of calcareous sandy soil, to distinguish them from those that are siliceous. The term clayey soil should not be applied to any

land which contains less than one sixth of impalpable earthy matter, not without considerably effervescing with acids; the word *loam* should be limited to soils, containing at least one third of impalpable earthy matter, copiously effervescing with acids. A soil to be considered as peaty, ought to contain at least one half of vegetable matter. In cases where the earthy part of a soil evidently consists of the decomposed matter of one particular rock, a name derived from the rock may with propriety be applied to it. Thus, if a fine red earth be found immediately above decomposing basalt, it may be denominated basaltic soil. If fragments of quartz and mica be found abundant in the materials of the soil, which is often the case, it may be denominated granitic soil; and the same principles may be applied to other like instances. In general, the soils, the materials of which are the most various and heterogeneous, are those called alluvial, or which have been formed from the depositions of rivers; and these deposits may be designated as siliceous, calcareous, or argillaceous; and in some cases the term *saline* may be added as a specific distinction, applicable, for example, at the mouth of rivers, where their alluvial remains are overflowed by the sea.

The following table enumerates the more common genera, species and varieties of soil. The application of the terms will be understood by every cultivator, though to attempt to describe the soils either chemically or empirically, (as by sight, smell or touch), would be a useless waste of time. From a very little experience in the field or garden, more may be gained in the study of soils, than from a volume of such descriptions. This table corresponds with the nomenclature adopted in the agricultural establishments of Fellenberg at Hofwyl in Switzerland, of Professor Thaer at Mœgeliu in Prussia, of Professor Thouin in his lectures at Paris, and in general with that of all the European professors. It is therefore very desirable that it should become as generally adopted as that of the Linnæan system in botany. The principle of the table may be extended so as to contain any other soil whatever.

TABLE.

Class.	Order.	Genus.	Species.	Variety.	Sub-Variety.			
PRIMITIVE SOILS.	Earths alone	Clay	Entire	Black	Moist. Dry. Rich. Poor. Sterile.			
			Lime	Entire	Red Yellow Coarse	Moist, dry, &c. Moist, dry, &c. Moist, dry, &c.		
		Earths and salts or metals	Clay	Entire	Fine	Moist, dry, &c.		
				Ferruginous	Black, red, yellow, coarse, fine, &c.	Moist, dry, rich, &c.		
	Earths and organic remains alone	Lime	Sand	Cupreous	Black, red, yellow, coarse, fine, &c.	Moist, dry, &c.		
			Clay	Saline	Black, red, yellow, coarse, fine, &c.	Moist, dry, &c.		
		Lime	Clay	Ferruginous	Black, red, &c.	Moist, dry, &c.		
				Cupreous	Black, red	Moist, dry, &c.		
		Sand	Clay	Saline	Black, red, yellow, coarse, fine, &c.	Moist, dry, rich, &c.		
				Ferruginous	Black, red, yellow, coarse, fine, &c.	Moist, dry, rich, &c.		
		SECONDARY SOILS:	Lime	Clay	Cupreous	Black	Moist.	
					Saline	Black	Moist.	
			Lime	Clay	Loamy	Black, red, yellow, &c.	Moist, dry, &c.	
					Peaty	Black, red, yellow, &c.	Moist.	
			Sand	Clay	Mouldy	Black	Moist.	
					Limy	Black	Moist.	
			Earths with organic remains, metals, salts and rocks	Lime	Clay	Sandy	Black, red, yellow, &c.	Moist, dry.
						Loamy	Black	Moist.
				Lime	Clay	Peaty	Black	Moist.
						Mouldy	Black	Moist.
Sand	Clay			Clayey	Black	Moist.		
				Loamy	Black	Moist.		
Granite	Lime			Limy	Black	Moist.		
				Peaty	Black	Moist.		
Basalt	Lime	Mouldy		Black	Moist.			
		Clayey		Black	Moist.			
Schist	Lime	Loamy		Black	Moist.			
		Clayey		Black	Moist.			
Sand stone	Lime	Ferruginous, loamy, &c.	Black	Moist.				
		Ferruginous, limy, &c.	Black	Moist.				
Lime stone	Lime	Ferruginous, sandy, &c.	Black	Moist.				
		Cupreous, loamy, &c.	Black	Moist.				
Coal	Lime	Cupreous, sandy, &c.	Black	Moist.				
		Saline, loamy, &c.	Black	Moist.				
Coal	Lime	Saline, sandy, &c.	Black	Moist.				
		Cinereous, loamy, &c.	Black	Moist.				
Coal	Lime	Cinereous, limy, &c.	Black	Moist.				
		Ferruginous, loamy, &c.	Black	Moist.				
Coal	Lime	Ferruginous, sandy, &c.	Black	Moist.				
		Cupreous, loamy, &c.	Black	Moist.				
Coal	Lime	Ferruginous, limy, &c.	Black	Moist.				
		Cupreous, loamy, &c.	Black	Moist.				
Coal	Lime	Ferruginous, loamy, &c.	Black	Moist.				
		Ferruginous, limy, &c.	Black	Moist.				
Coal	Lime	Cupreous, loamy, &c.	Black	Moist.				
		Ferruginous, loamy, &c.	Black	Moist.				
Coal	Lime	Ferruginous, sandy, &c.	Black	Moist.				
		Cupreous, loamy, &c.	Black	Moist.				
Coal	Lime	Ferruginous, limy, &c.	Black	Moist.				
		Cupreous, loamy, &c.	Black	Moist.				
Coal	Lime	Ferruginous, loamy, &c.	Black	Moist.				
		Ferruginous, sandy, &c.	Black	Moist.				
Coal	Lime	Cupreous, loamy, &c.	Black	Moist.				
		Saline, loamy, &c.	Black	Moist.				
Coal	Lime	Saline, sandy, &c.	Black	Moist.				
		Cinereous, loamy, &c.	Black	Moist.				
Coal	Lime	Cinereous, limy, &c.	Black	Moist.				
		Ferruginous, loamy, &c.	Black, red, yellow, &c.	Moist, dry, &c.				
Coal	Lime	Ferruginous, sandy, &c.	Black	Moist.				
		Cupreous, loamy, &c.	Black, red, yellow, &c.	Moist, dry, &c.				
Coal	Lime	Whin stone, &c.	Black	Moist.				
		Ferruginous, &c.	Black, red, yellow, &c.	Moist, &c.				
Coal	Lime	Micaceous, &c.	Black	Moist.				
		Chlorite, &c.	Black	Moist.				
Coal	Lime	Ferruginous, &c.	Black, &c.	Moist, &c.				
		Calcareous, &c.	Black	Moist.				
Coal	Lime	Argillaceous, &c.	Black	Moist.				
		Cupreous, &c.	Black	Moist.				
Coal	Lime	Chalky, &c.	Black, red, &c.	Moist, dry, &c.				
		Marble, &c.	Black	Moist.				
Coal	Lime	Shelly, &c.	Black	Moist.				
		Magnesian, &c.	Black	Moist.				
Coal	Lime	Sulphuric, &c.	Black	Moist.				
		Ferruginous, &c.	Black	Moist.				
Coal	Lime	Cupreous, &c.	Black	Moist.				
		Argillaceous, &c.	Black	Moist.				
Coal	Lime	Siliceous, &c.	Black	Moist.				
		Slaty, &c.	Black, red, yellow, &c.	Moist, dry, rich, &c.				
Coal	Lime	Pyritic, &c.	Black	Moist.				
		Stony, &c.	Black	Moist.				
Coal	Lime	Woody, &c.	Black	Moist.				
			Black	Moist.				

OF DISCOVERING THE QUALITIES OF SOILS.

The value of soils to the cultivator, is discoverable, botanically, chemically and mechanically ; that is, by the plants, that grow on them naturally ; by chemical analysis ; and by exterior and interior inspection or handling.

OF DISCOVERING THE QUALITY OF SOILS BOTANICALLY.

Plants are the most certain indicators of the nature of a soil ; for while no practical cultivator would engage with land of which he knew only the results of a chemical analysis, or examined by the sight and touch a few bushels which were brought to him, yet every gardener or farmer, who knew the sorts of plants it produced, would be at once able to decide as to its value for cultivation. For example, the garget and striped maple are generally found on a warm, loamy soil ; the rush on a clayey soil ; the mullein and sorrel on a dry, sandy soil ; and the cranberry on a peaty soil. But these plants, however, are not to be absolutely depended upon, as they are sometimes found in soils directly opposite ; as climate and natural irrigation of plants have much more influence on these plants than mere soils.

OF DISCOVERING THE QUALITIES OF SOILS BY CHEMICAL ANALYSIS.

Chemical analysis is much too nice an operation for general purposes. It is not likely that many practical cultivators will ever be able to conduct the analytic process with sufficient accuracy, to enable them to depend on the result. But still such a knowledge of chemistry as shall enable the cultivator to understand the nature of the process and its results, when made and presented to him by others, is calculated to be highly useful, and ought to be acquired by every man whose object is to join theoretical to practical knowledge. If it so happens that he can

perform the operations of analysis himself, so much the better, as far as that point is concerned ; but on the whole, such knowledge and adroitness is not to be expected from men who have so many other points demanding their attention, and who will, therefore, effect their purpose much better by collecting proper specimens of the soils to be studied, and sending them for analysis to a respectable operative chemist.

In selecting specimens, where the general nature of the soil of a field is to be ascertained, portions of it should be taken from different places, two or three inches below the surface, and examined as to the similarity of their properties. It sometimes happens, that upon plains, the whole of the upper stratum of the land is of the same kind, and in this case, one analysis will be sufficient : but in valleys, and near the beds of rivers, there are very great differences, and it now and then occurs that one part of a field is calcareous, and another part siliceous ; and in this case, and in analogous cases, the portions different from each other should be separately submitted to experiment. Soils, when collected, if they cannot be immediately examined, should be preserved in phials quite filled with them, and closed with ground-glass stoppers. The quantity of soil most convenient for a perfect analysis is from two to four hundred grains. It should be collected in dry weather, and exposed to the atmosphere till it becomes dry to the touch.

The soil best suited for culture, according to the analysis of Bergman, contains four parts of clay, three of sand, two of calcareous earth, and one of magnesia : and, according to the analysis of Fourcroy and Hassenfratz, 9216 parts of fertile soil contained 305 parts of carbon, together with 279 parts of oil ; of which, according to the calculations of Lavoisier, 220 parts may be regarded as carbon : so that the whole of the carbon contained in the soil in question may be estimated at about 525 parts exclusive of the roots of vegetables, or to about one sixteenth of its weight. Young observed that equal weights of different soils, when dried and reduced to powder, yielded by distillation quantities of air somewhat corresponding to the ratios of their values. The air was a mixture of fixed and inflammable gasses,

proceeding probably from decomposition of the water ; but, partly, it may be presumed, from its capacity of abstracting a portion of air from the atmosphere, which the soil at least is capable of doing. The following is the analysis of a fertile soil, as occurring in the neighborhood of Bristol, England. In 400 grains, there were of water, 52 ; siliceous sand, 240 ; vegetable fibre, 5 ; vegetable extract, 3 ; alumine, 48 ; magnesia, 2 ; oxide of iron, 14 ; calcareous earth, 30 ; loss, 6. But Kirwan has shown in his *Geological Essays*, that the fertility of a soil depends in a great measure upon its capacity for retaining water ; and if so, soils containing the same ingredients must be also equally fertile, all other circumstances being the same ; though it is plain that their actual fertility will depend ultimately upon the quantity of rain that falls, because the quantity suited to a wet soil cannot be the same that is suited to a dry one. And hence it often happens that the ingredients of the soil do not correspond to the character of the climate. Silica exists in the soil under the modification of sand, and alumine under the modification of clay. But the one or the other is often to be met with in excess or defect. Soils in which the sand preponderates retain the least moisture ; and soils in which the clay preponderates retain the most ; the former are dry soils, the latter are wet ones. But it may happen that neither of them is sufficiently favorable to culture ; in which case, their peculiar defect or excess must be supplied or retrenched before they can be brought to a state of fertility.

In the present state of chemical science, Dr. Ure observes, no certain system can be devised for the improvement of lands, independently of experiment ; but there are few cases in which the labor of analytical trials will not be amply repaid by the certainty with which they denote the best methods of melioration ; and this will particularly happen, when the defect of composition is found in the proportions of the primitive earths. In supplying organic matter, a temporary food only is provided for plants, which is in all cases exhausted by means of a certain number of crops ; but when a soil is rendered of the best possible constitution and texture, with regard to its earthy parts, its fertility may be considered as permanently established. It becomes capable of

attracting a very large portion of vegetable nourishment from the atmosphere, and of producing its crops with comparatively little labor and expense.

OF DISCOVERING THE QUALITIES OF A SOIL MECHANICALLY AND EMPIRICALLY.

The physical properties of soils and some of their most important constituents relatively to the cultivator, may be ascertained to a certain extent by various and very simple means.

The specific gravity of a soil, or the relation of its weight to that of water, may be ascertained by introducing into a phial, which will contain a known quantity of water, equal volumes of water and of soil, and this may be easily done by pouring in water till it is half full, and then adding the soil till the fluid rises to the mouth; the difference between the weight of the soil and that of the water, will give the result. Thus if the bottle contains 400 grains of water, and gains 200 grains when half filled with water and half with soil, the specific gravity of the soil will be 2, that is, it will be twice as heavy as water, and if it gained 165 grains, its specific gravity would be 1825, water being 1000.

The presence of clay and sand in any soil may be known two ways; the first by its tenacity, the other by its roughness to the touch, and by scratching glass when rubbed on it.

The presence of calcareous matter in soil may be ascertained by simply pouring any acid on it, and observing if it effervesces freely. Calcareous soils are also softer to the touch than any other.

The presence of organized matter in any soil may be ascertained very satisfactorily by weighing it after being thoroughly dried; then subjecting it to a red heat, and weighing it again, the weight last found will be the proportion of organic matter. The same object may also be obtained by ascertaining the specific gravity of the soil, but with less accuracy.

The presence of metallic oxides in a soil may generally be known by their color. Ferruginous soils, are red or yellow; cupreous soils, interspersed with greenish streaks, etc.

The presence of salts, sulphur, coal, etc. may be known by the absence or peculiarity of vegetation, as well as by color, and the appearance of the water of such soils.

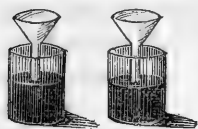


PLATE CII.

The capacity of a soil for retaining water may be thus ascertained. An equal portion of two soils, perfectly dry, may be introduced into two bell-glass, cylindrical vessels, (Plate 102) in the middle of each of which a glass tube is previously placed. The soil should be put into each in the same manner, not compressed very hard, but so as to receive a solidity approaching to that which they possessed when first obtained for trial. If, after this preparation, a quantity of water be poured into the glass tubes, it will subside; and the capillary attraction of the soils will conduct it up the cylinders towards the tops of the vessels. That which conducts it the most rapidly, provided it does not rise from the weight of the incumbent column of water in the tube, may be pronounced to be the better soil.

CHAP II.

OF THE DIFFERENT MODES OF REARING FOREST TREES.

It has been strongly controverted by some, whether it is better to raise trees for timber and like purposes, from their seeds and first rudiments, or to transplant such as we find have either raised themselves from their seeds, or sprung from their mother roots, or by grafting or inoculation. Now that to produce them immediately from the seed we contend is the better way, the following reasons may seem to evince. First, because they vegetate the soonest; secondly, because they produce the straightest and most uniform shoots; thirdly, because they will neither require staking nor watering, which are two very considerable articles; fourthly, because that transplanting in

general, unless they are taken up the first year or two, is a considerable impediment to the growth of forest trees : although it be true that many of those which are found in woods, especially young oaks, beeches and many others, spring from the self-sown seeds ; yet being for the most part dropped and disseminated among the half-rotten sticks, musty leaves and perplexities of the mother roots, they grow scraggy, and being overpowered, become squallid and are liable to accumulate moss. Nor can their roots expand, and spread themselves as they would do, if they were sown, or had been planted in a more open, free and ingenuous soil. On the truth of this, experience affirms, that an acorn, sown by the hand in a nursery, or ground where it may be free from these obstructions, shall in two or three years outstrip a plant of twice that age, which has either been self-sown in the woods, or removed, unless by some favorable accident, it had been scattered into a more natural, penetrable and better qualified place ; but this disproportion is yet infinitely more remarkable in the pine and in the walnut, where the seed set into the ground, usually overtakes a tree of ten years' growth which was planted at the same instant. And, lastly, for that grafting and inoculation, unless performed with the utmost skill, most frequently defeat the design of the cultivator ; besides, if they are well set they are liable to accidents from high winds, extreme cold, the deprivations of animals and numerous other causes.

OF THE SEMINARY.

From the foregoing observations we may infer that the most natural, direct and general way of raising trees and plants, is from seeds. In order to this, proper soils must be prepared for them, as suitable as possible to their respective natures ; and when the ground is ready, and well furnished with the embryo plants, it is properly and significantly called the *Seminary*. Its situation should be as near the nursery as possible ; and as it is of the utmost consequence to preserve the young plants from the range of animals, the ground should be fenced round with poles

of a sufficient height. Late in autumn let the land be trenched from a foot and a half to two feet deep, working the sward to the bottom ; and during the following spring, the surface should be carefully kept clear from weeds. About mid-summer, unless the soil be very rich, let a coat of manure be spread over the surface, after which it should again be trenched. By this second operation the rotten sward will be brought to the top, and the soil will wear a mellow appearance. From mid-summer to September, the ground should be kept clear from weeds ; and just before the seeds are committed to it, it should again be trenched, which will effectually produce an uniform mixture of all the parts. This being done let the ground be levelled, and the beds laid out for the different purposes, reserving proper portions for the reception of such seeds as must be sown in spring.

A very judicious planter recommends the following method of making a seminary. Trench the ground in November eighteen inches deep, if the soil will admit of it ; but where the staple is too thin, one foot will be sufficient, in which case the sward must be pared off very thin, and placed in the bottom of the trench. The following year let this land be cultivated with a crop of cabbages, turnips or rape, which must be eaten off by sheep. After this a common digging will be sufficient, previous to its being formed into beds for the reception of the seeds. It will be necessary to remark upon this mode of preparation, that the urine of sheep is considered as one of the most cherishing manures for all plants raised in a seminary. This mode of procedure will answer for most kinds of trees. Those which require a moister or cooler situation, may be cultivated with equal success by shading and irrigation. No greater error exists in the planter's art, than the doctrine that trees should be raised on the same quality of soil as that to which they are to be transplanted, as if a robust, healthy plant were less likely to withstand its subsequent casualties of situation, soil and local climate, than a weaker plant with contracted sap vessels, the invariable consequence of a poor seed-bed soil.

Experience fully confirms that principle of vegetable physiology

which teaches that robust, healthy plants, whether in the seedling stage of growth or of a larger size, succeed better than those of stunted growth, even when transplanted to the least favorable soil and exposure.

Where the land to be planted with forest trees is an extensive tract and remotely situated, and where the seeds of the several kinds can be procured genuine, of good quality, and at a small cost, the formation of a private seminary may be advisable; but where the plants can be procured from a reasonable distance, it will be found the most economical and effective to purchase them, and even in the former case one or two years' seedling should be procured in place of seeds, as a saving of time and expense.

The seminary being now ready, it follows that the planter should be instructed in the manner of sowing and raising the seeds of forest trees. The following directions upon this subject are either drawn from experience, or are transcribed from the best authorities.

OF THE SEEDS OF FOREST TREES.

The seeds of forest trees may be classed under the following heads, or general characters, indicating peculiar points to be observed in the practice of sowing them.

1st. *Seeds farinaceous, and covered with shells, nut seeds.* To this class belong the oak, chesnut, beech, horse chesnut, walnut, hazel, hornbeam, plane, sycamore, maple and ash, to which may be added, though not strictly belonging to the group, the birch, alder and lime. The first seven kinds, from the farina they contain, are least adapted for keeping out of the soil, and the same cause renders them more difficult to preserve in the soil when sown, by inducing the attacks of mice, birds, and other vermin. The spring is considered the best season for sowing, and the seeds must therefore be preserved carefully during the winter; the most approved mode is to spread them out in their layers on a cool, dry floor, but previously to this they should be thoroughly dried by the sun and air. The smaller kinds of seeds after being sufficiently dried, may be kept in a smaller space.

When sown, these seeds require different degrees of covering in the soil. The larger seeds, as those of the chesnut, oak, etc., should be covered with two inches of mould; for the smaller seeds of the plane, sycamore, hornbeam, maple and ash, it will be proper to mix with them sand, in quantity about equal to their bulk, placing the mixture on the ground a foot in thickness, and covering that with an inch thick of mould. The birch may be sown immediately as it is taken from the tree, or preserved in the seed loft until spring. When sown, the birch is generally covered half an inch with mould, the former seeds with one inch.

2d. *Hard seeds, or stones covered with a pulpy fruit.* The proper covering of these seeds is so hard, as to have acquired for them the name of stones. In this class are the persimon, june berry, tupelo, cherry, mountain ash, holly, pear, crab and thorn. To obviate the irregular vegetation of these seeds, which is attended with loss of time and inconvenience, the practice of preparing them for sowing by what is called pitting has been adopted; but as one, two, or even three years in the pit or preparatory bed are wanted for some of these seeds, it is requisite after they have lain a certain time in the pit to uncover them and turn them over, so as to assist in the separation of the pulp from the stones.

3d. *Leguminous, or bean seeds.* These, as regards forest trees are confined to the common acacia, or locust tree, (*Robinia pseud acacia*), and the glutinous robinia (*Robinia viscosa*). These seeds vegetate freely when sown from the tree, but it is the general practice to preserve them until spring in a dry, cool place. When sown, they require to be covered with about three fourths of an inch of mould. If sown too thickly, that is, less than one inch seed from seed, the plants soon injure one another and become diseased.

4th. *Light seeds.* Under this head we enumerate the poplar and the tree willows. These seeds being light, and separating freely from the tree when ripe, require care in collecting, as otherwise they are liable to be dispersed and carried away by the wind. They vegetate quickly and may be sown as soon as they are ripe. Spring, however, is preferred, as tender seedling plants are subject

to injury from severe weather in winter. They should be covered to the depth of one fourth of an inch of fine, sifted mould.

5th. *Resinous seeds* are those of coniferous or fir trees. Their vegetative power when cleaned or separated from the cones, is not to be preserved if they are kept out of the ground for any considerable length of time, and they require particular care in sowing. The soil of the beds ought to be of a light sandy nature, enriched with the vegetable mould of decayed tree leaves, or well-decomposed dung. If a proper quantity of the former manure be added, and well incorporated with the sandy loam above described, it will bring that soil to a suitable texture. The seeds are borne in cones furnished with scales of a hard woody consistence. The cones of the larch with much difficulty part from the seeds, and various means have been adopted to effect that object. The best is that of first opening the cone, or dividing it lengthways into two or four parts, then placing them on a kiln and drying by a very gentle heat until the valves begin to open, when they should be taken to a proper floor and threshed: the seeds may then be separated by a sieve. The cones of the spruces require also the aid of the kiln; but the seeds part from the cones easily, and the splitting of the cones is superfluous. The spring is the best season for sowing these seeds. The soil of the seedling beds should be in as finely a pulverized state as possible for their reception.

OF SOWING THE SEEDS.

The trees belonging to the following genera are the most suitable for cultivation by seeds.

Abies. All the trees of this genus affect moist, siliceous, sandy soils, but they will flourish on rocky, and comparatively barren soils, for which they are peculiarly adapted. The seeds should not be taken out of the cones till the time of sowing arrives, which is in March or April.

Acer. This genus requires a deep, rich, moist soil free from stagnant water : some species will thrive in a dryer soil. The seeds should be sown as soon as possible after they are ripe. Some are of opinion that they should be preserved in dry sand until March or April.

Alnus. This genus requires a moist, damp soil. The seeds should be sown in autumn or spring : if left until spring, they should be preserved in dry sand.

Andromeda. The seeds of this genus should be sown as soon as ripe in a sandy peat.

Betula. This genus will grow in every description of soil, from the wettest to the driest. The seed may be sown in autumn or spring ; to be kept in a dry, cool sand, from the time it is ripe until it is sown.

Carpinus. Poor clayey loams, incumbent on sand and chalky gravels, are well adapted for the growth of this genus. The seed should be sown in autumn.

Castanea. A rich sandy loam raises the chesnut to the greatest perfection as a timber tree ; but it appears to come to great maturity in clayey soils, if free from stagnant moisture. It will thrive also in gravel or sand, if not in too bleak or exposed a situation. The seeds should be planted in March or April.

Chamaerops. This genus requires a warm, rich garden mould. The seeds should be sown at their maturity.

Cupressus. This genus delights most in a sandy loam, but it will also thrive and grow to a considerable height in clayey soils. The seed should be sown in the spring, in a warm situation, or in pots, in dry, light earth : to be kept in the cones until the period of sowing.

Diospyros. The seeds of this genus should be sown at their maturity in a sandy loam.

Gleditschia. This genus requires a sandy loam : its seeds should be sown as soon as they are matured : they frequently remain in the earth two years before they vegetate.

Juglans. This genus requires a rich, loamy soil to bring it to perfection ; but it will succeed in very light, siliceous, sandy soils, as well as clayey ones. The nuts should be preserved

until March or April in their husk, after which they may be sown.

Larix. This genus requires a moist, cool loam in a shaded situation. The seeds may be sown in November, or kept in the cones until March or April and then be sown.

Laurus. This genus requires a soil composed of sand, peat and loam. The seeds should be sown at the period of their maturity.

Liquidambar. This genus will flourish best in a sandy loam, but will thrive in most kinds of soils of an intermediate quality between moisture and dryness. The seeds should be sown in the spring in pots or boxes of light earth; to be shaded during the summer, and protected from severe frosts in the winter, may be propagated also by layers.

Lyriodendron. The seeds of this genus should be sown at their maturity in a sandy loam.

Magnolia. The seeds of this genus should be sown, as soon as ripe, in pots or boxes filled with a mixture of loam and peat, and plunge them into an old hot bed of tanner's bark: they may also be propagated by layers.

Olea. The seeds of this tree should be sown as soon as they have matured in a sandy peat.

Pinus. All the fir and pine tribes affect siliceous, sandy soils, but they will flourish on rocky and comparatively barren ones, for which they are peculiarly adapted. The seeds should be sown in March or April, and should not be taken out of the cones until the time of sowing arrives.

Platanus. This genus prefers moist loam, but free from stagnant moisture. The seeds should be sown immediately after they are ripe.

Quercus. A rich loam, with a clayey sub-soil, brings the oak to the greatest perfection; but it may be profitably cultivated on almost every description of soil, except boggy or peat. They should be sown in November; or if deferred till spring, lay them upon a cool, dry floor, to prevent their vegetating.

Robinia. This genus will grow in almost any soil, but attains

to most perfection in such as is light and sandy. The seeds should be sown in March or April, on a bed of light earth.

Tilia. This genus will flourish in almost any kind of soil, if moderately damp. The seeds should be sown in autumn, in a shady border of moist, light soil; but the usual mode of propagation is by layers.

OF THE NURSERY AND PLANTATION.

The following are essential points to be considered in establishing an effective nursery: fencing, shelter, aspect, soil and management. The fence of a forest-tree nursery requires to be *rabbit proof*, or loss and disappointment are almost certain to follow. A foundation of brick work should be made for a superstructure of close paling. Where shelter is not an object, a very cheap and excellent substitute is found in iron wire netting, which is manufactured for the general purposes of fences to young plants. *Shelter* is indispensable to the free growth of seedling plants, the injurious consequences resulting from sudden checks, as also the bad effects of confined air to the health and prosperity of trees in every stage of growth; and therefore, at the same time that a full protection against cold, bleak winds and unfavorable aspects is necessary, a full and free circulation of atmospheric air must be secured, to allow of a well-grounded hope of success.

The *soil* of the nursery must be of an intermediate quality as to moisture and dryness, not less than eighteen inches deep to the subsoil, and under a south, east or west exposure, or intermediate points of these. The varieties of soil required for particular kinds of trees will have to be supplied where the natural soil is deficient.

Management. This head comprehends an ample degree of practical skill in the superintendant and workmen; the erection of proper sheds, the means of carriage for composts, soils, plants, etc., immediately when needed. A quantity of compost and different soils should always be in readiness when wanted for the seedling beds, layer stools, and cutting beds, and a proper assortment of nursery garden tools, which shall be specified

hereafter. The preparation of the soil, the mode of sowing, and the different kinds of forest-tree seeds, have already been described. All kinds of forest trees, however, are not raised from seeds, either because they do not perfect a sufficient quantity for the general purposes of propagation, or are accidental varieties only of a species losing their characters of distinction when reproduced from seed. The following modes of propagation are found effectual when seeds cannot be obtained: first, by *suckers*, second, by *layers*, third, by *cuttings*, and fourth, by *grafting*.

1st. *Suckers* are shoots produced by the creeping roots of a tree, which, when separated from the parent root and transplanted, become perfect trees. They are generally sufficiently rooted in the first season of their production, and they should not be suffered to remain longer than two seasons attached to the root of the tree; for if continued longer, the support they derive from the parent root prevents them from making independent roots of their own in such abundance as they do when separated or taken up at an earlier period. The spring is the most proper season for taking them from the parent roots. When a sufficient number of rootlets appear on the sucker, no part of the root from whence the sucker sprang should be left attached to it; but where the proper rootlets are deficient in number, a small portion of the parent root may be left with advantage. The plants should be planted in rows in fresh soil, and treated in all respects afterwards as directed for seedling transplanted trees. The kinds of trees chiefly reared in England in this mode are:

<i>Ailanthus glandulosa</i> ,	. . .	<i>Chinese Ailanthus.</i>
<i>Populus alba</i> ,	<i>Abele Tree.</i>
<i>Populus canescens</i> ,	<i>Common White Poplar.</i>
<i>Populus tremula</i> ,	<i>Aspen.</i>

The first three kinds may also be propagated by layers.

2d. *Layers*. The process of *layering* is well known: it consists in bending a young branch (Plate 103) into the soil to a certain depth, and elevating the top part of it out of the soil in an upright direction; in time the buried part takes root, and the shoot becomes a perfect plant. The root which produces the young shoots for layering is called the stool. Stools are planted

about six feet apart every way in a deep, fresh soil. The stem at first is either bent down into the ground as a layer, or cut over a few inches from the root. The shoots which are produced

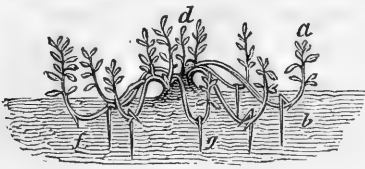


PLATE CIII.

from its sides form the layers (d). The rooting of the layers is much facilitated by obstructing in part the descending sap; this is essential to some kinds of layers, though not to all: the common laurel,

privet, etc., strike root readily without any artificial stoppage of the descending sap. The most expeditious mode of effecting this, is to cut a notch, slanting upwards to the origin of the layer, about half a diameter in length (f), and securing the position of the layer in the ground by a wooden peg (g). Where the shoot is of a nature that roots with difficulty, it is useful to split the *tongue* of the notch half way up, and to insert a small wedge of potsherd or wood to keep the division open. Rings of wire are also sometimes used for the same purpose, and cutting the bark round the part to within a little of the complete circumference of the shoot. In all ordinary cases, however, the slit or notching mode is perfectly effective. The ground should be kept quite clean of weeds, and watered in dry weather. When sufficiently rooted, the layers should be carefully cut away from the shoots, with all the fibrous roots attached to them, and planted in rows in fresh, well-prepared soil. The stools should have all the stumps of the branches cut away, and left to produce a fresh series of shoots for next autumn's layering. The following trees are propagated by layers.

<i>Acer eriocarpum</i> ,	. . .	<i>White Maple.</i>
<i>Acer montanum</i> ,	. . .	<i>Mountain Maple.</i>
<i>Acer negundo</i> ,	. . .	<i>Ash-Leaved Maple.</i>
<i>Acer rubrum</i> ,	. . .	<i>Red-Flowering Maple.</i>
<i>Acer striatum</i> ,	. . .	<i>Striped Maple.</i>
<i>Alnus glauca</i> ,	. . .	<i>Black Aldar.</i>
<i>Alnus serrulata</i> ,	. . .	<i>Common American Aldar.</i>
<i>Betula lenta</i> ,	. . .	<i>Black Birch.</i>
<i>Betula lutea</i> ,	. . .	<i>Yellow Birch.</i>
<i>Betula papyrifera</i> ,	. . .	<i>Canoe Birch.</i>

<i>Betula populifolia</i> ,	<i>White Birch.</i>
<i>Betula rubra</i> ,	<i>Red Birch.</i>
<i>Carpinus ostrya</i> ,	<i>Iron Wood.</i>
<i>Celtis crassifolia</i> ,	<i>Hack Berry.</i>
<i>Celtis occidentalis</i> ,	<i>American Nettle Tree.</i>
<i>Cerasus borealis</i> ,	<i>Red Cherry.</i>
<i>Cerasus caroliniana</i> ,	<i>Wild Orange.</i>
<i>Cerasus virginiana</i>	<i>Wild Cherry.</i>
<i>Cornus florida</i> ,	<i>Dog Wood.</i>
<i>Cupressus thyoides</i> ,	<i>White Cedar.</i>
<i>Fagus ferruginea</i> ,	<i>Red Beech.</i>
<i>Fagus sylvestris</i> ,	<i>White Beech.</i>
<i>Gordonia lasyanthus</i> ,	<i>Loblolly Bay.</i>
<i>Gordonia pubescens</i> ,	<i>Franklinia.</i>
<i>Hopea tinctoria</i> ,	<i>Sweet Leaf.</i>
<i>Kalmia latifolia</i> ,	<i>Mountain Laurel.</i>
<i>Laurus caroliniensis</i> ,	<i>Red Bay.</i>
<i>Magnolia acuminata</i> ,	<i>Cucumber Tree.</i>
<i>Magnolia auriculata</i> ,	<i>Long-Leaved Cucumber Tree.</i>
<i>Magnolia cordata</i> ,	<i>Heart-Leaved Cucumber Tree.</i>
<i>Magnolia Grandiflora</i> ,	<i>Big Laurel.</i>
<i>Magnolia tripetala</i> ,	<i>Umbrella Tree.</i>
<i>Morus rubra</i> ,	<i>Red Mulberry.</i>
<i>Nyssa aquatica</i> ,	<i>Tupelo.</i>
<i>Nyssa sylvatica</i> ,	<i>Black Gum.</i>
<i>Pinckneya pubens</i> ,	<i>Georgia Bark.</i>
<i>Pinus rigida</i> ,	<i>Pitch Pine.</i>
<i>Quercus pumila</i> ,	<i>Running Oak.</i>
<i>Rhododendron maximum</i> ,	<i>Dwarf Rose Bay.</i>
<i>Thuja occidentalis</i> ,	<i>American Arbor Vitæ Tree.</i>
<i>Tilia alba</i> ,	<i>White Lime Tree.</i>
<i>Tilia americana</i> ,	<i>Bass Wood.</i>
<i>Tilia pubescens</i> ,	<i>Downy Lime Tree.</i>
<i>Ulmus rubra</i> ,	<i>Red or Slippery Elm.</i>

3d. *Cuttings.* Shoots of one year's growth are the most proper to be used in this mode of propagating several kinds of forest trees. The shoots should be selected from the most healthy and free-grown branches, and cut into lengths of from six to eighteen inches, according to the kind of tree. If evergreens (*a*, Plate 104), the leaves should be cut off half way up from the root end of the cutting (*b*). Deciduous trees should have shed their leaves before the cuttings (*c*) are taken from them. The root ends of the cuttings should be cut finely smooth, and inserted from about a half to three parts of their length into the

soil. For every species of cutting, the soil should be light, and composed, at least, of half of fine siliceous sand. There are many species of exotic plants, whose cuttings will only strike root in pure siliceous sand. It need hardly be remarked, that in

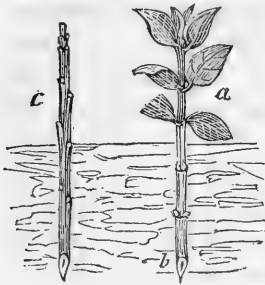


PLATE CIV.

this mode of propagating, watering is more particularly required to be attended to than in any other. The utility of the sandy nature of the soil consists in its retaining no stagnant moisture, but just sufficient for the wants of the shoot during the process of rooting. As soon as the cuttings are well rooted, if in a light soil of the above description, they should be carefully taken up and

transplanted to their proper soil ; for although the shoots produce roots more quickly and in greater abundance in the siliceous sandy soil, yet it is unable to support the growth of the plant after the proper functions of the roots begins. Next to that of propagation by seeds, plants may be increased by cuttings more generally than by any other mode : the process, however, requires more time, skill, and attention, than is demanded for rearing trees from suckers, or by layers or grafting, and it is therefore chiefly practised for the increase of exotic ornamental plants ; but the following forest trees are most advantageously raised from cuttings.

Anona triloba,	<i>Pawpaw.</i>
Platanus occidentalis,	<i>Button Wood.</i>
Populus angulata,	<i>Carolinian Poplar.</i>
Populus argentea,	<i>Colton Tree.</i>
Populus candicans,	<i>Heart-Leaved Poplar.</i>
Populus grandidentata,	<i>Large American Aspen.</i>
Populus hudsonica,	<i>American Black Poplar.</i>
Populus monilifera,	<i>Virginian Poplar.</i>
Populus tremuloides,	<i>American Aspen.</i>
Salix ligustrina,	<i>Champlain Willow.</i>
Salix lucida,	<i>Shining Willow.</i>
Salix nigra,	<i>Black Willow.</i>
Virgilia lutea,	<i>Yellow Wood.</i>

4th. *Grafting*, in forest-tree propagation, is chiefly had recourse to for those varieties of trees which lose their distinctive

characters when reproduced from seed, and which make finer trees when grafted on free growing stocks of their own species. The scions take more freely when not more than of one year's growth, but those of much older growth will succeed. The most perfect grafting is where the scion and the part of the stock to which it is to be united are nearly of an equal size, for on the perfect contact of the inner bark of the scion and stock depend the perfect union of the two in the shortest space of time, and consequent equal healing of the wound. The month of March or April is the best season for forest-tree grafting. The modes of grafting are numerous. French authors enumerate upwards of forty; for the purposes now under consideration, however, that termed *whip* or *tongue* grafting is generally followed. The scions should be selected from the more upright, free-growing branches; the middle portion of the shoot is the best; but where there is a scarcity of grafts, the top and bottom may be used, as these will succeed, though not likely to produce such fine trees. From two to five buds should be left for the production of a leading stem and branches. The stock should be cut in an oblique direction (*a*, Plate 105), and the scion in like manner at

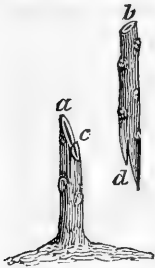


PLATE CV.

a corresponding angle (*d*); a slit should then be made in the stock about the middle of the wound, passing downwards (*c*), and a similar slit upwards in the scion (*b*); the upper division of the scion made by the slit, termed the *tongue* or *wedge*, is then inserted into the cleft of the stock, and the inner barks of the stock and scion brought into perfect contact, at least on one side. This should be effected with as little delay as possible. The parts are then to be bound with a riband of bass, and particular care should be taken that, in this part of the process, the junction of the two barks is not in the least displaced. To protect the grafted parts from drought and moisture, and from the action of the air, various means have been adopted, but the most direct and useful is well-worked clay, cleaned of gravel or small stones, and horse droppings, well incorporated and mixed in the proportions of three parts of the

former to one of the latter ; a little finely-chopped straw is added with advantage. The clay should be placed on the grafted parts an inch thick on every side, and extend about half an inch above and below the union of the stock with the graft. It is a highly useful practice to draw earth up round the clay so as to cover it entirely from the sun and air. Another mode, called

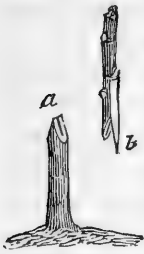


PLATE CVI.

saddle grafting, is perhaps better adapted for forest trees than the foregoing, but it takes up more time in the performance. The stock should be cut so as to leave the top in the form of a wedge (*a*, Plate 106); the scion split at the lower end, and each side of the incision pared obliquely, so as to form the two divisions into tongue-like processes (*b*); these are then seated on the wedge and made to fit accurately to each side of it. The

after operations of tying and claying are the same as in the former mode. The trees which come under the forester's care that require to be reared by grafting are the following.

<i>Fagus sylvestris</i>	. . .	<i>White Beech.</i>
<i>Fraxinus americana</i> ,	. . .	<i>White Ash.</i>
<i>Fraxinus platycarpa</i> ,	. . .	<i>Carolinian Ash.</i>
<i>Fraxinus quadrangulata</i> ,	. . .	<i>Blue Ash.</i>
<i>Fraxinus sambucifolia</i> ,	. . .	<i>Black Ash.</i>
<i>Fraxinus tomentosa</i> ,	. . .	<i>Red Ash.</i>
<i>Fraxinus Viridis</i> ,	. . .	<i>Green Ash.</i>
<i>Ilex opaca</i> ,	. . .	<i>American Holly.</i>
<i>Malus coronaria</i> ,	. . .	<i>Crab Apple.</i>
<i>Planera ulmifolia</i> ,	. . .	<i>Planer Tree.</i>
<i>Populus canadensis</i> ,	. . .	<i>Cotton Wood.</i>
<i>Populus candicans</i> ,	. . .	<i>Heart-Leaved Poplar.</i>
<i>Quercus Prinus Chinquapin</i> ,	. . .	<i>Small Chesnut Oak.</i>
<i>Robinia viscosa</i> ,	. . .	<i>Rose-Flowering Locust.</i>
<i>Ulmus alata</i> ,	. . .	<i>Wahoo.</i>
<i>Ulmus americana</i> ,	. . .	<i>White Elm.</i>
<i>Ulmus rubra</i> ,	. . .	<i>Red or Slippery Elm.</i>

The stocks for these trees should be raised from seed of the common species, to which each variety is nearest allied, for the nearer the connection of the stock with the graft the more lasting is the union and more perfect the growth. In trees that have been grafted on unsuitable stocks, we frequently see the base of the stem

abruptly contracted to a smaller circumference than the upper portion, and *vice versa*, just as the stock or the graft happens to possess the freest habit of growth. The stocks should be planted in rows two feet apart, and should be one foot distant plant from plant. When arrived at two years of transplanted growth they will be in a fit state to graft. The grafts should be united to the stock as near to the root as convenient. This facilitates the vigorous growth of the tree, and allows of the earth being drawn up on each side to cover the *clayed* portion of the graft. The clay should be removed from the grafts, and the ties or bandages loosened when the progress of the new shoots of the graft indicates the perfect completion of the process. In the spring following that in which the trees were grafted, many of them may be transplanted to their permanent sites; but it is better, as a general rule, to defer transplanting until the second autumn or spring. The *size* of the different kinds of trees most suitable for final transplanting is a point of some importance, particularly when the planting is on a large scale, and where the preservation of every fibre of the roots of the plants cannot be accomplished without an unnecessary expense of time and labour. A very young plant may be readily taken up and transplanted with its roots entire; but a plant of several feet in height requires considerable care in taking it up to preserve its roots from injury. The structure and the functions of the roots of trees, as connected with the produce and support of the plant were before described, and clearly point out the essential use of the minute rootlets and their accompanying spongeols or glands to the nourishment of the plant in every stage of its growth, and under every change of circumstance. Accordingly we find that, if a plant is taken up and transplanted with all its roots entire and uninjured, it experiences scarcely any perceptible check, unless its roots are exposed to the effects of the sun and wind for any considerable time, in which case it makes little, if any progress for a season. A moderate degree of pruning, however, of the overgrown and straggling roots of young trees, possessing the reproductive power in a full degree, and of the branches of their stems, is often expedient, and, when judiciously performed, is beneficial: it prevents the accident of doubling up the roots,

or improperly disposing them in the soil, an evil of worse consequences to the plant than the shortening of an overgrown root, or lateral branch. To trees which possess the reproductive power in a very imperfect degree, pruning the roots or branches preparatory to transplanting is injurious. The facility with which young plants of any kind can be taken up without hurting the roots, and the slight pruning which they require at that stage of growth, point out as a general rule in deciding on the most proper size of the different species of trees for final transplanting, that the non-reproductive kinds should be of the smallest size or earliest stage of growth, and those in which the reproductive power is greatest of the largest size. If we divide the stem of a white pine, or a larch, a corresponding stem is not reproduced; but if we cut down, in like manner, a willow, or even a chestnut, or an oak, a vigorous stem will follow. Where the habit of the roots is to divide into large branches, and run deep into the ground, as in the case of the oak, younger plants are required for transplanting than in those instances where the habit of the root is to produce numerous fibres. The nature of the soil also dictates, in some measure, the size of the plants. In rocky, elevated soils that cannot be ploughed or trenched, nor can allow of proper sized holes being made with the spade, plants of one or two years' growth, or such as have small roots, can only be planted: when exposed to severe winds, plants above one foot in height are loosened in the soil, and never prosper. For the purposes of general or extensive works of forest planting, the best sizes of the plants of the different species of trees at the period of transplanting to their timber sites, may be thus enumerated:

1st. NON-REPRODUCTIVE OR RESINOUS TREES.

	Height.
<i>Abies alba</i> , <i>White or Single Spruce</i> ,	from 6 to 20 inches.
<i>Abies balsamifera</i> , <i>American Silver Fir</i> ,	9 " 20 "
<i>Abies canadensis</i> , <i>Hemlock Spruce</i> ,	9 " 20 "
<i>Abies nigra</i> , <i>Black or Double Spruce</i> ,	6 " 20 "
<i>Cupressus thyoides</i> , <i>White Cedar</i> ,	9 " 20 "
<i>Juniperus virginiana</i> , <i>Red Cedar</i> ,	9 " 20 "
<i>Pinus inops</i> , <i>Jersey Pine</i> ,	6 " 18 "
<i>Pinus pungens</i> , <i>Table Mountain Pine</i> ,	12 "

	Height.
<i>Pinus rigida</i> , <i>Pitch Pine</i> ,	6 " 20 "
<i>Pinus rubra</i> , <i>Red or Norway Pine</i> ,	6 " 18 "
<i>Pinus serotina</i> , <i>Pond Pine</i> ,	6 " 18 "
<i>Pinus strobus</i> , <i>White Pine</i> ,	12 " 36 "
<i>Pinus tædia</i> , <i>Loblolly Pine</i> ,	6 " 18 "
<i>Thuja occidentalis</i> , <i>American Arbor Vitæ</i> ,	9 " 20 "

2d. REPRODUCTIVE TREES.

	Height.
<i>Acer nigrum</i> , <i>Black Sugar Maple</i> ,	from 6 to 24 inches.
<i>Acer saccharinum</i> , <i>Sugar Maple</i> ,	6 " 24 "
<i>Carpinus americana</i> , <i>American Hornbeam</i> ,	12 " 30 "
<i>Carpinus ostrya</i> , <i>Iron Wood</i> ,	12 " 30 "
<i>Castanea vesca</i> , <i>American Chestnut</i> ,	12 " 30 "
<i>Fagus ferruginea</i> , <i>Red Beech</i> ,	9 " 30 "
<i>Fagus sylvestris</i> , <i>White Beech</i> ,	9 " 30 "
<i>Fraxinus</i> , <i>Ash, different species of</i> ,	6 " 20 "
<i>Juglans</i> , <i>Hickory, different species of</i> ,	10 " 30 "
<i>Platanus occidentalis</i> , <i>Button Wood</i> ,	6 " 30 "
<i>Quercus</i> , <i>Oak, different species of</i> ,	6 " 30 "
<i>Salix</i> , <i>Willow, species of</i> ,	18 " 36 "
<i>Tilia</i> , <i>Lime, and other species</i> ,	12 " 36 "

Budding, or grafting by gems, consists in taking an eye or bud attached to a portion of the bark, of different sizes and forms, and generally called a shield, and transporting it to a place in another, or a different vegetable. It may be performed with buds of two or three years' standing, and on trees of considerable size, but not generally so. The object in view in budding is almost always that of grafting, and depends on the same principle; all the difference between a bud and a scion being, that a bud is a shoot, or scion, in embryo. In all other respects, budding is conducted on the same principle as grafting.

The operation of common budding may be performed any time from the beginning of July to the middle of August; the criterion being the formation of the buds in the axil of the leaf of the present year. The buds are known to be ready by the shield or portion of bark, to which they are attached, easily parting with the wood. The buds preferred are generally those on the middle of a young shoot, as being neither so apt to run to

wood as those at the extremity, nor so apt to lie dormant as those at the lower end. In some cases, however, the buds from the middle and extremity of the shoots are to be rejected, and those taken which are at the base of the annual shoots.

The stocks for budding may, in general, be much smaller than for grafting, as the operation may be performed on the same year's shoot. But it may also be performed on shoots or stems of several years' growth, and in such, by inserting a number of buds, a complete tree may be formed at once.

For gathering the shoots containing the buds, an early or late hour is chosen, on this principle, that the leaves being at these periods in a less active state of perspiration and suffer least from being separated from their parent plant. They are preserved fresh, and may be sent a great distance by inserting their ends in water or moist moss; though, in general, they should be used as soon after gathering as possible, and the whole operation should be performed with the greatest celerity.

Professor Thouin enumerates twenty-three species and varieties of budding; but we shall here describe only one, which is in general use: viz.

Shield budding, or T budding. This is performed by selecting a smooth part on the side of the stock, rather from than towards the sun, and of a height depending, as in grafting, on whether dwarf, half or whole standard trees, are desired; then with the budding knife, make a horizontal cut across the rind, quite through to the firm wood; from the middle of this traverse cut, make a slit downward, perpendicularly, an inch or more long, going also quite through to the wood. This done, proceed with all expedition to take off a bud; holding a cutting, or scion, in one hand, with the thickest end outward, and with the knife in the other hand, enter it about half an inch or more below a bud, cutting near halfway into the wood of the shoot, continuing it with one clean slanting cut, about half of an inch or more above the bud, so deep as to take off part of the wood along with it, the whole



PLATE CVII. with the flat haft of the knife separate the bark of the stock on each side of the perpendicular cut clear to the wood (c), for the admission of the bud, which directly slip down, close between the wood and bark, to the bottom of the split (d). The next operation is to cut off the top part of the shield (b) even with the horizontal first made cut, in order to let it completely into its place, and to join exactly the upper edge of the shield with the transverse cut, that the descending sap may immediately enter the bark of the shield, and protrude granulated matter between it and the wood, so as to effect a living union. The parts are now to be immediately bound round with a ligament of bass, or some substitute, (e), previously soaked in water, to render it pliable and tough, beginning a little below the bottom of the perpendicular slit, proceeding upward closely round every part, except just over the eye of the bud, and continue it a little above the horizontal cut, not too tight, but just sufficient to keep the whole close, and exclude the air, sun and wet.

Modes of transplanting. Much difference of opinion prevails on the comparative merits of the different methods of planting from time to time introduced, and more or less practised. Trenching is held by some to be essential to success, without considering that there are situations and soils where timber of the most valuable quality may be produced that cannot be dug or trenched. Others again infer, that to insert seedling plants into the soil in its natural state is all that is required for the production of timber and underwood possessing every requisite value.

These opinions are too exclusive; they have led to baneful effects, and still are the cause why many extensive tracts of land

lie waste, which otherwise might have been covered with profitable plantations. Well-regulated economy in the expense, or first outlay, is one of the principles of the art important to be attended to in practice. Accordingly it is not surprizing to find some modes of planting invented, and others misapplied, under the mistaken impression of furthering this principle, at the serious risk of retarding the healthy growth and prosperity of the trees, and of producing results completely subversive of the intention.

The great object of transplanting trees from seed beds, layer stools, cutting grounds, &c. to nursery rows, or beds previous to their final transplantation for good, is to increase the number of fibres and rootlets; and, by ensuring the free uninterrupted formation of healthy stems and buds, to lay the foundation of a vigorous constitution in each individual plant before it be finally transplanted to its timber site.

The different modes of planting trees on their timber sites are denominated, first, slit planting; second, holing or pitting; third, trench planting; fourth, furrow planting. There are also varieties of these characterized by the instruments or tools used for inserting the roots of the plants into the soil.

Slit planting is the most simple mode, and is practised on soils in their natural state, without any preparation of holing, ploughing or trenching. It is performed by three different kinds of instruments: viz. by the *moor planter*, (Plate 108 *a*), by the diamond dibble (*b*), and by the common garden spade.

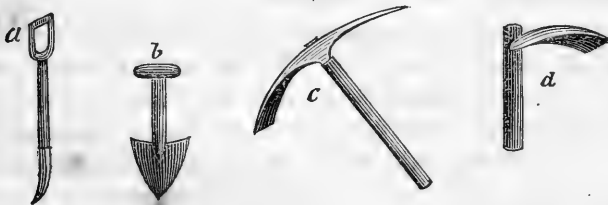


PLATE CVIII.

1st. The *moor planter* (*a*) is a heavy instrument, consisting of a wooden shaft and handle two feet nine inches in length, terminated by a single slightly curved prong of well tempered iron or steel fifteen inches in length, two and a half inches broad at the

insertion of the shaft, and gradually tapering to the point. The handle is made sufficiently large to be grasped by both hands, and the operator with one stroke drives the prong into the ground to the depth required for seeding trees, and by depressing the handle, the point of the instrument raises up the earth, leaving a vacuity or opening in loose earth, into which a person, holding a plant in readiness, places the root, and with the foot fixes it in the soil. A stout active workman with this instrument, and the aid of a boy, will transplant a greater number of seeding trees on light moor soils than by any other method at present known.

2d. The *diamond dibble* (*b*) is recommended by Sang: it is made of a triangular-shaped plate of steel, furnished with an iron shaft and wooden handle. The sides are each four inches long, and the upper part or side four inches and a half broad. It is used for planting on sandy and gravelly soils where the surface produce of herbage is short. In this case the planter makes the ground ready with the instrument in one hand, and inserts the plant with the other. He carries the plants in a bag or basket suspended from his waist; he strikes the dibble into the ground in a slanting direction so as to direct the point inwards, and, by drawing the handle towards himself, an opening is made, and kept open by the steel plate for the reception of the roots of the plant by the other hand. The instrument is then removed, and the earth made firm about the roots of the plant by a stroke with the heel of the instrument.

3d. By the *spade*, a cut is made in the turf with the spade and crossed by another at a right angle: the two cuts thus made resemble the figure of the letter T. The handle of the spade being depressed backwards forces open the edges of the cuts, and in the opening thus made the roots of the plant are inserted; the spade is then withdrawn, and the turf replaced by pressure with the foot.

Sir John Sinclair describes an improved mode of slit planting, as follows. The operator with his spade makes three cuts, twelve or fifteen inches long, crossing each other in the centre, at an angle of sixty degrees, the whole having the form of a star. He inserts his spade across one of the rays (*a*), a few inches from



the centre, and on the side next himself; then bending the handle towards himself and almost to the ground, the earth opening in fissures from the centre in the direction of the cuts that had been made, he, at the same instant, inserts his plant at the point where the spade intersected the ray (Plate 109 *a*), pushing it forward to the centre, and assisting the roots in rambling through the fissures. He then lets down the earth by removing his spade, having compressed it into a compact state with his heel; the operation is finished by adding a little earth with the grass side down, completely covering the fissures, for the purpose of retaining the moisture at the root, and likewise as a top dressing, which greatly encourages the plant to push fresh roots between the swards.

4th. The defects of the slit mode of planting are, that the earth is not properly reduced in its texture to suit the tender fibres of the roots of seedling plants, and the natural plants of the surface are left to contend with them for the nourishment afforded by the soil, nor can the rootlets of the young trees be disposed and placed in their right positions. The least objectionable practice is to cut a circular piece of the turf, a foot in diameter, and lay it on one side with the surface downwards; the workman then with his spade loosens and breaks down the texture of the uncovered soil, and, by making ample space for the extension of the roots of his plant in every direction, inserts it in the pulverized earth. The turf which had been reversed and laid on one side, is then with a stroke of the spade divided into two equal parts, and replaced on each side of the plant in its reversed position. The reversed turf supports the plant against the effects of the wind, retains the proper moisture of the soil, and prevents the evil consequences resulting to the lateral branches of the young tree, and to the healthy progress of the stem, from the uncontrolled growth of the herbage natural to the soil,—all of which, by the former modes, are rather encouraged than checked. In uninclosed commons or moors, the natural herbage and shrubby plants are kept under by cattle, &c.; but when such lands are inclosed for planting, and thereby protected from stock, the natural plants, which before appeared diminutive and slow of

growth, suddenly attain a size and vigorous vegetation highly detrimental to the young forest trees.

2. *Mattock* planting is confined chiefly to rocky ground, and to soils containing many coarse tough roots of herbage, heath, &c.; and under these circumstances the mattock is an indispensable instrument. It is thus described in the Planter's Kalendar:—'The handle is three feet six inches long; the mouth is five inches broad, and is made sharp; the length of it to the eye or shaft is sixteen inches, the small end or pick is seventeen inches long.' (c, Plate 108.) It may be unnecessary to mention that the broad or hoe end should be faced with steel and kept well sharpened; it is perfectly effective in cutting or paring the heath, furze, &c., and the pick end is equally so for thoroughly loosening and fitting the soil to be operated on with the spade or *planter* (d). The *hackle* prongs are recommended for clayey, tenacious soils, which are difficult to work with the spade. It is made with two or three prongs; the former of two for the soil just mentioned, and the latter of three prongs for stony or gravelly soils.

3. *Holing*. Holes or pits are dug out, and the loosened soil left for a season to the action of the weather, to meliorate or reduce its texture. Time should be afforded for the rotting or decomposition of the turf or surface produce taken off the space which is opened, previous to the period of planting. The size of the holes should vary according to the size of the plants to be planted, and to the nature of the subsoil. Plants from one and a half to two feet high should have the holes two feet wide and eighteen inches deep, prepared in the summer or autumn for the reception of the plants in the spring. For trees of larger growth, the extent of the roots must determine the size of the holes, making an allowance of from six inches to a foot of extra width beyond the extreme points of the roots. Holes made in tenacious clays retain the water which falls into them, and rots the roots of the trees; dry, light, sandy soils cannot be benefitted by the pulverizing action of the sun and air; rocky soils admit but imperfectly of holing; and some kinds of binding gravelly soils are as liable to the retention of moisture as stiff clays. The practice of

holing is therefore never attended with success on these kinds of soil.

Spade planting applies to land prepared for the reception of the plants by trenching. Although this mode of planting is the most common in use, and may appear to require but little exercise of skill on the part of the operator, it is nevertheless often very badly executed. It is best performed when the holes are made a few inches wider than the roots of the plant extend; the earth of the bottom of the hole should be broken down with the spade, the sides all round should be made to slope inwards so as to cause the bottom to be wider than the top. The person who holds the plant should then place it in the centre of the pit, and the operator with the spade should have ready some fine surface soil to cover the bottom and raise it up to the proper height, the person holding the plant raising it at the same time, so that it may stand not deeper in the soil than it previously stood. The earth should then be carefully thrown in a finely-divided state, and the plant during the operation slightly moved, so as to prevent the roots from being covered in bundles, and to afford each root and rootlet to have a portion of the soil intervening between it and the rest. Treading should be avoided, as it renders the soil cohesive, which in stiff or heavy land is an evil of great magnitude to newly-planted roots. In light soils, however, a slight pressure with the foot to keep the plant steady in its place is necessary, particularly if the weather is dry during the season of planting; but in cases where it is practicable, it is much more beneficial to *settle* the earth about the roots of the plants by a free application of water in the usual manner.

It is the best and most expeditious practice to have one set of men to make the holes, and another to finish the planting. When different species of trees are to be mixed in the plantation, and in unequal proportions, each species is successively distributed and planted. What we have already stated respecting the great importance to the success of the plants of not suffering the roots to be dried by exposure to the sun or wind, may render it unnecessary to urge here, that the distribution of the plants on the ground should not be farther in advance than just to keep the planters

fully employed. Before laying the plants out on the spots where they are to be planted, it is a most useful practice to dip the roots in water, or in a puddle made of water and rich mould. In planting on a confined scale, the plants may be distributed as before, and two workmen may proceed to open the pits on the spots. As soon as the hole is opened, one of the operators places the roots of the plant in the hole, while the other with his spade finishes the process as above directed. By this method the holes can be made proportionate to the size of the roots of the different plants, which, when of various species, are oftentimes also of different sizes. When circumstances warrant the previous preparation of the soil necessary to this mode of planting, it should be adopted, as being the most perfect and effective.

Furrow planting is performed by opening a furrow with the trenching plough, or with two common ploughs; the one succeeding the other in the same trench or furrow, and opening it to the depth to be required by the roots of the trees. The roots being placed in the furrow at the proper distances, the workman with the spade finds no difficulty in obtaining the necessary quantity of pulverized soil to complete the work. This mode of planting has been practised with success on the Duke of Bedford's estates in Bedfordshire, and in Buckinghamshire in the neighborhood of Woburn, England. The implement employed was a very strong plough, drawn by six horses, and opening a furrow from twelve to sixteen inches deep, turning the sward or heath over on each side. This was followed by a scuffler or grubber of three tines, which completely stirred and pulverized the soil. On light land eight acres a day was done in this way, but the soil must be light and free from large stones or other obstructions.

That extensive and valuable plantations have been made by *slit planting*, there are abundant proofs, and on elevated, thin, light soils incumbent on rock, or where trenching cannot be effected or the furrow plough be used, this mode may be adopted with economy and success. Before planting by this method, however, it is essential to know the precise nature of the subsoil, and that there does not exist a hardened stratum, impervious to water, beneath the surface, which frequently happens in heaths,

or siliceous, sandy moor lands, it generally consists of the heath soil in a compact layer about an inch thick, containing a large proportion of oxide of iron, and impervious to water. Beneath, and next to this, is generally gray or white sand, surcharged with water; and whenever trees are planted, by the slit mode, on soils so constituted, they never make any healthy growth, but perish so soon as the roots reach the hardened stratum: trenching, or the furrow plough must be employed in such cases to destroy the impervious stratum, and render free the circulation of water and air, otherwise the attempt to establish trees will be vain. When the land is clean, friable, moderately deep, free from, and not retentive of stagnant moisture, the mode of planting by holing may be adopted with propriety. Lands of a tenacious, clayey nature, and also those of the best quality, employed for forest planting, ought to be trenched, as being the most economical ultimately, and the most effectual, for these kinds of soil.

The principle on which manure is objected to for the rearing of forest trees, is, that it will force the growth of the tree beyond its natural state, and render the deposit of vegetable fibre soft, and of diminished strength and durability. This, however, is carrying the point to an extreme to which it is never likely to be in the power of any planter to arrive, were he even willing to attempt it. To manure a poor soil, for it should be here kept in view that this and not a rich, or even moderately rich soil, is intended, can have but one effect, and that is to improve the growth of the trees. But the great, immediate, and important object of manure here, is to furnish a liberal supply of food while the plant is in its first stages of growth, thereby giving it the means to form a strong constitution, enlarging its number of roots and rootlets, and, at the same time, improving the quality of the exhalations from the soil, for absorption by the leaves, which is, in fact, a melioration of the local climate or air. All these important points to the health of the tree, to the value of its timber, and to the attainment of the object in view, a valuable return in the shortest space of time for the capital expended, are thus highly promoted, and, in a great measure, secured by trenching,

manuring, and keeping clean of weeds or surface culture for a limited period after planting.

The proper distances at which young forest trees should be planted on their timber sites depends on the natural habits of growth of the different species, the nature and preparation of the soil, and the size of the plants to be planted.

The larch, spruce, and pine require less space than the oak, chesnut, elm, &c. The nature of the soil will determine the peculiar species of trees which should predominate in the plantation, and point out the distances at which they should be placed. If the soil is thin and of a light texture, the fir tribe should occupy the largest proportion, if not the whole space of land; if clayey, the oak, elm, ash, &c., should be the principal trees in the design; and, if a deep sandy soil, or if the soil be calcareous, elevated land, the beech ought to have the preference — all with the view to the ultimate produce of timber. The following table may be useful for readily pointing out the number of trees required for a statute acre of land when planted at any undermentioned distances:—

Distance apart.	Number of Plants.	Distance apart.	Number of Plants.
1 foot	43,560	10 feet	435
1½ "	19,360	11 "	360
2 "	10,890	12 "	302
2½ "	6,969	13 "	257
3 "	4,840	14 "	222
3½ "	3,556	15 "	193
4 "	2,722	16 "	170
4½ "	2,232	17 "	150
5 "	1,742	18 "	134
6 "	1,210	19 "	122
7 "	889	20 "	108
8 "	680	25 "	69
9 "	537	30 "	49

In profitable forest-tree planting, the nearest distance at which young trees should be planted on their timber sites, is a yard, or three feet, and the widest space five feet; the medium distance of four feet plant from plant is, or ought to be, that most generally adopted. Seedlings of three years' growth, or plants which have remained two years in the seed bed and one year in transplanted

nursery rows, should be planted on their timber sites three feet apart every way, it being understood at the same time that the soil is thin, light, or sandy, and that the slit or holing-in method of planting is used. But should the soil have been prepared by ploughing and trenching, and be in a clean fallow state, the medium distance of four feet, or three and a half feet, if the species of trees to be planted are exclusively of the fir or pine tribe, will be the most proper. Trees of the age now alluded to will vary in size from nine to twenty inches in height, exclusive of some species of poplar, elm, &c., which grow faster than the generality of forest trees. In well-prepared land of a deeper surface soil than the above, plants from eighteen to twenty-four inches in height of the fir tribes may be planted with advantage; and deciduous trees, as the oak, chesnut, elm, &c., from three to four feet in height, may be planted at the distance of five feet apart. In the last case a return of profits from thinnings will be obtained at least two years earlier than from transplanted seedlings, under the like circumstances of soil. Trees planted as nurses for assisting the progress of those intended for timber are of quick growth, and in the course of from seven to twelve years will have attained to a size fit for the purposes of fencing, or to be used as poles, coopers' ware, &c., according to local demand. When the nurse trees have arrived at this stage of growth, they will require to be partially thinned, to make room for the timber trees, or *principals* of the plantation, as they are termed. Whenever the branches of the former interfere with those of the latter, no time should be lost in remedying the evil, by pruning the nurse trees, or cutting them down. If the different operations of planting have been judiciously performed, the value of the trees thinned out at this period, will cover the rent of the land, with compound interest on the capital expended in planting it. Hence the importance of nurse trees, and the propriety of furnishing the ground at first with a sufficient number of young plants to be cut down and taken away periodically, until the principal timber trees have attained to maturity. In poor soils, where the original outlay of capital and the rent of the land are both small, the expenditure will be covered by the periodical crop of thinnings, and

vice versa in better soils, authorizing a larger expenditure in the preparation, in the size of the plants, and in the mode of planting, a comparatively superior number of trees of increased value will be produced at each periodical thinning. These results are certain to follow judicious planting.

The third and last mode of rearing forest trees proposed to be discussed at the head of this chapter, is that of selecting the superior shoots of coppice stools, and training them to full-grown timber trees. The oak, on account of the value of its bark, is more frequently reared in this way than the elm, ash, and chesnut. The timber of coppice trees is in general faulty, and of inferior quality to that reared from seeds. Where care, however, is taken in the selection of the shoots from healthy and not over-aged coppice stools, timber of the best quality may be obtained from them.

The produce of coppice stools consists of materials for fence wood, fuel, besoms, &c. Poles and bark are the most valuable of this produce, where the practice is to leave no standards, or saplings of timber. It is, however, perfectly clear, that when a wood or coppice offers to the purchaser produce of various sizes convertible to various uses, along with full-grown timber for navy purposes, the sale is more readily effected, and generally on better terms, than when the produce consists of smaller wood only. In making choice of the shoots of coppice stools to be trained for timber trees, great care should be had to select none but such as are straight and vigorous, and which originate as near to the roots of the stool as possible. The neglect of this latter circumstance is the chief cause of the unsoundness of coppice-reared timber, particularly at the root or *butt* end of the bole. The *parent wood* of coppice stools is most frequently suffered to rise too high from the roots, consequently the shoots emitted from it never grow with so much vigor, or attain to so great a size in a given space of time, as when the stool is kept within an inch or two of the surface of the ground. When the parent stool is a foot or more in height from the root, it becomes divided into pointed rugged parts, and if a tiller or shoot, left for a tree, is situated near to one or other of these, the *stub* is in time encompassed

by the bark of the young tree wholly or partially, which causes blemish and unsoundness in the timber, as well as obstruction to its prosperous growth. The stumps of coppice stools should, therefore, be cut near to the surface of the ground, and the face of the *stubs* as level and free from fractures as can be. The kinds of trees most profitable for coppice produce are those which possess the reproductive power in the highest degree ; these were before enumerated. It may be necessary here to observe that the non-reproductive trees, such as all the pine and fir tribes, are unfit for the purposes of coppice. The shoot, or tiller, being selected with due attention to these essential points, all other shoots belonging to the parent stool should be cut away close to the root. The young tree should then receive the same treatment as other trees reared by seed or transplanting.

Simple plantations consist of one or two species of trees only ; *mixed plantations* of many different species. The latter, on suitable soils, are the most profitable ; they afford an earlier, more permanent, and a larger return for capital than simple plantations. The judicious arrangement of the different forest trees, not only promotes the greatest returns of profit from the plantations, but likewise effects the highest embellishment to the estate and surrounding country.

Shelter in winter and *shade* in summer are also important points. Evergreen trees, and such deciduous ones as retain their leaves to a later period of the year (the beech, and some varieties of the oak) afford much greater shelter in winter and in early spring, when it is most wanted, than those which lose their leaves early in autumn, and should, therefore, be planted wherever shelter is most desired. Shade is best afforded by trees which, rising with naked stems to a certain height, afterwards send out an extended series of branches, as the oak, beech, chesnut and elm, which can be readily trained to that state by pruning, and their spreading branches and umbrageous foliage are highly superior for this intention than those of the ash, sycamore, plane, etc.

Although mixed planting, as just now observed, is the most profitable, and, under skilful massing and grouping, the most

embellishing to the landscape, yet there are certain circumstances connected with the growth of the various species of forest trees, which, when they occur, effectually control the choice of the planter in his modes of arrangement : these are, first, the peculiar nature of the soil to be planted ; secondly, the climate, or the exposure and elevation of the site of the plantation. In planting, soils may be divided into *simple* and *mixed*. The latter allows of the fullest scope to mixed planting. *Simple* soils are those which contain the smallest number of ingredients in their composition, or which consist chiefly of one substance ; as sandy soils, containing from nine-tenths of sand to one twentieth, the supposed point of absolute sterility for even common herbage, are properly termed simple sandy soils, and on which the pine, fir, larch, and perhaps the birch, can only be planted. Soils consisting of from seven-eighths to a larger proportion of chalk will rear the beech chiefly ; and when the proportion of one half of vegetable matter to one half of sand and loam meet in a soil, it is properly simple vegetable earth, and comes under the denomination of peat, of which there are several kinds, but which will be more particularly mentioned under the head of soils. On this last-mentioned soil the planter is chiefly confined to the poplar and alder : the willow and birch only partially succeed, or when the vegetable matter is in a less proportion to the other ingredients above stated.

The elevation of the sight of the intended plantation above the level of the sea, where that is considerable, influences the local climate so much as often to confine the choice of the planter to one or two species of trees only, even though the soil should be otherwise favorable for mixed planting.

It is calculated that an elevation of six hundred feet diminishes the temperature of a site equal to that of one degree of north latitude ; the degree of dryness or humidity of the atmosphere, and the force of the winds seem also to increase in proportion to the elevation of the land. Accordingly we find that different species of trees occupy different regions, and degrees of elevation on the mountains of the torrid, temperate and frigid zones.

According to Humboldt, the trees which grow in the highest

elevation are the pine and the birch, (these also it may be observed will flourish in the lowest situations, the birch in particular will grow in soils periodically overflowed or covered with water for two or three months in a year). The highest altitude of the growth of the pine is stated to be from twelve thousand to fifteen thousand feet above the level of the sea, in latitude 20° ; and the limits of the growth of the oak appears to be confined to ten thousand three hundred. The last species of trees found nearest to the limits of perpetual snow on Mount Caucasus, in latitude $42^{\circ} 30'$, and on the Pyrenees, are the common birch (*Betula alba*), and the hooked pine (*Pinus uncinata*), and the red spruce fir (*Pinus rubra*). On the Alps, latitude from 45° to 46° , the common spruce appears limited to an elevation of about five thousand nine hundred feet. In Lapland the birch is found at the altitude of one thousand six hundred feet in latitude 67° and 70° .

The influence of different altitudes on the distribution and growth of forest trees, is evident even in the inferior elevations of the forests of Britain. The pine, fir and birch occupy the highest points; next the sycamore and mountain elm; lastly, the oak, beech, poplar, ash and chesnut. When the ground to be planted is, therefore, so high above the level of the sea, as to influence materially the nature of the climate, the forest trees to be planted should be selected according to the above principles. In practice this may be termed *region planting*. By imitating the natural process in this respect, not only the most profitable returns which the site and soil are capable of producing will be secured, but also the most ornamental effects produced on the landscape, and the useful ones of judicious shelter obtained. It generally happens in extensive planting that the soil varies in different parts of the site in its properties and fitness to rear one species of tree better than another. When these different soils are, therefore, planted with the different trees best adapted to each, masses of diversified outline will adorn the landscape, having all the effect of a tasteful design, and the trees will be

individually of the most healthy growth, a point of the last importance in ornamental effect.

For low, damp and boggy soils, the alder, ash, birch, and the willow, are the best.

Transplanting trees of large growth for immediate effect properly belongs to another division of the subject, ornamental planting. It may not be unnecessary, however, to state shortly the principles of the practice as lately brought forward by Sir H. Stewart, in his *Planters' Guide*. These are to take up the tree, with all its roots, fibres and rootlets, and also the green or external system of branches and buds entire and unbroken, then to transplant these roots, rootlets, and external system of the tree in the same perfect state. The soil into which such trees are transplanted should be of a superior quality to that from whence they were taken, or at least that portion of it applied immediately to the rootlets should have an addition of very rotten manure. A point of great importance to success is the selection of the subjects. 1st. The tree should have a superior thickness and induration of the bark compared to that of trees which have grown up in a crowded state. 2d. Stoutness and superior girth of stem. 3d. Numerousness of roots, fibres and rootlets. And 4th, extent, balance and closeness of branches. Where a tree, otherwise desirable, possesses not these protecting properties, it should be provided with them previous to transplanting by uncovering the roots partially, so as not to injure the stability of the tree during the process. To these exposed roots is applied a compost of fine earth, into which they shoot, and produce in two or three years numerous rootlets fit for transplanting. The overgrown branches are reduced so as to balance the top on every side, if it require it. To assist the bark, such trees as intercept the air and solar rays are removed. These effects are also produced to the roots by cutting a trench at a proper distance from the stem round the roots, and filling up the trench with good soil; in two or three years, the roots will be increased in numerous ramifications as in the former mode.

CHAP. III.

OF THE SOILS AND SITES MOST PROFITABLY EMPLOYED IN
THE GROWTH OF TIMBER.

From what has been said respecting the advantages of judicious planting, the lands and sites most proper for the growth of timber will have been generally understood. There has been a difference of opinion whether land under woods or under tillage is the most profitable and beneficial to the proprietors and the public ; the question is similar to that which exists respecting the comparative value of tillage land and permanent pasture, and may be solved in the same manner, viz., that the prosperity, if not the absolute existence, of the one is dependent on the other, and the interests of individuals as well as the public on both. The occupiers of land where woods are scarce, or wanting altogether, and those where they are in too great abundance, will coincide in the truth of this observation. The proportion which woods should bear to tillage and pasture lands in any one district of country depends on the nature of the soil, and the local demand for certain kinds of produce.

There can be but one opinion as to the advantages of planting exposed waste lands, and those that are steep, rocky or precipitous. The loss to individuals and to the nation, by such large tracts of lands as those now alluded to lying utterly unproductive, is incalculable.

Lands of rather a superior quality to those, or which are accessible to the plough, and the barrenness of which is owing to exposure and ungenial climate, offer great inducements to forest-tree planting. For when the improvement is completed it is, to its extent, so much added to the territorial extent of the country, in affording the means of sustenance as well as the enjoyment of human life.

Lastly, where the local climate and soil are good, but where, at the same time, a scarcity of timber exists for the periodical wants of agricultural and manufacturing operations, as for the various purposes of buildings, implements of husbandry, fencing,

poles, machinery, fuel, etc., planting is of great importance and utility to the community. In many cases, where the soil is of greater value, the planting may be confined to the angles of inclosures, and to hedge rows.

In this last case it may be necessary to observe, that the land of the lowest comparative value for corn crops, and the most eligible for shelter and shade where required, should be chosen for planting.

It may be useful to take a more intimate view of the nature or composition of those varieties of soil which have been alluded to. It is proper, however, to observe, that the following statements of the nature or constituents of these soils are not intended to convey the idea that they are the best sorts respectively for the different kinds of forest trees, but principally to show that on such soils these trees have attained to great perfection of growth. The soils were selected from the spots where the trees mentioned in connexion with the soils were found by a celebrated forester, and the trees were, on an average, the finest of the respective kinds which have come under his observation.

The great importance of precision in the nomenclature of soils, whether in the details of planting or in husbandry, must be so clear and evident to every person who may be desirous to profit by the results of others' experience in these subjects, that it would be superfluous here to add more on the point.

1st. Heath soil, or siliceous sandy moor soil, incumbent on shale or ferruginous stones, and frequently on siliceous sand of great depth.

400 parts consisted of, fine siliceous sand,	320
Carbonate of lime,	2
Carbonate of magnesia,	1
Decomposing vegetable matter, chiefly composed of the decaying leaves of heath,	55
Silex, or impalpable earth of flints,	11
Alumina, or pure matter of clay,	3
Oxide of iron,	4
Soluble matter, principally common salt, or muriate of soda, 4	

The birch and the beech, are found to succeed better on a soil of the above description than any other kind of tree. For the latter, however, it is necessary that the subsoil should be a deep sand. The larch and spruce, under the like circumstances as to subsoil, will also attain to a good perfection on heath soil; but where the subsoil is rocky, or impervious to a free circulation of moisture by indurated sand, which is sometimes the case, these last-mentioned trees never succeed.

2d. 400 parts of poor sandy soil, incumbent on shale, or very coarse gravel.

Fine sand, principally siliceous,	360
Impalpable earthy matter, 40 consisting of carbonate of lime,	0
Decomposing vegetable matter, destructible by fire,	4
Silex, or pure earth of flints,	22
Alumina, or pure matter of clay,	7
Oxide of iron,	5
Soluble saline matters, chiefly muriate of soda,	2
	<hr/>
	400

The pine, larch, spruce, birch and sycamore are the most proper for this kind of soil.

3d. Sandy loam, incumbent on siliceous sand, containing a large proportion of oxide of iron. 400 parts.

Fine sand, partly calcareous, and partly siliceous,	200
Coarse sand,	84
Carbonate of lime,	6
Decomposing vegetable matter,	15
Silex, or the earth of flints,	56
Alumina,	12
Oxide of iron,	5
Soluble vegetable matter, containing sulphate of potash, vegetable extract, and common salt,	4
Loss,	24
	<hr/>
	400

The larch, pine, and fir tribe in general will succeed well on a soil of this texture, although the beech comes to the greatest perfection, or is, perhaps, the plant most profitable to employ in planting soils of this nature, particularly when the subsoil happens to be deep sand.

4th. Light sandy siliceous soil, incumbent on a damp, clayey subsoil.

Siliceous sand, of various degrees of fineness,	290
Gravel partly calcareous,	40
Impalpable loamy matter, consisting of carbonate of lime,	5
Silica, or earth of flints,	38
Alumina or clay,	9
Oxide of iron,	5
Decomposing vegetable matter,	8
Moisture and loss,	5
	<hr/>
	400

The oak grows rapidly on this soil, and should constitute the principal timber tree of the plantation. The chesnut also attains to great maturity in the same kind of soil. The nurse trees most proper are the larch, spruce, and particularly the silver fir. The elm planted on this soil had not attained to the size of the above-mentioned trees in the same period from planting, but the timber was considered of a superior quality.

5th. Clayey loam, incumbent on a clayey subsoil.

Coarse gravel, partly calcareous,	40
Fine sand,	190
Carbonate of lime,	16
Decomposing vegetable fibre,	14
Silex, or pure matter of flints,	90
Alumina, or pure matter of clay;	30
Oxide of iron,	7
Soluble vegetable extract and saline matters, containing gypsum, common salt, and sulphate of potash,	5
Loss and moisture,	8
	<hr/>
	400

This soil brings the oak to the highest state of perfection.

6th. Damp clayey soil incumbent on clay.

Coarse siliceous gravel,	60
Fine sand,	120
Vegetable matter, destructible by fire,	9
Carbonate of lime,	15
Silica, or earth of flints,	130
Alumina or pure clay,	48
Oxide of iron,	10
Soluble saline matter, with vegetable extract and gypsum,	8
	<hr/>
	400

The oak, elm, ash and hornbeam attain to greater perfection here than any other kind of forest tree. The tulip tree (*Liriodendron tulipifera*) grows freely on this soil when it is properly prepared by trenching.

7th. Fertile peat moss, incumbent on clay or marl.

Fine siliceous sand,	231
Undecomposed vegetable fibre,	13
Decomposing vegetable fibre,	57
Silica, or impalpable earth of flints,	50
Alumina, or pure matter of clay,	18
Soluble matter, principally vegetable extract,	4
Oxide of iron,	2
Moisture and loss,	25
	<hr/>
	400

This variety of peat soil when prepared for planting by draining off the superfluous moisture, with which it is found almost always saturated, is capable of growing very profitable trees, as the birch, poplar and willow. A piece of ground of this nature, prepared by cutting open drains at such distances from each other, as to leave a sufficient breadth or body of earth to retain a due proportion of moisture in dry weather, and yet prevent saturation of moisture in the wettest weather, was planted with a variety of trees. The trees above mentioned succeeded remarkably well, and made an improved return of a hundred per

cent. in comparison to that afforded by the natural produce of the surface. The following variety of peat, which is not uncommon, is to be carefully distinguished from the above.

8th. Inert peat soil.

Fine pure siliceous sand,	29
Inert vegetable matter destructible by fire,	289
Alumina,	14
Oxide of iron,	30
Soluble vegetable extractive matter, sulphate of iron, and sulphate of potash,	11
Sulphate of lime,	12
Loss and moisture,	15
	<hr/>
	400

The outward characters or appearance of this soil is so similar to those of the first mentioned variety of peat, that they are scarcely to be distinguished by common observation. The above soil, in its natural state, is absolutely sterile. Large applications of caustic lime and of common salt, in a smaller proportion, had the effect of improving the nature of this soil so much, as to render it capable of vegetating turnip seed; and of bringing the roots to the size of small turnips. It has not been proved, however, what the results of planting forest trees might be on this soil, improved in the manner now stated.

9th. Chalky soil, incumbent on chalk rock.

Calcareous sand,	280
Carbonate of lime,	60
Decomposing vegetable fibre,	5
Silica,	28
Alumina,	10
Oxide of iron,	8
Vegetable and saline soluble matters,	4
Moisture and loss,	5
	<hr/>
	400

The beech, ash, and oak thrive better on a soil of the above composition, than any of the resinous or fir species of trees.

Of the above varieties of soils, if we except the sandy loam No. 3, and the clayey loam No. 5, there is not one which, on its natural site, could be profitably cultivated under corn or green crops, but which, by skilful planting, might be made to return considerable profits to the owners, and also to the public the many advantages which judicious planting always confers.

Although there may be found shades of difference in the proportions of the constituents of soils receiving the same designation, such, for instance, as the poor sandy soil, containing ten per cent. more or less of sand in one situation more than another, yet the actual produce of timber, all other circumstances being equal, will be found to vary but little, if any. But where the difference in the proportions of the ingredients is found so great as exists between the sandy loam No. 3, and the poor sandy soil No. 2, or, in a wood as between any two of the soils now attempted to be described from practical experience in their culture, as well as from a careful chemical examination of their properties and constitution, a very marked and decisive difference will be found in the comparative produce of timber, and the peculiar species or kinds of trees which should have been planted in the greatest number, or in preference to others.

CHAP. IV.

OF THE MOST APPROVED MODES OF PREPARING DIFFERENT SOILS, FOR THE RECEPTION OF PLANTS.

In no improvement of landed property is economy in the first outlay of capital more essentially required than in forest planting. Want of attention to this important point has caused much loss to the country as well as to individuals, it having had the effect of discouraging forest planting generally, and more par-

ticularly of those lands emphatically termed wastes. The evil is perpetuated by statements confounding the expenses of planting different descriptions of land, such as that of a superior soil immediately connected perhaps with a mansion, and that of a distant hill or waste heath. In the former case the return of produce is early, great, and fully ample for every expense judiciously incurred in the plantation; while, at the same time, something must be allowed for obtaining the more immediate ornamental effect of wood. In the latter case the returns of profit are more distant, though equally certain, and the outlay of capital or expense of formation proportionally less. To estimate or make them equal to those of the first description of land, would be absurd, because unnecessary, and, in fact, impracticable, as in the case of rocky sites or thin heath soils, where the more expensive processes of the preparations of soils cannot be carried into effect.

Fencing is one of the most expensive but essential concomitants of planting; for unless young trees are completely protected by proper fences, extensive failure will be the certain consequence.

Draining is essential wherever stagnant moisture prevails in the soil. Boggy lands and tenaceous clays are chiefly the soils which require it, for trees will thrive in a degree of moisture that would be highly hurtful to the nutritive grasses, and to corn-crops. Under drains are of little service for forest trees, as their roots soon render these ineffective. In general, therefore, open cuts should be used. Where the excess of dampness is caused by springs, as in most bogs and morasses, it is essential to ascertain the source of the principal springs which feed the secondary ones, and their numerous outlets over the surface. Sub-aquatic plants, as the alder, rushes, &c., often point out the spots where the search should be made, although these plants are frequently supported by stagnant surface water. Boring with the auger is the best mode of ascertaining the source of the spring, or at least that level of its course in the strata which conducts the water to the boggy land, and where it can be effectually cut off from

supplying the secondary springs and outlets in the lower levels. When the source is ascertained, a drain should be cut to the depth of the strata through which it passes, so as to obstruct its progress. It should be made sufficiently deep, or the water will continue to pass under it, and the work will be useless. From this main drain formed across the declivity, other secondary drains should be made to conduct the water thus collected, from the source to the most convenient outlet. It would be incompatible with the space of these pages to enter into details of this subject. Elkinton's mode of draining, as given in Johnstone's Treatise on the subject, is on the above principle, and shows with precision the advantages of it, and with how much facility lands, which by the old method of draining were considered incapable of being profitably improved, may be made fit for planting and returning a valuable produce of timber.

Clayey soils which are rendered barren by surface water stagnating upon them, may be made to produce valuable timber by the simple process of constructing open drains, and forming the surface between these into ridges.

On steep acclivities, rocky soils, and thin heath, or moor lands, incumbent on rock or shale, where ploughing or trenching is impracticable, a depth of pulverized soil cannot be obtained for the reception of the roots of trees of more than two, or at most three years' growth; the mattock planter, diamond dibble, and spade, can be used with the best effect. To attempt any more expensive preparation on such lands, than may be made by these implements for the reception of the individual plants, would be injudicious. For the preparation of heath soils, incumbent on sand or loose gravel, an improved paring plough (Plate 110, Fig. 9 and 10), which we call Fyshe Palmer's planting plough, is a valuable implement.

The plough consists of two mold boards as in common use, but resting on a triangular and somewhat convex plate of iron (Fig. 9). This iron plate is furnished with sharp steel edges rivetted to it (Fig. 10, c). The fixed share (*a*, Fig. 10),

Fig. 9.

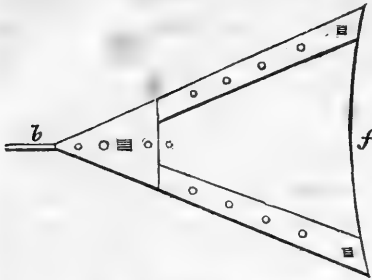


Fig. 10.

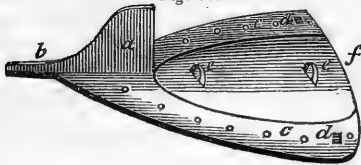


PLATE CX.

which divides the turf for each side of the double moldboard, six inches high at the shoulder, with a sharp edge tapering to a point at (*b*). The sole of the plough is screwed and bolted to the instrument by the bolt sockets (*e*), and the nut screw sockets (*d*). The base of the triangular plate (*f*, Fig. 9) is twenty-one inches, with a curve of one inch, which facilitates the action of the instrument when paring in gravelly or stoney ground. The whole length of the plate is thirty-five inches from the base (*f*) to the point of the share (*b*). Wherever the land is of a moderately level surface, and when paring is desirable, this plough will be found a valuable implement. The whole surface may be pared as in clayey soils, where burning the turf is essential; or spaces of twenty-one inches, as in heath soils, may be pared off with intervals of thirteen inches, on which the reversed turf may rest to decay, and become food for the roots of the trees. When the soil is of sufficient depth to allow of trenching, the common plough, following the track of the paring plough, will effect this object at a comparatively small expense.

Much difference of opinion prevails on the comparative advantages and disadvantages of trenching ground for forest trees; nothing is more certain than that trenching and manuring is more advantageous to the trees than holing, or any other mode of preparation. But there are certain soils which will produce valuable timber, and that cannot be ploughed or trenched; these have already been mentioned: there are others which are capable of receiving benefit from this mode of preparation, but where it would be inexpedient to bestow it. There is one instance in

which trenching cannot on any account be dispensed with, which is that of ground near a mansion, where the value of trees in respect to landscape effect, shelter, shade, concealment and the improvement of local climate, have equal if not superior claims to that of the actual value of the timber produced by the individual trees of the plantation. As many local circumstances interfere with the performance of these different processes, as the comparative cheapness of labor, of manure, the facility of obtaining the most proper sized plants, to anticipate two or three years' earlier return of produce, &c., it would be of little use here to give any calculations of expense and profits, as data by which to estimate the results of either mode of practice, that would be applicable to every soil and site alluded to. Where the local demand for the smaller-sized products of plantations are great, the more expensive process of trenching should be adopted, inasmuch as the growth of forest trees to the size of poles, and of materials for fencing, &c., is highly promoted by trenching and manuring, and the returns of profits from these products of planting are in proportion earlier and larger. That this superiority extends in the same proportion to the ultimate produce of timber in trees, may not appear so clear, because it may be urged by those who undervalue trenching and manuring as preparation of the soil for planting forest trees, and there are no satisfactory records of the comparative rate of increase of timber, or of solid vegetable fibre, after the first twenty or thirty years' growth of the different species of forest trees, which have been planted on trenched and manured grounds, and the contrary, being under all other circumstances the same until their last stage of perfection; and yet the truth of such continued superiority of increase, is the only test by which the question can be decided, and an unerring rule of practice be obtained. The results of mere observation, or conclusions drawn from the apparent contents of trees, will not be found to warrant the adoption of any new mode of practice. But the comparative increase and ultimate produce of timber should be ascertained up to the period of the trees attaining to perfect maturity in the most satisfactory manner, by actual admeasurement; and correct records kept of the age of the trees, comparative value of the

plants when planted as to their size, roots, and constitutional vigor at the time of planting; as also the intimate nature of the soil, subsoil and local climate. In the oak, after the first fifty or sixty years' growth, the annual rate of increase of the diameter diminishes greatly.

In order to have at all times the most convenient as well as the most pleasant access to the interior of the plantation, rides or broad drives should be marked out and left unplanted.

CHAP. V.

OF THE CULTURE OF PLANTATIONS.

The judicious culture of plantations is a point of the last importance to secure a full return of profits from the capital expended in their formation, as well as for every other advantage that judicious planting confers; for let the care and skill employed in their formation have been ever so great, if the proper culture be not continued from the period of planting to maturity of growth, disappointment in obtaining the effects of wood, and loss of profits will be the certain results. The numerous instances to be seen almost every where of the bad effects resulting from the neglect of judicious pruning and thinning of the trees of plantations, and the great loss caused thereby to the proprietors, evince fully the importance of this branch of the subject, which embraces the following points:—1st. Culture of the soil. 2d. Pruning, 3d. Thinning.

First. The culture of a trenched soil of a newly formed plantation, consists in keeping the surface clean of weeds until the shade of the trees prevents their growth. It is true that these weeds take a portion of nourishment from the soil, but from what was before stated regarding the food supplied to the plants by the soil, it is clear that the growth of herbaceous weeds can injure but little, if in any degree, the growth of forest trees. When

the trees are young and of a small size, however, the mechanical effects of these weeds are extremely hurtful when they are suffered to grow and mingle their shoots with the lower branches of the young trees, by obstructing the free circulation of air, and preventing the genial influence of the solar rays from reaching to their tender shoots, and this is evident to common observation in the decay or death of the branches subjected to contact with them, and in the consequent unhealthy appearance of the leading shoot of the tree.

Hoing the surface as often as may be required to prevent perennial weeds from forming perfect leaves and new roots, and annual ones from perfecting seeds, is all that is required. Two seasons of strict adherence to this rule, even in the worst cases, will render the labor or expense of future years comparatively trifling, and the healthy progress of the trees will reward the care and attention.

On soils planted by the slit, or holing-in mode of planting, it is essentially necessary to prevent the natural herbage of the soil from mingling with the lateral branches of the young tree. An active workman with a steel mattock hoe will clean round the plants on a large space of ground in a day. Summer is the best season for the work, as the weeds are more effectually destroyed, and the partial stirring of the soil about the roots of such plants as require cleaning benefits their growth.

Should the planting and culture now described have been faithfully executed, there will be few failures. When these happen, however, the vacancies must be filled up, at the proper season, with stout plants, and the holes be properly prepared for the reception of the roots. It is a good practice for the first two or three years of a trenched plantation to take a crop of potatoes, mangel wurzel, or carrots, according to circumstances. The rule, which must be strictly adhered to in the introduction of these crops, is, that no part of the foliage or tops of the green crop touch or even approximate near to the young trees; a rule of practice which, if broken through, produces equal damage as from a rampart crop of weeds to the plantation.

Second. There are three different kinds or modes of pruning, which, in practice, have been named close pruning (*a*, Plate 111). Snag pruning (*b*), and foreshortening (*c*).

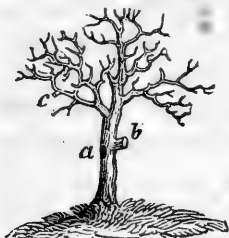


PLATE CXI.

By leaving a snag (*b*) of the branch, it in time forms a blemish in the timber, in consequence of young wood forming round the stump, and embedding it in the tree. Snag pruning is the most rude and injudicious mode that can be practised, being invariably attended with injury to the quality of the timber: it should never be adopted under any

circumstances whatever. Close pruning (*a*) is performed by sawing or cutting off a branch close to its parent stem or primary leading branch (*c*). This is the only mode to be adopted in training, or rather improving, the stem or bole of a tree, or wherever it is desirable that no reproduction of branches from the point should follow. The most perfect manner of executing the work is to saw the branch off close to the parent stem, and smooth any roughness that may be left on the surface of the wound with a sharp knife, taking care not to reduce the edges of the bark which surround the wound more than is actually necessary to remove the lacerated surface. To prevent the action of air and moisture on the naked wood, a dressing should be applied, composed of ingredients that will adhere to the spot, and resist the action of drought and rain. Three parts of cow dung and one of sifted lime will be found a very effective substitute for the more compound dressing of Forsyth. The dressing should be laid on one quarter of an inch in thickness, or more when the wound is large: when rendered smooth and firmly pressed to the part, powdered lime should be thrown over the surface, and pressed into it by the flat side of the pruning knife, or a spatula. The bark will sooner cover the wound when protected from the influence of the weather by this or by any similar means, than when left naked and exposed.

In general forest pruning this process is unnecessary, or rather the benefit is not sufficiently great to warrant its cost; but for

particular trees connected with ornamental effects it is well worth the trouble.

Fore-shortening pruning (*c*) is the only one that can be usefully practised in reducing the size of lateral branches. When these become too crowded, or when particular ones assume a disproportionate vigor of growth and increase, it is highly useful to reduce the number or size of such over-luxuriant branches. The chief point to be attended to in the operation is that of dividing the branch at a point from whence a healthy secondary branchlet springs, that it may become the leader to that branch. When the shoot is of one year's growth only, and has no lateral shoots, as in stone fruits trained on walls, the division is made near to a strong healthy bud, which will become the conducting shoot.

For young forest trees which require the branches to be regulated and balanced, so that one side may not have a disproportionate number or weight of branches to the other, and for trees in hedge rows whose lateral branches extend too far on either side, injuring the quick fence or the crops of the field, foreshortening is the most useful mode of pruning.

For non-reproductive trees, such as all the different species of the pine or fir tribe, this mode of pruning is improper, as the branch thus shortened does not produce a second shoot, but remains with all the objectionable properties of a *snag*, to the great injury, in time, of the quality of the timber. Where the purposes of evergreen masks, near the ground, in the margins of plantations are desirable, the foreshortening of the leading shoots of spruce firs, etc., is highly useful, as these trees do not afterwards increase in height, but only extend laterally by thin side branches.

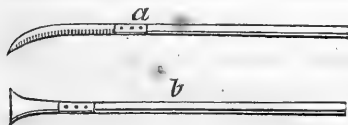


PLATE CXIII.

The most effectual pruning instruments are a strong knife, hook, saw and chisel. For pruning elevated branches a small saw firmly fixed to a long handle

is highly useful (Plate 113, *a*); a chisel, likewise furnished with a long handle (*b*), and driven by a hand mallet, is very effective

in taking off branches close to the stem or bole, in circumstances where the saw cannot be freely used from the upright direction of the branch, or the situation of the adjoining branches. Such are the manuals of forest pruning. It may be justly said that in no one process of the culture of forest trees is a just knowledge of vegetable physiology, or that of the structure and functions of the organs of vegetable life of more importance than in this one of pruning, which directly and especially applies to the assisting and directing, as well as the checking, of these functions in the production of wood as in forest trees, and in that as well as of flowers and fruit in garden trees.

A timber tree, as before observed, is valued for the length, straightness, and solidity of its stem. Judicious pruning tends greatly to assist nature in the formation of the stem in this perfect state. In natural forests, boles or stems possessing properties of the most valuable kind are found, where no pruning, trenching, or any other process of culture ever was applied to the rearing of the trees. It should not, however, be concluded from this circumstance that these processes are of little value. If we examine the growth of trees, when left to the unassisted efforts of nature by the neglect of pruning and thinning, we find that but a small number only, on any given space of planted ground, attain to perfect maturity, compared to those which never arrive at any value but for fuel. The like results, though varying according to local advantages, are exhibited in the produce of self-planted forests. Hence, instead of an average of two or three perfect trees on any given space (suppose an acre) left by the unassisted efforts of nature, we shall have from forty to three hundred perfect trees, according to the species of timber, by the judicious application of art in the preparation of the soil and the after culture of the trees, and probably on soils, too, which, without such assistance, could never have reared a single tree.

But though judicious pruning greatly assists in the production of a tall, straight bole, free from blemish, yet unless those circumstances before mentioned are favorable, as a vigorous, healthy constitution of the plant in its seedling stage of growth, transplantation to its timber sites at a proper age, and a soil

suitably prepared and adapted to the species of tree, pruning will be found but of small efficacy.

It was supposed that when branches are taken from a tree, so many organs of waste are cut off; and it has been practically insisted upon that, by the removal of large branches, the supply of sap and nourishment which went to their support would go to a proportionate increase of the stem. From what has already been stated respecting the course and movement of the sap, it may be unnecessary to add that this opinion is erroneous in principle, and that when a branch is cut off a portion of nourishment to the stem is cut off also specifically from that part of it which lies between the origin of the branch and the root, downwards to the root. Every branch of a tree, of whatever size it may be, not only draws nourishment and increase of substance from that part of the stem which stands under it, and from the roots, but also supplies these with a due proportion of nourishment in return, and by which their substance is increased. If the branch, whether large or small, acted merely as a drain on the vessels of the stem, and that the sap it derived from it was elevated to the leaves of the branch, and from thence returned no farther than to the origin or point of its union with the stem, then the above opinion would be correct: on the contrary, however, when it is found that the existence and increase of every twig, branch and leaf, depends on a communication with the root, and that this communication passes through the stem downwards to that organ, and from it upwards periodically, and, moreover, that every periodical series of new vessels thus formed in the branch has a corresponding series of vessels formed in the stem from its point of emitting the branch to the root, it is clear that a branch not only increases in substance by the functions of its own organization, but must, of a necessity, periodically increase the substance or diameter of the trunk.

The results of practice agree with this; for if an overgrown limb or branch of a free-growing tree be pruned off, the annual increase of the diameter of the stem is not found to exceed its previous rate of increase; or the excess, if any, is not equal to

the contents of wood which had been periodically formed by the branch or branches thus separated from the stem.

When branches are not allowed to perfect one year's growth, but are pruned off annually within a ~~lead~~ or two of their origin with the stem, they act rather as organs of waste than those of increase of wood to the stem. But although the rate of periodical increase of the diameter of a tree be thus lessened, in a certain extent, by the loss of a full-grown lateral branch, yet the increase of the stem in height or length is not thereby retarded, the ligneous vessels of the root corresponding with those of the stem or wood, probably act with but little diminished force in sending up sap to the higher extremities of the tree.

It is of great importance that branches which indicate an over-luxuriant growth should never be suffered to become large, or to exceed the medium size of the majority of the boughs of the tree, but should be pruned off close to the stem when the general interests of the plant will admit of it. These over-luxuriant branches, which, when suffered to take the lead in growth of the general boughs, become so hurtful to the perfection of growth of the stem, are evidently produced and supported by the accidental circumstance of a superior portion of soil being in the way of, and into which the roots immediately connected with these boughs penetrate and afterwards keep possession. By taking off such branches early, therefore, the extra supply of nourishment afforded by such local circumstance of soil is directed to the stem and useful lateral branches.

By depriving a tree, to a certain extent, of its side branches, the growth of the stem in length is promoted, but the diameter, strength, or thickness of it is not increased in the same proportion. When the side branches are destroyed by natural causes, or by the neglect of judicious thinning, the like injurious effects ensue to the primary object here in view, that of obtaining the largest quantity of timber of the best quality on a given space of land.

When the lateral branches perish or cease to be produced, except towards the top of the tree, from the want of pure air and of the vital influence of the solar rays on the foliage, the existence of the tree may continue for years, but the produce or increase

of timber of any value ceases, and it dies prematurely, affording at last a produce comparatively of no value, after having obstructed the profitable and healthy growth of the adjoining trees during its latter unprofitable stages of life. In the contest for the preservation of existence which takes place after a certain period of growth among the individual trees of a plantation which has been neglected, or left without the aid of judicious pruning or thinning, there will be found trees which, from the accidental circumstance of having originally a vigorous, healthy constitution, and from partially escaping the numerous injuries and obstructions of growth that accrue to trees by neglect of culture, have attained to a valuable timber size. The timber of the few such trees, however, as have thus gained the supremacy, is frequently much blemished by the stumps of the dead branches having become imbedded in the wood; and this serious injury to the quality of the timber and value of the tree, is the invariable consequence of neglecting to prune off these stumps as soon as they appear, or rather neglecting to cut away close to the stem such branches as indicate decay, and before they cease growing.

The time at which pruning should begin, depends entirely on the growth of the young trees. In some instances of favorable soil and quick growth of the plants, branches will be found in the course of four or five years to require foreshortening, and in case of the formation of forked leaders, to be pruned off close to the stem. When the lateral branches of different trees interfere with each other's growth, pruning, so as to foreshorten, should be freely applied in every case, in order to prevent the stagnation of air among the branches, or the undue preponderance of branches on one side of the tree. Perfect culture, in this respect, requires that the plantation should be examined every year, and by keeping the trees thus in perfect order there will never be any danger of making too great an opening, or depriving a tree too suddenly of a large proportion of branches. The operation will also be so much more quickly performed, as to render the expense of management less than if the pruning were delayed, or only performed at intervals of years, as is too frequently practised. By this management there will be little, if any,

necessity for pruning close to the stem, until the tree attain to twenty feet in height, or even more than that, provided the stem be clear of lateral branches from five to eight feet from the root. When the lateral branches are regular and moderately large, the smaller length of clear stem may be adopted, and where the branches are larger towards the top, the greater space of close pruning. Five years from the first close pruning will not be too long before the second is performed; one, or at most, two tire of branches may then be displaced in like manner. The increase of diameter of the stem, is the only certain test for deciding whether the larger or smaller number of branches may be pruned off to most advantage, or whether it may be prudent to take any away from the stem until it attain greater strength and thickness. By examining the trees of a plantation annually, the critical time for pruning every branch for the best interest of the trees is secured. Some trees may be pruned with great advantage successively for years, while others may only require it every three or five years, and others again not at all.

It has been disputed whether resinous or non-reproductive trees are benefitted by pruning; but the value of judicious close pruning to that tribe of trees cannot be doubted: at the same time it is but too true that, in numerous instances, it has been carried to a mischievous excess. Young firs and larch trees, when deprived of their lateral branches, to within four or five tire of shoots of the top, are frequently seriously injured by the winds acting on the tuft of branches, which become as a lever loosening the roots, and producing all the evils of a suddenly checked growth, besides those of excessive bleeding or loss of the resinous sap, and the want of the periodical supply of nourishment to the stem afforded by these branches. At sixteen years' growth, larches standing at four feet apart, will be benefitted by moderate pruning, that is, of two or three tire of the lowermost branches, particularly should these appear to be *decreasing* in their former vigor of growth; and afterwards in every third or fourth year, successively, the like treatment should be adopted to these lowermost branches evincing a decline of healthy growth. The same rule applies to the pine and the spruce;

but the former, having large and compound branches, should be pruned at an earlier age than the latter, or before the lateral shoots are more than two inches in diameter. When the branch to be taken off is several inches in diameter, the wound is so large, the excavation of resinous sap so great, and the heart wood, or the vessels which constitute it, so indurated, as to render the perfect union of the new and the old wood less certain than in young branches, all which make the removal of large branches productive of more evil than service to the growth of the tree and quality of the timber. On the contrary, when the pruning of the pine is altogether neglected, and the dead or rotten stumps or snags of branches are left to be imbedded in the wood, or to form cavities for the accumulation of water or other extraneous matters in the substance of the stem, all the purposes of profit and of pleasure are sacrificed to neglect or unskilful culture.

Judicious thinning may be said to be productive of the same valuable effects to a plantation of timber trees in the aggregate, as those which judicious pruning produces on every individual tree composing it: by the admission of a proper circulation of air and the solar rays, and permitting the free expansion of the essential lateral branches of the trees, as well as by preventing an unnecessary waste or exhaustion of the soil by the roots of all supernumerary trees.

The great advantages of judicious thinning are not confined to the object of obtaining the largest quantity of timber of the best quality on a given space of land in the shortest space of time; but the produce of the trees thus thinned out ought to afford a return sufficient to pay the expenses of culture, interest of capital, and the value of the rent of the land. In many instances the profits arising from the thinnings of well managed woods have covered these charges before the period of twenty years from the time of planting. The time at which the process of thinning should be commenced, depends on the like causes as those which regulate pruning, and need not here be repeated.

In general the freest growing plantations require to have a certain number of trees taken out by the time they have attained to eight years of growth from planting. On forest-tree soils of a

medium quality, the age of ten or twelve years may be attained by the young trees before thinning is necessary; but should fifteen years elapse before the trees demand thinning, it will be found that the plantation has been imperfectly formed.

No certain rule can be given to determine the number of trees to be thinned out periodically, which will apply to all plantations and to every kind of forest tree in them. A well-grounded knowledge of the principles of vegetable physiology, and of the habits of trees, is absolutely essential, to execute with success this very important branch of arboriculture.

The proper season for cutting down timber trees is that in which the sap is most quiescent, viz., midwinter and midsummer; but particularly the former. Trees whose bark is valuable require to be felled before the complete expansion of the leaf. From the last of April to the end of June is the proper time for the oak; the larch should be peeled earlier. The birch having a tough outer cuticle of no use to the tanner, and as this is more easily separated from the proper bark after the sap has partially circulated in the leaves, it is generally left standing until the other species of trees are felled and barked.

The process of barking is, in general, well understood. The harvesting of the bark is of the greatest importance, for if it be suffered to heat or ferment, it loses its color, becomes mouldy and of little value. The best mode is to make what the foresters term temporary lofts of about two feet in width, and of a length sufficient to hold a day's peeling of bark. These lofts are formed by driving forked stakes into the ground for bearers, about three feet in height in the back row, and two and a half feet in the front; a sloping floor is then constructed by laying loppings between the forks of the bearers. The bark is then placed on the sloping floor with the thick ends towards the top or higher side, the smaller bark is laid on to the depth of six or ten inches, and the broad pieces placed over the whole as a covering to carry off the wet, should rain happen before the bark is sufficiently dry to be stacked. In three or four days it should be turned to prevent heating or moulding, and in ten days, more or less, it will be sufficiently dry to be stacked until wanted for the tanner.

In order to prevent fermenting when stacked, the width of the pile should not exceed eight feet. The roof should be formed and thatched as a corn or hay stack.

The most judicious mode of felling forest trees is by grubbing up, or taking the solid part of the root with the bole, in every case where coppice stools are not wanted, for the expense of taking up the roots afterwards when either planting or tillage may be demanded on the sites of the felled trees, will be found to exceed that of taking up the root with the stem in the first instance, besides the injury to the immediate fertility of the soil by the introduction of fungi and insects, the first agents generally of decomposition of the roots of felled trees which do not stole or reproduce shoots. Besides the advantages now alluded to, there is another, that of the value of the solid part of the roots of trees. The peculiar structure of many roots afford the best materials for what is termed ornamental rustic work ; and also the compact texture of the wood, and the diversified lines of the medullary rays and concentric circles, fit it for the manufacture of very interesting cabinet works.

APPENDIX.

The table on the succeeding pages shows the result of experiments for determining the comparative quantities of heat evolved in combustion of the principal varieties of wood used for fuel in the United States, by Marcus Bull, and read by him before the American Philosophical Society in April, 1826.

NAMES OF WOODS.		Specific gravity of dry woods.	Avoirdupois lbs. of dry wood in one cord.
<i>Acer pseudo platanus</i> ,	<i>European Sycamore,</i>	.535	2391
<i>Acer rubrum</i> ,	<i>Red-Flowering Maple,</i>	.597	2668
<i>Acer saccharinum</i> ,	<i>Sugar Maple,</i>	.644	2878
<i>Aronia arborea</i> ,	<i>Wild Service,</i>	.887	3964
<i>Betula lenta</i> ,	<i>Black Birch,</i>	.697	3115
<i>Betula populifolia</i> ,	<i>White Birch,</i>	.530	2369
<i>Carpinus americana</i> ,	<i>American Hornbeam,</i>	.720	3218
<i>Castanea vesca</i> ,	<i>American Chesnut,</i>	.522	2333
<i>Cerasus virginiana</i> ,	<i>Wild Cherry,</i>	.597	2668
<i>Cornus florida</i> ,	<i>Dog Wood,</i>	.815	3643
<i>Diospyros virginiana</i> ,	<i>Persimon,</i>	.711	3178
<i>Fagus sylvestris</i> ,	<i>White Beech,</i>	.724	3226
<i>Fraxinus americana</i> ,	<i>White Ash,</i>	.722	3450
<i>Hamamelis virginica</i> ,	<i>Witch Hazel,</i>	.784	3505
<i>Ilex opaca</i> ,	<i>American Holly,</i>	.682	2691
<i>Juglans cathartica</i> ,	<i>Butternut,</i>	.567	2534
<i>Juglans laciniosa</i> ,	<i>Thick Shellbark Hickory,</i>	.829	3705
<i>Juglans nigra</i> ,	<i>Black Walnut,</i>	.681	3044
<i>Juglans porcina</i> ,	<i>Pignut Hickory,</i>	.949	4241
<i>Juglans squamosa</i> ,	<i>Shellbark Hickory,</i>	1.000	4469
<i>Kalmia latifolia</i> ,	<i>Mountain Laurel,</i>	.663	2963
<i>Laurus sassafra</i> ,	<i>Sassafras,</i>	.618	2762
<i>Liquidambar styraciflua</i> ,	<i>Sweet Gum,</i>	.634	2834
<i>Lyriodendron tulipifera</i> ,	<i>Poplar or Tulip Tree,</i>	.563	2516
<i>Magnolia grandiflora</i> ,	<i>Big Laurel,</i>	.605	2704
<i>Nyssa sylvatica</i> ,	<i>Black Gum,</i>	.703	3142
<i>Pinus inops</i> ,	<i>Jersey Pine,</i>	.478	2137
<i>Pinus mitis</i> ,	<i>Yellow Pine,</i>	.551	2463
<i>Pinus rigida</i> ,	<i>Pitch Pine,</i>	.426	1904
<i>Pinus strobus</i> ,	<i>White Pine,</i>	.418	1868
<i>Populus dilatata</i> ,	<i>Lombardy Poplar,</i>	.397	1774
<i>Pyrus malus</i> ,	<i>Apple Tree,</i>	.697	3115
<i>Quercus alba</i> ,	<i>White Oak,</i>	.855	3821
<i>Quercus banisteri</i> ,	<i>Bear Oak,</i>	.728	3254
<i>Quercus catesbæi</i> ,	<i>Barrens Scrub Oak,</i>	.747	3339
<i>Quercus falcata</i> ,	<i>Spanish Oak,</i>	.548	2449
<i>Quercus ferruginea</i> ,	<i>Black Jack Oak,</i>	.694	3102
<i>Quercus obtusiloba</i> ,	<i>Post Oak,</i>	.775	3464
<i>Quercus palustris</i> ,	<i>Pin Oak,</i>	.747	3339
<i>Quercus prinus acuminata</i> ,	<i>Yellow Oak,</i>	.653	2919
<i>Quercus prinus monticola</i> ,	<i>Rock Chesnut Oak,</i>	.678	3030
<i>Quercus prinus palustris</i> ,	<i>Chesnut White Oak,</i>	.885	3955
<i>Quercus rubra</i> ,	<i>Red Oak,</i>	.728	2254
<i>Ulmus americana</i> ,	<i>White Elm,</i>	.580	2592
<i>Vaccinium corymbosum</i> ,	<i>Swamp Whortleberry,</i>	.752	3361

Product of char- coal from 100 parts of dry wood by weight.	Specific gravity of dry coals.	Pounds of dry coal in one basket.	Pounds of char- coal from one cord of dry wood.	Bushels of charcoal from one cord of dry wood.	Time 10° of heat were maintained in the room by the combustion of one lb. of each article.		Value of specified quantities of each article, compared with shellbark hickory as the standard.
					h.	m.	
23.60	.374	19.68	564	29	6	30	52
20.64	.370	19.47	551	28	6	00	54
21.43	.431	22.68	617	27	6	10	60
22.62	.594	31.26	897	29	6	20	84
19.40	.428	22.52	604	27	6	00	63
19.00	.364	19.15	450	24	6	00	48
19.00	.455	23.94	611	25	6	00	65
25.29	.379	19.94	590	30	6	40	52
21.70	.411	21.63	579	27	6	10	55
21.00	.550	28.94	765	26	6	10	75
23.44	.469	24.68	745	30	6	30	69
19.62	.518	27.26	635	23	6	00	65
25.74	.547	23.78	888	31	6	40	77
21.40	.368	19.36	750	39	6	10	72
22.77	.374	19.68	613	31	6	20	57
20.79	.237	12.47	527	42	6	00	51
22.90	.509	26.78	848	32	6	30	81
22.56	.418	22.00	637	31	6	20	65
25.22	.637	33.52	1070	32	6	40	95
26.22	.625	32.89	1172	36	6	40	100
24.02	.457	24.05	712	30	6	40	66
22.58	.427	22.47	624	28	6	20	59
19.69	.413	21.73	558	26	6	00	57
21.81	.383	20.15	549	27	6	10	52
21.59	.406	21.36	584	27	6	10	56
22.16	.400	21.05	696	33	6	20	67
24.88	.385	20.26	532	26	6	40	48
23.75	.333	17.52	535	33	6	30	54
26.76	.298	15.63	510	33	6	40	43
24.35	.293	15.42	455	30	6	40	42
25.00	.245	12.89	444	34	6	40	40
25.00	.445	23.41	779	33	6	40	70
21.62	.401	21.10	826	39	6	20	81
23.80	.387	20.36	774	38	6	30	71
23.17	.392	20.63	774	38	6	30	73
22.95	.362	19.05	562	30	6	20	52
22.37	.447	23.52	694	29	6	20	66
21.50	.437	22.99	745	32	6	20	74
22.22	.436	22.94	742	32	6	20	71
21.60	.295	15.52	631	41	6	10	60
20.86	.436	22.94	633	28	6	00	61
22.76	.481	25.31	900	36	6	30	86
22.43	.400	21.05	630	30	6	20	69
24.85	.357	18.79	644	34	6	40	58
23.30	.505	26.57	783	29	6	30	73

GLOSSARY.

- Abrupt leaf*, A pinnate leaf which has not an odd or terminal leaflet.
- Acotyledonous*, Having no cotyledons or seed lobes; as ferns.
- Acrimonious*, Sharp; bitter; corrosive; pungent.
- Acuminate*, Abruptly sharp pointed, the point curved towards one edge of the leaf.
- Acute*, More gradually sharp pointed than acuminate.
- Aggregate flowers*, Those seated on the same receptacle or inclosed in the same calyx without the anthers being united.
- Albumen*, The white of an egg. A like substance is a chief constituent in all animal solids.
- Alburnum*, The white and softer part of wood, between the inner bark and the heart wood; the sap wood.
- Ament*, Flowers collected on chaffy scales, and arranged on a thread or slender stalk; as in the chesnut and willow.
- Angular*, Forming angles; when the stems, calyxes, capsules, etc., have ridges running lengthwise.
- Annual*, Living but one year, during which it produces flower and seed.
- Animalcule*, A little animal, invisible to the naked eye.
- Anodyne*, Assuaging pain; causing sleep or insensibility.
- Anomalous*, Whatever forms an exception to general rules.
- Anther*, That part of the stamen which contains the pollen.
- Antiscorbutic*, Counteracting the scurvy.
- Antiscorbutics*, Substances which cure eruptions.
- Antiseptic*, Opposing or counteracting putrefaction.
- Antispasmodic*, Opposing spasm; as anodynes.
- Aperient*, Opening; laxative.
- Apetalous*, A flower without petals.
- Apex*, The end, or point.
- Aquatic*, Growing in or near water.
- Arboriculture*, The art of rearing trees.
- Arid*, Dry and rough.
- Aril*, An outer covering of some seeds, which in ripening falls off.
- Armed*, Having thorns or prickles.
- Aromatic*, Sweet scented.
- Articulated*, Jointed.
- Arundinaceus*, Resembling reeds or stiff large grass.
- Assimilation*, The process by which bodies convert other bodies into their own nature.
- Astringent*, Binding; contracting; strengthening.
- Astringents*, Substances which condense the fibres.
- Axil*, The angle between a leaf and stem on the upper side.
- Axillary*, Growing out of the axils.
- Barb*, A straight process armed with teeth pointing backwards.
- Barren*, Producing no fruit; containing stamens only.
- Berry*, A pulpy pericarp enclosing seeds without capsules.
- Biennial*, Living two years, in the second of which the flower and fruit is produced; as in wheat.
- Bole*, The stem, trunk or body of a tree, after it has attained to upwards of eight inches in diameter, or to that size which constitutes timber.
- Border*, The brim or spreading part of a corolla.
- Bottom*, A low ground; a dale; a valley: applied in the United States to the flat lands adjoining rivers, etc.
- Branch*, A division of the main stem, or main root. [twig.]
- Branchlet*, Subdivision of a branch; a
- Bud*, The residence of the infant leaf and flower.

- Bulbs**, Called roots, sometimes found growing on the stem; strictly speaking bulbs are buds, or the winter residence of the future plants.
- Bush**, In gardening and planting, applies exclusively to every perennial ligneous plant (mostly with several stems from its root), which in its natural state seldom attains to a timber size, that is, having a stem *girting* six inches. We understand currant bush, goosberry bush, rose bush, holly bush, laurel bush, etc., but never oak, elm or ash-bush, etc. The limits between a shrub or bush and a tree cannot be more precisely defined than by the girth or diameter of the stem, under ordinary circumstances of culture, never attaining to, or exceeding the above dimensions.
- But end**, That portion of the stem of a tree which is situated nearest to the root.
- Calcareous**, Containing lime, applied to shells of oysters, etc.
- Caloric**, Heat.
- Calyx**, Outer covering of the flower.
- Cambium**, Gelatinous substance between the wood and bark.
- Capillary**, Hair-form.
- Capsule**, A little chest; that kind of hollow seed vessel which becomes dry and opens when ripe; a capsule that never opens is called a *samara*.
- Carbon**, Pure charcoal.
- Cathartic**, Purging; cleansing the bowels; promoting evacuations by stools; purgative.
- Catkin**, See Ament.
- Caudex**, The main body of a tree or root.
- Cell**, The hollow part of a pericarp or anther; each cavity in a pericarp that contains one or more seeds is called a cell. According to the number of these cells the pericarp is one-celled, two-celled, three-celled, etc.
- Cellular**, Made up of little cells or cavities.
- Cephalic**, Pertaining to the head.
- Channelled**, Hollowed out longitudinally, with a rounded groove.
- Cicatrise**, To heal, or skin over.
- Cion, scion**, Properly a shoot one or two years old, or a cutting of a branch of that age for the purpose of grafting. Used sometimes to denote the shoots of a coppice stool.
- Class**, The highest division of plants in the system of Botany. Linnæus divided all plants into 24 classes, 3 of these are now rejected, and the plants which they included placed in the remaining 21 classes.
- Cleft**, split or divided less than halfway.
- Colored**, Different from green; in the language of botany, green in the vegetable is not called a color. White, which in reality is not a color, is so called in botany.
- Common**, Any part is common, which includes or sustains several parts similar among themselves.
- Compound**, Made up of similar simple parts.
- Compressed**, Flattened.
- Concave**, Hollowed on one side.
- Concentric**, Having a common centre.
- Cone**, A scaly fruit like that of the pine.
- Coniferous**, Bearing cones.
- Contorted**, Twisted.
- Contracted**, Close; narrow.
- Converging**, Approaching or bending towards each other.
- Convex**, Swelling out in a roundish form.
- Convolute**, Rolled into a cylindrical form, as leaves in the bud.
- Coopers' ware**. The lower ends of oak, hickory and ash poles cut from six to eighteen feet long, according to the length of the shoot. They are cleft for the use of the cooper, waggon-tilts, etc.
- Corculum or Corcle**, The embryo or miniature of the future plant, which is found in seeds often between the cotyledons.
- Cordiform**, Heart-shaped.
- Cordate**, Heart-shaped, side lobes rounded.
- Coriaceous**, Resembling leather; thick and parchment-like.
- Corolla**, (A word derived from *corona*, a crown,) usually incloses the stamens.
- Cortex**, The bark.
- Cortical**, Belonging to the bark.
- Corymb**, Inflorescence, in which the flower stalks spring from different heights on the common stem, forming a flat top.
- Cotyledons**, Seed lobes. The fleshy part of seeds which in most plants rises out of the ground and forms the first leaves, called seminal or seed leaves.
- Creeping**, Running horizontally; stems are sometimes creeping, as also roots.

- Cruciform*, (From *cruz*, *crucis*, a cross), Four petals placed like a cross.
- Crural*, Relating to the leg.
- Culinary*, Suitable for preparations of food.
- Culm* or *Straw*; The stem of grasses; as Indian corn, sugar cane, etc.
- Culmiferous*, Bearing culms; as wheat, grasses, etc.
- Cuneiform*, Wedge-form, with the stalk attached to the point.
- Curved*, Bent inwards.
- Cutaneous*, Relating to the skin.
- Cuticle*, The outside skin of a plant, commonly thin, resembling the scarf or outer skin of animals.
- Cylindrical*, A circular shaft of nearly equal dimensions throughout its extent.
- Deciduous*, Falling off in the usual season; opposed to *persistent* and *evergreen*, more durable than *caducous*.
- Declined*, Curved downwards.
- Decomposition*, Separation of the chemical elements of bodies.
- Decortication*, The act of stripping off bark or husk.
- Deflected*, Bent off.
- Defoliation*, Shedding leaves in the proper season.
- Deltoid*, Nearly triangular, or diamond form, as in the leaves of the Lombardy poplar.
- Dendrology*, The history of trees.
- Dense*, Close; compact.
- Dentate*, Toothed; edged with sharp projections; larger than *serrate*.
- Denticulate*, Minutely toothed.
- Depressed*, Flattened, or pressed in at the top.
- Diaphoretic*, Having the power to increase perspiration; sudorific; sweating.
- Dicotyledonous*, With two cotyledons or seed lobes.
- Diffused*, Spreading.
- Disk*, The whole surface of a leaf, or of the top of a compound flower, as opposed to its rays.
- Diuretic*, Tending to produce discharges of urine.
- Divaricate*, Diverging so as to turn backwards.
- Diverging*, Spreading; separating widely.
- Drooping*, Inclining downwards, more than nodding.
- Drupe*, A fleshy pericarp inclosing a stone or nut.
- Eliptic*, Oval.
- Elongated*, Exceeding a common length.
- Embryo*, Pertaining to any thing in its first rudiments, or unfinished state.
- Emetic*, Inducing to vomit.
- Emollient*, Softening; making supple; relaxing the solids.
- Entire*, Even and whole at the edge.
- Epidermis*, See *Cuticle*.
- Equivocal*, Uncertain; proceeding from some unknown cause, or not from the usual cause.
- Esulent*, Eatable.
- Etiolation*, The operation of being whitened by excluding the light of the sun.
- Evergreen*, Remaining green through the year, not deciduous.
- Exfoliate*, To come off in scales.
- Exotic*, Plants that are brought from foreign countries.
- Expanded*, Spread.
- Expectorant*, Having the quality of promoting discharges from the lungs.
- Eye*, See *Hilum*.
- Falcated*, Sickle shaped. Linear and crooked.
- Farina*, The pollen. Meal or flower.
- Farinaceous*, containing meal, or farina.
- Fascicle*, A bundle.
- Febrifuge*, Relating to a fever.
- Fertile*, Pistillate, yielding fruit.
- Fibre*, Any thread-like part.
- Filament*, The slender thread-like part of the stamen.
- Filiform*, Very slender.
- Flaccid*, Too limber to support its own weight.
- Fleshy*, Thick and pulpy.
- Floret*, A little flower; part of a compound flower.
- Flower stalk*, See *Peduncle*.
- Foliaceous*, Leafy.
- Follicle*, A seed vessel which opens lengthwise, or on one side only.
- Foot stalk*, Sometimes used instead of *Peduncle* and *Petiole*.
- Forked*, Divided into two equal branches.
- Fructification*, The flower and fruit with their parts.
- Fungi*, the plural of *Fungus*; a mushroom.
- Fungous*, Growing rapidly, with a soft texture like the fungi.
- Gallic*, Belonging to galls or oak apples.
- Gemma*, A bud.
- Generic name*, The name of a genus.

- Genus**, (The plural of genus is genera), a family of plants agreeing in their flower and fruit. Plants of the same genus are thought to possess similar medical powers.
- Germ**, The lower part of the pistil which afterwards becomes the fruit.
- Germination**, The swelling of a seed, and the unfolding of its embryo.
- Gibbous**, Swelled out commonly on one side.
- Glabrous**, Sleek, without hairiness.
- Glandular**, Having hairs tipped with little heads or glands.
- Glaucous**, Sea green, mealy, and easily rubbed off.
- Glutinous**, Viscid; adhesive.
- Gramina**, Grasses and grass like plants. Mostly found in the class Triandria.
- Gramineous**, Grass-like.
- Grandiflorous**, Having large flowers.
- Granular**, Formed of grains, or covered with grains.
- Grooved**, Marked with deep lines.
- Habit**, The external appearance of a plant, by which it is known at first sight, without regard to botanical distinctions.
- Hair-like**, See Capillary.
- Hanging**, See Pendant.
- Head**, A dense collection of flowers, nearly sessile.
- Heart**, See Coraculum and Corele.
- Heart-form**, See Cordate.
- Herb**, A plant which has not a woody stem.
- Herbaceous**, Not woody.
- Herbage**, Every part of a plant except the root and fructification.
- Herbarium**, A collection of dried plants.
- Hermaphrodite**, Designating both sexes in the same animal, flower or plant.
- Hexagonal**, Six-cornered.
- Hilum**, The scar or mark on a seed, at the place of attachment of the seed to the seed vessel.
- Horizontal**, Parallel to the horizon.
- Humid**, Moist.
- Husk**, The larger kind of glume, as the husks of Indian corn.
- Hybernalis**, Growing in winter.
- Hybrid**, A vegetable produced by the mixture of two species, the seeds of hybrids are not fertile.
- Ichor**, A thin watery humor, like serum or whey.
- Imbricate**, Lying over, like scales, or the shingles of a roof.
- Included**, Wholly received, or contained in a cavity; the opposite of exsert.
- Indigenous**, Native, growing wild in a country, (some exotics after a time, spread and appear as if indigenous.)
- Indurated**, Becoming hard.
- Inferior**, Below; a calyx or corolla is inferior when it comes out below the germ.
- Inflorescence**, The manner in which flowers are connected to the plant by the peduncle, as in the whorle, raceme, etc.
- Irregular**, Differing in figure, size or proportion of parts among themselves.
- Irrigation**, The act of watering or moistening.
- Inserted**, Growing out of, or fixed upon.
- Intermittent**, Ceasing at intervals.
- Integument**, The covering which invests the body, as the skin or membrane that invests a particular part.
- Internode**, The space between joints; as in the grasses.
- Involucrum**, A kind of general calyx serving for many flowers, generally situated at the base of an umbel or head.
- Involute**, Rolling inwards.
- Kernel**, See Nucleus.
- Kidney-shaped**, Heart-shaped without the point, and broader than long.
- Labiate**, Having lips; as in the class Didynamia.
- Lacinate**, Jagged; irregularly torn; lacerated.
- Lamellated**, In thin plates.
- Lamina**, The broad or flat end of a petal, in distinction from its claw.
- Lanceolate**, Spear-shaped, narrow with both ends acute.
- Lateral**, On one side.
- Latent**, Hidden, concealed, (from lateo, to hide.)
- Leaflet**, A partial leaf, part of a compound leaf.
- Leaf stalk**, See Petiole.
- Legume**, A pod or pericarp, having its seeds attached to one side or suture; as the pea and bean.
- Leguminous**, Bearing legumes.
- Liber**, The inner bark.
- Ligneous**, Woody.
- Lignum**, The hard part of wood; the heart wood.

- Liliaceous**, A corolla with six petals gradually spreading from the base.
- Limb**, The border or spreading part of a monopetalous corolla.
- Lobe**, A large division, or distinct portion of a leaf or petal.
- Log**, The trunk or body of a timber tree prepared for the sawyer.
- Lubricating**, Rendering smooth and slippery.
- Lymph**, Water, or a colorless fluid in animal bodies, separated from the blood and contained in certain vessels called *lymphatics*.
- Margin**, The edge or border.
- Maritime**, Growing near the sea.
- Medulla**, The pith.
- Melliferous**, Producing or containing honey.
- Membranous**, Very thin and delicate.
- Mesh**, The opening or space between the threads of a net.
- Midrib**, or **Midriff**, The main or middle rib of a leaf running from the stem to the apex.
- Miscible**, That which may be mixed.
- Naked**, Destitute of parts usually found.
- Narcotic**, Causing stupor, or insensibility to pain; inducing sleep.
- Natural character**, That which is apparent, having no reference to any particular method of classification.
- Nectarium**, or **Nectary**, The part of a flower which produces honey; this term is applied to any appendage of the flower which has no other name.
- Nerves**, Parallel veins.
- Nerved**, Marked with nerves, so called, though not organs of sensibility like the nerves in the animal system.
- Nodding**, Partly drooping.
- Nucleus**, Nut, or kernel.
- Nut**, *Nux*, See Nucleus.
- Oblique**, A position between horizontal and vertical.
- Oblong**, Longer than oval, with the sides parallel.
- Obtuse**, Blunt; rounded; not acute.
- Oleaginous**, Having the qualities of oil; unctuous.
- Opaque**, Not transparent.
- Ophthalmia**, Inflammation of the eye or its appendages.
- Opiate**, A medicine that has the quality of inducing sleep or repose; a narcotic.
- Oval-acuminate**, A leaf is oval-acuminate when one end is round and the other pointed.
- Ovary** or **Ovarium**, The base of the pistil, which fertilized, produces a new plant.
- Ovate**, Egg-shaped; oval with the lower end largest.
- Oviparous**, Animals produced from eggs; as birds, etc.
- Ovum**, An egg.
- Palmated**, Hand-shaped; divided so as to resemble the hand with the fingers spread.
- Panicle**, A loose, irregular bunch of flowers with subdivided branches; as the oat.
- Panicled**, Bearing panicles.
- Parenchyma**, A succulent vegetable substance; the cellular substance; the thick part of leaves between the opposite surfaces; the pulpy part of fruits; as in the apple, etc.
- Parted**, Deeply divided; more than cleft.
- Partial**, Used in distinction to general.
- Partition**, The membrane which divides pericarps into cells, called the *dissepiment*. It is *parallel* when it unites with the valves where they unite with each other. It is *contrary* or *transverse* when it meets a valve in the middle, or in any part not at its suture.
- Pedicle**, A little stalk or partial peduncle.
- Peduncle**, A stem bearing the flower and fruit.
- Pellicle**, A thin membranous coat.
- Pendant**, Hanging down; pendulous.
- Pentangular**, Having five corners or angles.
- Perennial**, Lasting more than two years.
- Perforate**, Having holes as if pricked through; differs from *punctate*, which has dots resembling holes.
- Pericarp**, A seed vessel or whatever contains the seed.
- Permanent**, Any part of a plant is said to be permanent when it remains longer than is usual for similar parts in most plants.
- Petal**, The leaf of a corolla usually colored.
- Petiole**, The stalk which supports the leaf.
- Physiology**, Derived from the Greek, a discourse of nature.
- Phytology**, The science which treats of the organization of vegetables, nearly synonymous with the *physiology of vegetables*.

- Pinnate*, A leaf is pinnate when the leaflets are arranged in two rows on the side of a common petiole; as in the rose.
- Pinic*, Relating to pine.
- Pistil*, The central organ of most flowers, consisting of the germ, style and stigma.
- Pistillate*, Having pistils but no stamens.
- Pith*, The spongy substance in the centre of the roots and stems of most plants.
- Plaited*, Folded like a fan.
- Plane*, Flat with an even surface.
- Plumula* or *Plume*, The ascending part of a plant at its first germination.
- Pod*, A dry seed vessel, not pulpy, most commonly applied to legumes and siliques.
- Poles*, Shoots from coppice stools on the stems of young trees of various lengths, according to the purpose for which they are wanted; those for hops should be from ten to eighteen feet long.
- Pollen*, The dust which is contained within the anthers.
- Polygamous*, Having some flowers which are perfect, and others with stamens only or pistils only.
- Pome*, A pulpy fruit, containing a capsule; as the apple.
- Porous*, Full of holes.
- Prickle*, Differs from the thorn in being fixed to the bark; the thorn is fixed to the wood.
- Prinus*, The ancient name of an oak which inhabited moist places; the Holm Oak.
- Prismatic*, Having several parallel flat sides.
- Process*, A projecting part.
- Prop*, Tendrils and other climbers.
- Pseudo*, when prefixed to a word it implies obsolete or false.
- Pubescent*, Hairy; downy or woolly.
- Pulmonary*, Relating to the lungs; affecting the lungs.
- Pulp*, The juicy cellular substance of berries and other fruits.
- Pungent*, Sharp; acrid; piercing.
- Purgative*, See Cathartic.
- Radiate*, The ligulate florets around the margin of a compound flower.
- Radicula*, The ramifications, or smaller fibres of the root.
- Radix*, A root.
- Radical*, Growing from the root.
- Radicle*, The part of the corculum which afterwards forms the root; also the minute fibres of a root.
- Ramify*, To shoot into branches.
- Ray*, The outer margin of a compound flower.
- Receptacle*, The end of a flower stalk; the base to which the different parts of fructifications are usually attached.
- Reclined*, Bending over with the end inclining towards the ground.
- Refrigerant*, Cooling; allaying the heat.
- Resin*, An inflammable substance, hard when cool, but viscid when heated, exuding in a fluid state from certain kinds of trees, as pine, either spontaneously or by incision.
- Rhomboid*, Diamond-form.
- Rib*, A nerve-like support to a leaf.
- Rigid*, Stiff, not pliable.
- Ring*, The band around the capsules of ferns.
- Root*, The descending part of a vegetable.
- Rootlet*, A fibre of a root; a little root.
- Rosaceous*, A corolla formed of roundish spreading petals without claws, or with very short ones.
- Rubefacient*, In medicine a substance or external application which excites redness of the skin.
- Rubra*, Red.
- Rugose*, Wrinkled.
- Rupestris*, Growing among rocks.
- Saccharine*, Pertaining to sugar or having the qualities of sugar.
- Sap*, The watery fluid contained in the tubes and little cells of vegetables.
- Sapling*, A young tree under six inches diameter at four feet from the ground; in some places it is used to denote a young tree raised immediately from the seed, which is them termed a maiden tree; in others it is considered a young tree, the produce of a coppice stool, old root, or stub, and, by a few, a long young tree, the produce of either.
- Savanna*, An extensive plain or meadow.
- Scions*, Shoots proceeding laterally from the roots or bulbs of a root.
- Secernent*, That which promotes secretion.
- Segment*, A part or principal division of a leaf, calyx or corolla.
- Seminal*, Pertaining to seed, or to the elements of production.
- Serrate*, Notched like the teeth of a saw.

- Serrulate*, Minutely serrate.
- Sessile*, Sitting down; placed immediately on the main stem without a foot stalk.
- Shaky, shakes*, The fissures, cracks or longitudinal openings often found in the timber of trees which have suffered from injudicious culture and an ungenial soil.
- Sheath*, A tubular or folded leafy portion including within it the stem.
- Shoot*, Each tree and shrub sends forth annually a large shoot in the spring, and another in June.
- Shrub*, A plant with a woody stem, branching out nearer the ground than a tree, usually smaller.
- Sinus*, A bay; applied to the plant, a rounded cavity in the edge of the leaf or petal.
- Slivery*, Small, straight shoots of large ash, etc., cleft into hoops for the purposes of the cooper.
- Spatula*, A slice.
- Species*, The lowest division of vegetables.
- Specific*, Belonging to a species only.
- Spike*, A kind of inflorescence in which the flowers are sessile, or nearly so; as in the mullein, or wheat.
- Spine*, A thorn or sharp process growing from the wood.
- Spiral*, Twisted like a screw.
- Sprig of wood*, In some instances understood as the branches of a tree.
- Spur*, A sharp hollow projection from a flower, commonly the nectary.
- Squamosus*, Scaly.
- Stamen*, That part of the flower on which the artificial classes are founded.
- Staminate*, Having stamens without pistils.
- Standard*, The shoots of a coppice stool, selected from those cut down as underwood to remain for large poles or timber trees.
- Stem*, The body of a tree in all its stages of growth, from a seedling to that of a full-grown tree.
- Sterile*, Barren.
- Stigma*, The summit, or top of the pistil.
- Stipe*, The stem of a fern, or fungus; also the stem of the down of seeds, as in the dandelion.
- Stipule*, A leafy appendage, situated at the base of petioles, or leaves.
- Stomachic*, Strengthening to the stomach; exciting the action of the stomach.
- Stool*, The root of a tree which has been left in the ground; the produce of another tree, or shoot for saplings, underwood, etc.
- Striated*, Marked with fine parallel lines.
- Stub*, See Stool.
- Style*, That part of the pistil which is between the stigma and the germ.
- Styptic*, That stops bleeding; having the quality of restraining hemorrhage.
- Subsessile*, Almost sessile.
- Succulent*, Juicy; it is also applied to a pulpy leaf, whether juicy or not.
- Sucker*, Properly the young plants sent up by creeping-rooted trees, as in the poplar, elm, etc. These suckers are oftentimes very troublesome, under the circumstance of their often appearing in lawns, or grass fields near a mansion. The term sucker is also applied in some places, to denote the side shoots from a stool or stub.
- Sudorific*, Causing sweat; exciting perspiration.
- Sulcate*, Furrowed; marked with deep lines.
- Superior*, A calyx or corolla, is superior, when it proceeds from the upper part of the germ.
- Synopsis*. A condensed view of a subject or science.
- Sylvestris*, Growing in woods.
- Tannin*, The astringent substance contained in vegetables, particularly in the bark of the oak and chesnut, and in gall nuts.
- Tap root*, The first root produced by the seed of a tree, which descends at first perpendicularly into the earth, and supports the plant until the proper leaves are produced, which, in their turn, assist in the production of fibres or proper roots.
- Tegument*, The skin or covering of seeds; often bursts off on boiling, as in the pea.
- Temperature*, The degree of heat and cold to which any place is subject, not wholly dependant upon latitude, being affected by elevation; the mountains of the torrid zone produce the plants of the frigid zone. In cold regions, white and blue petals are more common; in warm regions, red and other vivid colors; in the spring we have more white petals, in the autumn more yellow ones.
- Tendril*, A filiform or thread-like

appendage of some climbing plants, by which they are supported by twining round other objects.

Terminal, Extreme; situated at the end.

Tetragonal, Having four angles or sides.

Thorn, A sharp process from the woody part of the plant; considered as an imperfect bud indurated.

Tomentose, Downy; covered with fine matted pubescence.

Tonic, Increasing strength, or the tone of the animal system; obviating the effect of debility, and restoring healthy functions.

Toothed, See *Dentate*.

Trachea, Names given to vessels supposed to be designed for receiving and distributing air.

Transverse, Crosswise.

Trifid, Three cleft.

Truncate, Having a square termination, as if cut off.

Trunk, The stem or bole of a tree.

Tube, The lower hollow cylinder of a monopetalous corolla.

Tuberous, Thick and fleshy; containing tubers, as the potato.

Tubular, Shaped like a tube; hollow.

Umbel, A kind of inflorescence in which the flower stalks diverge from one centre, like the sticks of an umbrella.

Umbelliferous, bearing umbels.

Unctuous, Greasy; oily.

Undulate, Waving; serpentine; gently rising and falling.

Univocal, Certain; regular; pursuing always one tenor.

Vacuum, Space empty or devoid of all matter or body.

Valves, The parts of a seed vessel into which it finally separates; also, the leaves which make up a glume, or spatha.

Variety, A subdivision of a species, distinguished by characters which are not permanent; varieties do not with certainty produce their kind by their seed. All apples are but varieties of one species; if the seeds of a sour apple be planted, they will produce, perhaps, some sweet apples, some of a green color, some red: there are as many trees of different kinds of fruit, as there are seeds planted. The quince is a species of the same genus, or family, as the apple; but, the seed of a quince has never been known to produce an apple tree.

Vascular, Pertaining to the vessels of animal or vegetable bodies.

Veined, Having the divisions of the petiole irregularly branched on the under side of the leaf.

Ventricose, Swelled out.

Vernal, Appearing in the spring.

Vertical, Perpendicular.

Vesicular, Made up of cellular substance.

Viridis, Green.

Viscid, Thick; glutinous; covered with adhesive moisture.

Vitellus, Called also the yolk of the seed; it is between the albumen and embryo.

Viviparous, Producing others by means of bulbs or seeds, germinating while yet on the old plant.

Volatile, Capable of wasting away, or of easily passing into the aeriform state.

Wedge-form, Shaped like a wedge; rounded at the large end; obovate with straightish sides.

Wings, The two side petals of a papilionaceous flower.

Wood, The most solid parts of trunks of trees and shrubs.

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