



Pyramidal Pear-tree regrafted (see p. 220)

THE
ART OF GRAFTING
AND
BUDDING.

BY CHARLES BALLET.

"You see, sweet maid, we marry
A gentle scion to the wildest stock;
And make conceive a bark of baser kind
By bud of nobler race; this is an art
Which does mend nature; change it rather; but
The Art itself is Nature."—SHAKESPEARE.

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P R E F A C E

THE art of Grafting and Budding has for many years been practised in France on such an extensive scale, and with such remarkable success, that the gardeners of that country are now far in advance of all others in this branch of horticulture. The present work is a translation of M. Charles Baltet's "L'Art de Greffer," and embodies all that is known on the subject, so that the reader will find in its pages the fullest information on every point which relates to these operations. Every method of Grafting and Budding is described at length, with numerous illustrations, and an enumeration of the trees, shrubs, &c., to which each mode of operation is best applied. The book concludes with a practical application of the previous instructions to about a hundred various kinds of trees and shrubs, which are then more particularly mentioned, with the season and mode of grafting proper in each case, special observations being added when necessary. M. Baltet is well known in the horticultural world as one of the most experienced fruit-growers on the Continent, and his "L'Art de Greffer," or "The Art of Grafting and Budding" is the most complete manual of these operations that has yet appeared in any language.



THE ART

OF

GRAFTING AND BUDDING.

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DEFINITION AND AIM OF GRAFTING.

GRAFTING is an operation which consists in uniting a plant, or a portion of a plant, to another which will support it, and furnish it with a part of the nutriment necessary for its growth. The plant which receives the graft should be furnished with roots; it is destined to draw nutriment from the soil, and transmit it to the part grafted. It is called the stock. We shall mention a few exceptions where the stock is a simple cutting without roots; but it is planted in such a manner as to be soon furnished with them. The other plant, or portion of plant, which is grafted on the stock, should have at least one shoot or eye, and be in good condition—that is, neither withered, nor mouldy, nor decayed, nor wet. It is called the graft or scion; it is analagous to a cutting in communication with the soil, and continues its normal growth through the intervention of the stock. Notwithstanding the intimate union of the stock and the graft, they preserve their

individual character and constitution distinct: their layers of wood and bark continue to be developed without the fibres and vessels of one converging with those of the other. It is, as it were, a federative union which leaves to the interested parties their independence. Not unfrequently the union of the grafted pieces suffers a clean severance at the point of contact, either in consequence of the weight of the branches, the violence of the wind, or some other casualty. However, the parts thus broken may be used again, either as stocks or grafts, just as before. Almost all dicotyledonous plants may be grafted. Up to the present the monocotyledonous plants have been tried without success. Their structure does not present the least capacity for the adhesion of the parts when put together; and without this intimate union, grafting is impossible.

OBJECT OF GRAFTING.

The object of grafting is—1st. To change the character of a plant, by modifying the wood, the foliage, or the fruit which it was required to produce. 2nd. To excite the development of branches, flowers, or fruit on the parts of a tree where they are deficient. 3rd. To restore a defective or exhausted tree by the transfusion of the fresh sap of a vigorous kind. 4th. To bring together on the same stem the two sexes of monoecious plants, in order to facilitate their reproduction. 5th. To preserve and propagate a great number of woody or herbaceous plants for use or ornament, which could not be reproduced by any other means of multiplication. Without grafting, our orchards would not contain such rich collections of fruits for all seasons; our forests would be without a large number of important kinds of trees; and we should not experience the pleasure of seeing in our parks such a brilliant array of native and exotic shrubs. There remains one more observation to be made in favour of grafting, that is, that the

plant, or rather fragment of plant, grafted on another preserves its original qualities and characteristic properties. It will produce branches close or spreading, leaves purple or silvery, flowers white or rose-coloured, fruit large or small, early or late, exactly resembling the variety from which it was taken, and without being influenced by the neighbourhood of, or contact with, several similar kinds grouped on the same stock. We could also quote instances of plants which, when grafted, grow more vigorously than when on their own roots. When it is considered that grafting is easy to be practised, that it involves only a trifling degree of bodily exertion, and develops a love for gardening, it will be allowed that it is both a useful and an agreeable operation.

CONDITIONS OF SUCCESS.

In grafting, a great deal of the success depends on the skill of the operator. The other conditions essential to success are affinity between the species, vigour of the stock and graft, the condition of their sap, their intimate union, the season, and temperature.

Affinity between Species.

The laws of the affinities of species are almost unknown. The observations hitherto made have been undertaken in a practical rather than a purely scientific spirit, as in the fertilizing of plants. The results obtained up to the present can only be regarded as a matter of fact. No theory has as yet been deduced from them, except that kinds to be united by grafting must be of the same botanic family.

For instance, the peach and the apricot are grafted on each other with difficulty, while both do well on the almond-tree and the plum-tree. All the cherries unite with the Mahaleb; but it will not succeed as a graft on any of the cherries. The sweet chestnut prospers on the oak; but will not do so if

grafted on the horse-chestnut, which belongs to another family. The medlar and the quince, which have solitary flowers, flourish on the hawthorn, whose flowers are in corymbs. The *Chionanthus*, so nearly allied to the lilac by its paniced flowers and simple leaves, only succeeds well on the common ash and on the flowering ash, which have compound leaves. On the other hand, the *Sorbus*, with pinnate leaves, is more vigorous when grafted on the thorn, (whose leaves are more entire) than it is when grown on its own roots.

The grafting of evergreen trees on deciduous kinds presents more than one singularity.

The *Photinia*, allied to the beam-tree, and the *Eriobotrya*, allied to the medlar, are grafted on the medlar, and not on the hawthorn. On the last, as a stock, the *Cotoneaster* and the *Pyracantha* do well. The *Mahonia* flourishes on the *Berberis*, and the common laurel succeeds on the bird-cherry and even on the wild cherry, from which it differs so much in appearance.

The grafting of deciduous plants on those that are evergreen has, in almost every case, been attempted in vain. Those who are fond of oddities can, with the assistance of grafting, have on the same thorn stock at the same time fruiting branches of the pear, the medlar, the beam-tree, the service-tree, the mountain-ash, the European and Japanese quince, and also see there the flowers of the double and red thorns, the *Cotoneaster*, and the *Pyracantha*.

They may gather from the same plum stock plums, apricots, peaches, nectarines, almonds, the corymbs of the Canadian cherry, and flower garlands of the Chinese and Japanese plum. But these whimsicalities are unworthy the attention of cultivators.

Whoever wishes to study grafting in the works of celebrated ancient authors on horticulture will find a string of absurdities,

some of which we shall mention. Virgil speaks of a plum-tree which bore apples after having been grafted, and recommends the grafting of the pear on the ash. Martial advises the grafting of the cherry on the poplar. Columella, whose works are equally trustworthy, would have the olive grown on the fig. Palladius speaks of the walnut being grafted on the Arbutus, the pear on the almond, and the citron of his native island of Sardinia on the mulberry-tree. Pliny considers thunder injurious to trees grafted on the white-thorn.

Madame de Genlis, it is said, grafted the rose on the holly or the black currant, in order to obtain green or black roses; and the Abbé Rozier recognised the possibility of it. Others united, in their imagination, the apple to the briar, hoping to gather therefrom Calvilles; the orange to the holly, in order to acclimatize the former in open woods; the vine to the walnut-tree, so as to have grapes full of oil. They are merely so many hallucinations, like the story of a cornel grafted on a peach-tree in a garden at Troyes, published by M. de Caylus in his "History of the Conjunction of Plants." The ancients are not the only persons guilty of falsification in the matter of grafting. There have been many instances of it in our own time, and we shall long continue to hear of black roses being produced from a black currant stock, &c.

Mutual Vigour of the Parts.

It will always be better to unite by grafting only such subjects as have between them some analogy in point of vigour, time of commencing to vegetate, and hardiness. If any difference should exist, it would be preferable that the graft should be of later vegetation than the stock, and also more vigorous and hardy. Tender varieties suit well with a stock of moderate vigour; but on a weakly stock they produce a worthless tree. When grafted on too vigorous a stock, it is difficult for them to absorb all the sap furnished by the roots; an evenness of

growth cannot be established between the stock and the graft. Then follow weakness and disease—disagreeable results. The reverse of this, to have the graft more vigorous than the stock, is more admissible. The pear-tree on the quince, the apple on the paradise, the cherry on the Mahaleb, give us proofs of this. The tree will be less vigorous than if perfect harmony existed between the two parts, and, its growth being thus tempered, it tends more to the production of fruit. Very great differences in the matter of vigour may be lessened by means of double grafting, in which we first graft on the stock a variety of intermediate vigour, and on this, later on, we graft the variety which we desire to propagate. The stock should always be strong enough to receive the graft. If it is weakly, although the graft will unite with it, the future tree will always be tender. Stocks that have been planted a year at least should employed. The number of the grafts on each stock should be in proportion to its vigour, so as to obtain the favourable results which will follow from the exact adjustment of the powers of vegetation. Sometimes grafting is successfully performed, during the repose of the sap, on stocks taken up out of the soil, which are replanted immediately after grafting. The graft, on its part, should come from a pure source. The tree which furnishes it should be healthy, if it is desired to transmit health and hardiness. In the raising of plants, it is easier to prevent than to cure disease. The degeneration—more apparent than real—of species and varieties is especially due to the selection of bad subjects for propagation. The parent plant or tree which furnishes the scions should always be of a strong healthy constitution.

Intimate Union of the two Parts.

In every kind of grafting it is indispensable that the two parts grafted should be in close communication, not by means of the epidermis or the pith, but through the generating layers

—that is, the new and living layers of inner bark or alburnum, in the tissue of which the cambium flows. A perfect joining is not effected except on this condition. A multiplicity of points of contact is favourable to a more complete union, which will also be assisted by a similarity of texture between the scion and the stock, especially as regards the herbaceous or woody nature of their tissues. Lastly, the speedy cohesion of the parts depends on the skill of the operator, who should know how to avoid wounds, or to cicatrise them, and to preserve them from the action of the atmosphere.

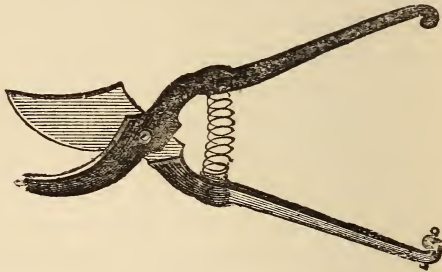
Season for Grafting.

On principle, grafting should be performed while the sap is in motion. When it is done in spring or in autumn, the time should be chosen when the sap has begun to flow, or before it has ceased to do so. In summer it is best to avoid the period of its greatest activity. In all kinds of grafting, the condition of the sap should be nearly similar in both scion and stock; when it is not so, it is much better to have the scion in a less advanced stage than the stock. The season of grafting in the open air is from the month of March till September, that is, generally speaking; in warm countries vegetation commences a month sooner. Certain plants also preserve the flow of the sap up to October and November, which permits a delay in grafting them until that time. The time most suitable for the different methods of grafting will be indicated further on when we come to describe each method. The tradition which ascribes greater vigour to grafts made at the time of new moon, and greater productiveness to those made at the end of the last quarter, we consider simply ridiculous. A calm atmosphere, and warm rather than rainy or cold, is both agreeable to the operator and conducive to the success of the operation. Heat, within certain limits, stimulates the nutritious fluid; while cold, on the contrary, chills

and benumbs it. During the frosts of winter, grafting cannot be carried on except in the shelter of the propagating-house, where artificial heat and the other arrangements of the horticulturist will bring on vegetation to the desired extent at all seasons. Grafting under glass, either in houses or frames or under the cloche, is constantly practised from January to March, and from July to September.

IMPLEMENTS AND APPLIANCES FOR GRAFTING.

Simple, handy tools, with well-steeled blades, and kept in good condition, are preferable to complicated implements with several blades, or bristling with salient or cutting points, which may wound both the tree and the operator. The tool with a fixed blade is more firm in the handle, but one with a



The *Sécateur*.

closing blade is more easily carried in the pocket, the apron, the tool-case, or the basket.

The Sécateur.

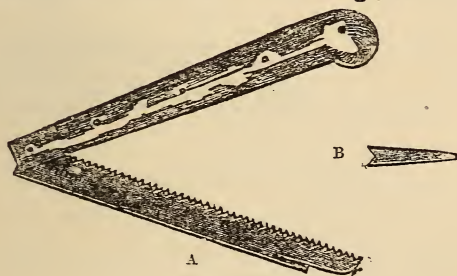
This is an implement formed with two arms of steel or iron, one of which terminates in a cutting blade, the other in a blunt bevelled crescent, against which the branch to be cut rests. The handles being wide and roughened on the back are, in consequence, easier to hold and less fatiguing to the hands. The *sécateur* is used for the following purposes:—

1. For cutting off the heads of stocks which are too thick for the pruning-knife, and not thick enough to require the saw, in those modes of grafting which demand a preliminary shortening of the stock.
2. For cutting off scions from the parent tree.
3. After grafting, for cutting, above the scion, any stocks that have not been previously shortened, with the object of stimulating the development of the graft.
4. For cutting off the heels of grafts made on the branches of the stock after a year's growth.
5. For severing from the parent-tree scions grafted by approach.
6. For pruning spine-bearing plants and trees.

In general, the wounds occasioned by the sécateur require to be dressed with the pruning-knife.

The Saw.

Hand-saws, with either a fixed or closing blade, are used for



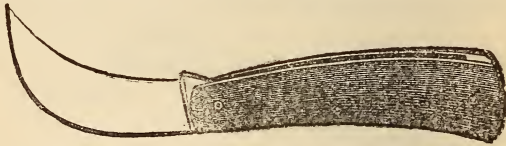
A
The Saw.

cutting strong branches and thick stocks for crown-grafting with a tall or a short stem, and for cutting off the heels of grafts made on the branches of the stock when they are dry or too thick for the pruning-knife or the sécateur. When a strong branch is to be sawn, the heavy branchlets above the place of incision should first be removed; this will render it

easier to work the saw, and the bark of the trunk will not be so likely to be injured. Moreover, the operator slackens the movement of his arm when the branch is nearly sawn through; it is often even prudent to cease sawing altogether then, and finish the amputation with the pruning-knife, holding with the other hand the part which is being cut off. Cutlers manufacture saws with a single or a double row of teeth, and with the back of the blade (A) thinner than the toothed part (B). Grafters use excellent saws made of scythe blades, with one row of teeth, and set in the handle at an angle. The saw should never be used on a living tree without dressing and smoothing its marks with the pruning-knife, otherwise the furrows left by the saw will retain moisture on the surface of the wound and retard its healing.

The Pruning-Knife.

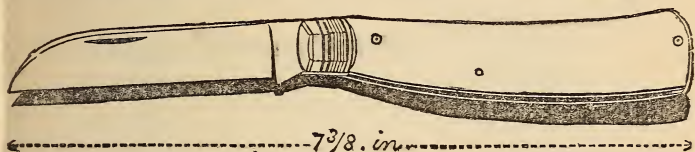
The pruning-knife consists of a handle of wood or horn,



French Pruning-Knife (*Serpette*).

either straight or slightly curved, and a blade curved at the end. The point of the blade is more or less prominent. The workman becomes so accustomed to a particular shape that he often prefers an old, almost worn-out, knife to a new one of more even form. The pruning-knife is necessary for dressing the wounds caused by the saw or the sécateur, for trimming bruised or torn tissues, and for smoothing down a cut, so that it may present a level surface, without inequalities, bruises, or splinters. In order to smooth properly, the hand which holds the handle of the tool should have the thumb supported

against the branch or stem, while the other hand directs the blade. In the case of a stock of moderate thickness, the shortening of the stem is effected by means of the pruning-knife, without having recourse to the saw. The pruning-knife



English Pruning-Knife (straight-bladed form).

is also employed for cutting up the scions into suitable lengths. If it is preferred to employ a pruning-knife, in cutting and dressing them finally it will be advisable to have in reserve another finer-edged one, and keep the first for heading down, cutting off old stems, and such rough work. Grafters who use the pruning-knife for every operation of grafting should choose a blade not much curved, which will be found very handy when it is required to split the stock. The pruning-knife is also used, after grafting, in shortening those stocks which have not been previously cut, and also for removing the heel of the graft after a year's growth. The handle is held with both hands, and thus the heel is cut off with greater ease. This implement is also useful in trimming thorny trees.

The Budding-Knife.

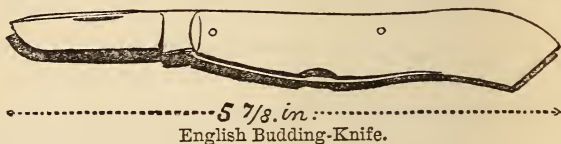
The budding-knife is a tool with a narrow blade, widening



French Budding-Knife (*Greffoir*).

towards the end, and with the point curving backwards. At the end of the handle is a spatula, or small thin blade of ivory, which is used for raising the bark. This spatula should

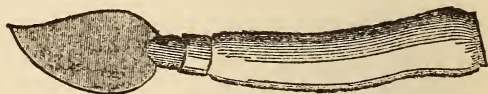
not be made of metal, as that would soon be rusted by the sap. The budding knife is indispensable for bud-grafting, for cutting the scions in branch-grafting, for raising the bark, for



grafting under glass, or cutting ligatures when too tight for the graft, &c.

The Grafting-Knife.

The handle of this implement is slightly curved, in order to facilitate grafting near the surface of the ground; the blade, in form of a comma or drop, is useful for splitting stocks intended for cleft-grafting when a partial cleft is required. A cleft from side to side is obtained by means of a knife with a



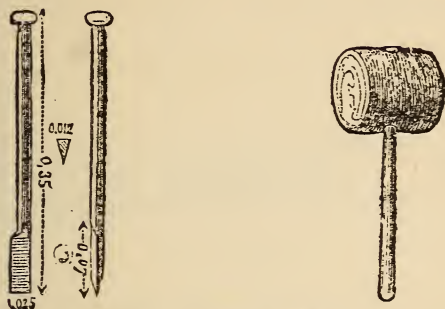
Grafting-Knife.

straight blade, like a table-knife in shape. The handle and back of such a knife should be strong enough to support the blows of the mallet, which the operator is sometimes obliged to use in cleaving very thick or hard-wooded stocks.

The Grafting-Chisel.

The grafting-chisel has the blade and the handle all in one piece, iron and steel. It has every advantage of solidity and resistance when it is required to cleave strong stems, either with or without the help of the mallet. When the cleft is made, we can, by half withdrawing the chisel, use it as a lever or wedge to keep the cleft partially open, and facilitate the

introduction of the graft. The chisel used by the vine growers of the south of France measures fourteen inches in



Grafting-Chisel and Mallet.

length. The blade is about two and three-quarter inches long.

The Grafting-Gouge.

The grafting-gouge here represented comprises a handle about four inches long, and an iron stem nearly eight inches in length, the upper part of which for about two inches is curved inwards, and terminates in a curved gouge, with which



Grafting-Gouge.

the groove to receive the graft is cut. This implement, which is recommended by M. Rose-Charmeux, of Thomery, is useful in grafting by approach.

Combined Grafter.

M. Auguste Rivière, head gardener at the Luxembourg, Paris, is the inventor of this implement, the special use

of which is in grafting by inlaying, which will be alluded to further on. The blade has a double purpose: the gouge (B) at the upper end is angular, so as to produce in the stock a wedge-shaped incision. At the bottom of the blade is a similar angular gouge (C), with which the scion is cut into a triangular wedge, which will fit perfectly into the incision made

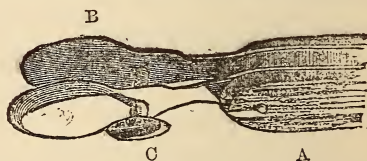


Combined Grafter.

in the stock, as the two gouges (B and C) are made with the same angle. That at C may be turned the other way, so as to suit a left-handed workman. Between these two parts, the blade is sharp-edged at A, and serves for cutting the scion from its parent-tree, or for smoothing the angles, if they have been imperfectly cut by the gouge at C.

The Métro-Greffe.

This tool is composed of a double spatula, which is fitted into the handle of an ordinary grafting-knife. Its



The Métro-Greffe.

use is to measure the scion and stock, so as to make them fit exactly in those modes of grafting in which the two parts are placed in juxtaposition by simple veneering. The handle (D) bears at one end the blade of the grafting-knife which cuts the scion; and at the other end the double spatula, the two

parts of which (A and B) are joined by a screw (C). The *métro-gresse* answers the purpose of a pair of compasses for measuring the back of the bevel of the graft, and then tracing on the stock a corresponding width for the groove which is to receive it.

All these tools are not indispensable in the practice of grafting; but they have each a special use. The last three are intended to facilitate nice and complicated operations in grafting.

KEEPING THE TOOLS.

They should always be in a serviceable and clean condition. In the course of repeated operations, especially when the sap is flowing freely, it thickens and accumulates on the blade of the tool. It should be constantly removed by the application of water or moist earth. The dirt interferes with the proper management of the tool, and injures the internal layers of the bark and wood which come into contact with the blade. Frequent sharpening of the cutting implements should not be neglected, as wounds heal much more readily when the cuts are clean. When the tool gets blunt, it should be ground down on a grindstone, and afterwards rubbed on a finer stone, to remove the wire-edge. In long-continued operations the tool should be rubbed on the fine stone frequently during the day. The Turkey, or any other fine-grained stone, is the best for sharpening pruning-knives. The slate-stone is suitable for the grafting-knife and the *sécateur*. There is also the fine stone used for razors and penknives; on this, with a drop or two of oil, fine blades for delicate operations are sharpened. In nurseries, after passing the tools over the stone, they are stropped on the leather of the boot or shoe, or on the palm of the hand. The mode of sharpening depends on the skill or the practice of the operator. The object should be to sharpen the cutting parts without weakening them; otherwise, in

rough work, the edge will soon become blunt, and is easily notched. The saw is sharpened with a file made for the purpose. Delicate tools, and even the *sécateur*, should be sent to the cutler.

Ligatures.

Almost all the modes of grafting require a ligature to fasten up separated tissues or raised bark, to tie clefts together, and to keep the graft firmly on the stock. If any considerable interval should be allowed to occur between the insertion of the scion and the application of the ligature, (the action of the atmosphere would not fail to have an injurious effect on the graft. The best ligatures are those which can neither expand nor contract under hygrometric influences, and which possess a certain amount of elasticity permitting them to accommodate themselves to the increasing diameter of the stock without cramping it. The thicker the stock is, the firmer should the ligature be; for in this case the healing of the wound is naturally more tedious, and everything should be done to accelerate it. In cases of grafting where the bark only has been raised, it is sufficient to bring the cortical layers together, and to tie up the graft without compressing it. The ligature is applied with both hands. It is rolled in a spiral manner around the grafted part, drawing it tight at every turn, especially at the beginning and the end, where it is most liable to become loose. It does not matter whether the turns are made very close to each other or not; the essential point is that the ligature should keep the graft firm. Should it yield on passing the finger over it, it is not sufficiently tight, and must be done over again. Woollen thread combines all the qualities to be wished for in a good ligature; it adapts itself to the growth of the tree, and is not affected by moisture, as it has been passed through oil in its manufacture. It is very much used in bud-grafting on small branches and medium-

sized fruit trees and shrubs, conifers, and rose-trees, or small stocks grafted in the open air or under glass. Two or three threads of it are put together (without twisting them) in lengths proportioned to the thickness of the stocks and the depth of the clefts to be covered. For large stocks this thread would not be sufficiently strong. Cotton-thread is not affected by hygrometric changes, but it does not possess the elasticity of the woollen material. We recommend it for bud-grafting on strong stems, or such as are of slow increase in bulk, and also for grafts under glass. In applying it as a ligature, it is best to fasten it with a knot so that it can be easily untied, when it becomes too tight, as cotton is difficult to cut across, and the same ligature can then be used another season. The expense of purchasing cotton and woollen materials for ligatures in nurseries has led to an inquiry for cheaper substitutes. After trying various species of carex and bulrushes, two aquatic plants were found which supply an excellent material for ligatures. These are the reed-mace (*Typha latifolia*) and the bur-reed (*Sparganium ramosum*), both of which grow in abundance on the banks of rivers and ditches, in ponds and marshes, and belong to the natural family of Typhaceæ. The plants are gathered when full-grown, either about the end of summer for the following season's use, or in spring to be used the same year. The leaves, which are thickly crowded at the base, are separated, and put to dry in the shade or in a loft, where they are hung up in bundles formed by tying the ends together. When the time for using them arrives, they are cut into the lengths required, usually from one foot to twenty inches. A short time before grafting, these ligatures, tied in a bundle, are plunged into water, where they are left for a few hours; they are then taken out and wrung dry in the same way that linen is wrung. Very often they are merely put into a cellar to keep them cool and moist, and in places where water

cannot be conveniently employed, they are placed under the soil with the same object. This kind of ligature requires a proper medium of dryness and moisture. If too dry, the leaf of the reed-mace or of the bur-reed will not have sufficient resisting power, and will break; if too moist, it will cause the graft to rot, in addition to being just as brittle as in the other case.



Reed-Mace.



Bur-Reed.

The leaf is generally broad enough to be divided lengthways, and fastens better when it is put on edgeways, and not laid flat, and when it is slightly twisted in winding it round the graft. With the exception of those modes of grafting which require the woody tissues of the stock to be cleft, and for which the leaf of the reed-mace or the bur-reed is not

sufficiently tough, we recommend this ligature for the greater number of grafting processes. The soft leaves of the common flag (*Iris Pseud-acorus*), which do not cut like the leaves of the carex, will furnish a pliant and firm ligature, but not so strong as the preceding. The bark of the lime-tree, as it is prepared for the manufacture of well ropes, furnishes a good ligature for cleft-grafting or crown-grafting, or grafting by approach, and in all cases where it is necessary to oppose a certain amount of resistance to large stocks or broken tissues. Dipped in water, then dried and divided, this kind of ligature possesses a suitable amount of elasticity, and does not tighten on the stock, as pack-thread or hamper-twine would. Packing-mats, which come as coverings of colonial imports, offer the same advantages, and the ligatures which they furnish will not injure the tender bark of the young wood in various kinds of grafts. Pack-thread, single or doubled, and old twine unravelled are very often used, because they are easily procured. They should, however, not be twisted, and must be carefully looked after when the graft begins to swell. Split osiers are hardly ever used except at country places, where anything better is not always to be had. They may be employed as ligatures for old trees, whose diameter does not increase so rapidly as to cause injury in any form to result from over-tight compression. The bark of the elm and the willow, dried and afterwards moistened, are neither better nor worse than the split osiers, Their defect is that they contract too speedily, unless they have been prepared a year before-hand. The office of the ligature is a temporary one; it ceases when the union of the parts is sufficiently advanced for the development of the graft. We shall see further on, when we come to discuss the subject more at length, what additional attention is required by the ligature, and at what time it is considered to be proper to dispense with it.

Grafting-Wax.

In grafting, it is necessary to cover the wounds and cuts with an unctuous composition, which will not have the defect of drying-up or burning the wound, nor of running or cracking under the action of the air or from being badly made. This must be applied copiously and without stint to the wounds and clefts of both stock and scion when the graft is fixed in position. A well executed graft may fail in consequence of the bad quality of the wax. Those modes of grafting in which no cut surface is exposed to the air, bud-grafting for instance, do not require any application of this kind. In spite of numerous new inventions, good compositions are still few, but those which we possess are sufficient.

Grafting-Clay, or Onguent de Saint-Fiacre of the French.

This primitive composition consists of two parts of clay and one part of cow-dung. It is held on the graft by means of pack-thread or a piece of rag, and presents the form of an oblong ball. Some persons put a strip of bark between the cut and the composition, to prevent the latter from penetrating into the clefts. Others mix finely-chopped hay or grass with it, to give it more consistency. Two thousand years ago, authors recommended the covering of the "kneaded luting and glue of the graft" either with a borage leaf or with moss. Grafting-clay is much used in many country places, and is an economical composition, especially for the grafting of all sorts of old trees.

Warm Mastic.

For a long time, nurserymen have manufactured their own mastic. The composition of it varies; the base being usually Burgundy pitch, black pitch, bees-wax, suet, and resin. To these ingredients some add ochre, hog's lard, flowers of sulphur, Venice turpentine, or sifted cinders. All are melted

together over the fire in an iron pot, and the composition should be allowed to cool before it is used. Practice makes it easy to judge of the proper proportions of the ingredients ; the pitch tends to thicken the composition, the suet to make it lighter, the resin imparts dryness to it, and the bees-wax gives it oiliness. The following mixture is in high repute at the establishments of MM. André Leroy, of Angers, and Baltet Frères, of Troyes :—First, melt together, resin 2lbs. 12 ounces, Burgundy pitch 1 lb. 11 ounces ; at the same time melt separately, suet 9 ounces. Pour the suet, when thoroughly melted, into the first mixture, stirring it well while doing so. Then add 18 ounces of red ochre, dropping it in gradually in small portions, and stirring the whole up for a good while. Whatever composition may be used, it should always be unctuous, easily worked, and free from acidity, and is best applied lukewarm, rather cool than hot, and when of a consistency approaching the liquid rather than the solid. It is brought into this condition with the help of a small portable stove, heated like a warm bath, or with a spirit-lamp, or by any of the common methods. It is applied with a small paint-brush, or a stick with a rag wrapped round the end, or, better still, with a wooden spatula. The warm mastic is an economical kind for large operations, and is preferable to the cold mastic for autumn grafting, as the frost has been found to have less effect upon it.

Cold Mastic.

The inconveniences that always attend the use of warm compositions, and the trouble of making them, have brought very much into fashion cold mastics, which soften under the heat of the hands, or remain unctuous from the nature of their composition. Up to the present time, no cold mastic can compete with that of M. Lhomme-Lefort, manufactured by his son at Belleville, Paris. This mastic is sold in tin boxes,

in which it preserves its pliability, even after the box is opened. It is spread on the graft with a spatula, and should it be necessary to touch it with the fingers, these should first be wetted. Once exposed to the air, it hardens a little. It does not crack with frost nor run in hot weather, and is the best composition that can be used. We have seen in Germany a cold composition invented by M. Lucas, pomologist. This is made of Burgundy pitch melted over a slow fire. Into this is poured the third of its weight of alcohol of 90°, stirring the mixture constantly with a stick. The only drawback with cold mastics is that they do not harden sufficiently in winter when they are applied in autumn; then the frost, having an advantage over a soft substance, can reach the tissues of the tree thus insufficiently protected.

Accessories.

Grafting under glass requires certain accessories, such as pots, composts, mats, screens, canvas, coverings, &c., although the stocks grafted are intended for future culture in the open air. When the young grafts begin to vegetate, stakes, osiers, and rushes are indispensable auxiliaries. The stakes are made of small branches or twigs of resinous trees, or of willow, poplar, chestnut, &c., cut in different lengths. These are more manageable than stakes made of split wood. They will last for a long time if plunged, when fresh cut and prepared, into a bath of dissolved sulphate of copper (bluestone), made in the proportion of about one pound of the sulphate to four gallons of water. Saplings more or less branched will answer for staking young grafts on strong, well-grown stocks. These should be treated with sulphate of copper like the others. The solution may also be applied with advantage to mats, canvas, hot-bed frames, &c., as anything so treated will be secured from the attacks of insects, snails, or other vermin.

Osiers (*Salix purpurea* or *S. vitellina*) are cut in winter from pollards. They are used, either fresh or dried, for fastening stocks or branches to the stakes. They are sorted in sizes, tied in bundles, and put in a shady, dry place. They should be soaked in water for at least twenty-four hours before using.

Rushes (*Juncus diffusus* and *J. glomeratus*) are used for tying up young herbaceous scions to the stakes. When the scion becomes woody, the rushes will not be sufficiently strong, and must be replaced by osier twigs, strips of lime bark or willow, bast mat, or the leaves of the reed-mace and bur-reed. Rushes are gathered in summer, dried moderately, and laid by in a loft. They require to be steeped in water for only a few hours before using.

STOCKS AND SCIONS.

Raising the Stocks.

First stage.—The plants intended for stocks are obtained either from seed, layering, or grafting. A sucker does not answer so well, as the operation of grafting and its consequences have a tendency to excite it to produce suckers.

Sowing.

Seeds should be sown as soon as they are ripe:—1st, from April to June; 2nd, from August to October. If it is not convenient to sow them immediately, they should be placed in a shallow vessel, in alternate layers of seed and sandy soil, and laid by in a cellar. When they begin to germinate, they may be sown in the open air. The soil of the seed-bed should be well pulverised and carefully cleaned. The seed may be sown either broadcast, or in rows, or in holes. When it is small in size, or near germinating, or when the season and the soil are cold, it should be but slightly covered. If sown

too thickly, the seedlings will be puny; if too thinly, they will remain short and sprawling. The vigour of the plant and its ultimate destination should be taken into account. If the sowing has been too thick, it should be judiciously thinned out in summer. Earthing up, watering, weeding, destroying insects, and keeping off birds, are matters requiring some attention.

Layering.

This is performed in spring, summer, or autumn, with woody or herbaceous branches not separated from the parent stem, around which a small trench is dug at a short distance. Into this the strong and healthy branches are pegged down, then bent abruptly, and the end turned up vertically, and cut off, so as to leave a couple of eyes above ground. The trench is then filled up with good soil. In *multiple layering*, a branch is laid down from the parent stem horizontally in a trench. This branch should form a number of young herbaceous branchlets about three or four inches long. Each of these will take root, and in autumn may be cut away as a separate plant. Kinds that are slow in sending out roots should have an incision made, either lengthways or across, immediately under an eye on the part that is put under the soil. Tender kinds and evergreens should be layered in pots. In all modes of layering, the layer should be separated from the parent plant as soon as it is well rooted. It is then taken up and planted permanently or in the nursery.

Hillock-Layering.

This is used for the quince, the Paradise and Doucin apples, the plum, the fig, the hazel, &c. The stock is cut down level with the ground; in summer, a small mound is raised about it, and the ends of the young shoots are pinched, which excites them to throw out a number of rootlets. In autumn the

mound is cleared away, and the young stems which have taken root are separated from the stump, and planted out. If a shoot should be badly rooted, it should be earthed up again until the following year. Stumps may be thus layered every year, or every second year.

Cuttings.

Pieces of branches or of roots, when placed in the soil, take root, grow, and form new plants. These pieces, if of branches, should be from ten to sixteen inches long, and have one or more eyes. If of roots, they may be from two inches to six inches in length. Cuttings of branches are planted in spring or in autumn, and at this last season should be planted at once, as soon as they are prepared. If planted in spring, they should be prepared during the previous winter, when they should be cut, and buried vertically, upside down, in a trench deep enough to cover them completely. When spring arrives, they are planted out in their natural position, and so as to have one or two eyes above ground. Kinds that are inclined to throw out underground shoots, like the Manetti stock, should have all the eyes removed from the part of the cuttings which is buried. A cutting with two eyes should be completely buried in the earth in a vertical position. This is a good plan for subjects of a tender kind, which do not bear frost well, as the vine and the fig. Instead of a shoot, a thick branch or a stem may, in some cases, be planted as a cutting, and will take root. The poplar and willow succeed in this way. Root cuttings consist of pieces of root from two inches to six inches long. They are planted in trenches in a shady place, in such a way that a very small portion of each cutting is exposed to the air. Short cuttings which have not more than a single bud are planted under glass in a cool place. Cuttings of evergreens succeed best in this way.

Transplanting.

Transplanting consists in taking up young plants, and re-planting them in another place for a time, with the view of developing the fibrous root and strengthening the neck of the plant. It is chiefly practised with plants raised from seed, which are transplanted after the first year's growth. Seedlings of resinous trees and evergreen shrubs should be transplanted between the middle of August and the end of September, or between March and May. Seedlings of deciduous trees should not be removed until the sap has gone to rest, and in their case only can the stems and roots be cut too long. Transplanting is done with a dibble, in rows of about eight inches apart, with a distance of four inches at least between the plants. After a couple of years, the plant will be sufficiently grown to be removed to the nursery or to a permanent position. By planting it at once where it is intended to remain, we avoid both the cost and labour of a future transplanting and the delay, as well as the chance of failure. Careful nursery treatment is almost indispensable for very young subjects, which require continual attention in culture and pruning.

The Nursery.

This should be in a favourable position, well aired, well drained, and having good easily worked soil. Porous soils, which are liable to be always too dry, should be avoided, if possible, as also should those that are too compact, as they retain the water on the surface. As regards the improvement of the soil in a nursery, a mixture of vegetable mould is preferable to manure off the dung-heap. A tree raised in soil richly manured is better than one grown in bad soil, but inferior to one grown in good natural soil composed of various elements. The ground is broken up before winter, and the soil and compost mixed together in the trench, and not

deposited in layers. Stones, roots, and weeds are removed. When the season for planting arrives, all that has to be done is to level down the soil, giving it a second and final turning. Although we are not partial to the use of dung-heap manure in nurseries, nevertheless, soils of inferior quality must be improved by the addition of slowly-decomposing materials, which will impart to them the elements in which they are deficient, and secure a vigorous growth to the plants. Such are road scrapings, deposits of streams, stable refuse, old mortar or plaster, garden rubbish, old bones and horns, cinders, parings off meadows, sand, &c., all which are to be mixed and spread long before the time of planting.

Planting,

A young, compact, well-rooted plant should be selected. If more than one year old, it should have been transplanted. Before planting, it is dressed, that is, its roots and branches are pruned and cleaned. The stem should be cut down to about ten inches from the collar, if the graft is to be low down, and about four inches in cases of stocks for standards. The side branches should be cut away, or rather shortened. Evergreens and certain kinds with hollow wood, as the sweet and horse chestnuts, the walnut, and the tulip-tree, should not be topped. The trees should be planted in rows, so that those of each successive row may be opposite the spaces of the preceding one, and at distances calculated according to the future size of the subjects. A space of twenty inches between the plants, and thirty inches between the rows, is the average in well-kept nurseries. This may be increased or diminished as the plant is likely to branch much or not, and in proportion to the length of time it is to remain in the nursery. The planting is done with a dibble or spade. If it is carried on slowly, or in a time of great heat, the roots of all the plants

should be dipped in mud, or in a mixture of soft clay and cow-dung, which will prevent them from suffering by being kept out of the ground. The soil should be well pressed down after planting. Watering will generally be necessary the first year only, and then chiefly at the commencement of vegetation.

Cutting down the Stem;

During the first year we confine ourselves to the culture and care of the plant. We will suppose that it is intended for a tall standard: we will speak further on of low stocks. After the first year of growth, or before the second commences, the plant intended for a tall standard is cut down to within two inches from the surface of the soil. This operation should not be performed until the month of February or March, when the sap is at rest and the winter frosts are no longer to be feared. During the summer we select the finest shoot which has sprung from the stump, and bend and tie it up to the stump, so as to give it a vertical position. All the other shoots are cut away; and in autumn the stump itself is cut away. Should it be found difficult to fasten the shoot properly to the stump, a stake may be used instead. The following year the young tree will be allowed to grow on. If it should turn out badly, it must be cut down a second time, or else grafted at the base with a vigorous kind, which, when it has grown sufficiently, will furnish a suitable stock. This cutting down is, of course, unnecessary in the case of fine, stout, vigorous, and straight stocks; but with doubtful subjects it is better to practise it.

Trimming the Young Stock.

This consists in cutting off the useless branches. In general, the strong ones are removed altogether, being cut close to the stem; the medium-sized are shortened, and the weak ones

left as they are. The shortened branches may be left from two to ten inches long, always retaining some of the eyes. It should not be forgotten that cutting the branches weakens a tree, and that retaining them has the opposite effect. In this operation, therefore, the healthy growth, as well as the form of the stock, should be considered. When the stem is strong, it will not suffer from the removal of the lateral branches from the neck up to the place intended for the graft. In short, strong stems should be cut closely, weakly ones only partially, and poor ones as little as possible. In cutting away a branch entirely, it is well to leave a small portion with a bud on it at the base. In making the cut, the direction of the pruning-knife should be from below upwards, as it requires very great skill to make a clean cut in the other direction, and avoid tearing the wood. To prevent the growth of useless thick branches near the terminal shoot, the buds on that part should be pinched off in the spring. The young leading shoot should be trimmed moderately; its branches being shortened where they are too long, and the others left as they are. It should not be topped until it has grown at least a foot beyond the height intended for the graft.

Preparation of the Stock for Grafting.

Whether the stock shall be headed down or not will depend on the mode of grafting employed. The removal of the head, indispensable in crown-grafting, is effected at the moment of commencing the operation, as the wound is then not likely to become inflamed, being covered immediately with the grafting-wax, as soon as the graft is in position. However, when large trees are grafted, they should be cut some weeks beforehand; and the same may be said of all kinds of grafting which are done at the time when the sap begins to flow, and which require the stock to be cut in this way. During the dead

season, after the heavy frosts have passed, the head of the stock should be cut down to within about 4 inches above the place where it is intended to insert the graft. At the time of grafting it is cut finally, or else the wood is simply trimmed by slightly reducing the length of the stock, so that the graft may be placed in contact with a living and healthy part. Side-grafting does not require the removal of the head of the stock. It is sufficient that the part which is to receive the graft should be clear, and that the shoots for 4 inches above and below it be cut away. The upper branches will then continue to draw up the sap, and the lower ones will promote the growth of the stock. In summer graftings, the stocks should be trimmed a month beforehand. The flow of the sap, which is diminished by this operation, will then have had time to recover its activity, and will contribute to the success of the graft. But cutting off superfluous branches a week or so before grafting would be followed by a check in the flow of the sap at that time, which would be very detrimental to the uniting of the parts of the graft. It would be better not to cut them till the moment of grafting, as the junction would be complete before the vegetation had suffered much abatement. These operations should be performed with keen-edged tools, and by a skilful workman, who would neither bruise the stock nor leave stumps full of supplemental buds. Resinous trees do not require this preparatory treatment. With the exception of bushy kinds, stocks grafted low down the first year of their planting have seldom any branches to be removed. It is sufficient to wipe with the hand or a rag the place which is to receive the graft. Usually, grafting is performed on a low stem, which has been shortened down to 10 inches at the time of planting. In grafting briars, any prickles that are in the way should be removed, as well as any buds of the stock that might come under the bandage. This is done

at the time of grafting. If, from any cause, the flow of the sap is arrested in mid-summer, vegetation should be excited by liquid-manure waterings, moving the soil about the roots, and a mulching of old hot-bed manure.

Selection of the Scion.

The tree, branch, or shoot which is grafted on the stock, and which it is desired to propagate, is termed the scion or graft. The plant from which it is taken is called the parent plant or tree. The scion should be of good quality, healthy, hardy, and of sound constitution. An unsound scion propagates whatever defect it possesses, and a bad selection repeated for several generations leads to a degeneration of the variety, which is, however, local and not general. The proof of this is furnished by the sub-varieties of trees with variegated leaves. The variegation is propagated by grafting, yet the type remains none the less exempt from the disease which produces it. Though the defect is not always visible, as in the case of variegation, propagation with inferior scions is sure to lead to degeneration; one should be very cautious about taking scions from a tree of unknown quality. In nurseries great importance is very properly attached to the vigorous condition and true name of the parent trees. These, while supplying scions, are also carefully trained. They are pruned in order to obtain a greater number of branches, but care is taken to reserve, from one year to another, some branches uncut, if it is desired to have scions that will arrive at maturity more speedily. The shoots which are developed on the upper part of an uncut branch ripen their wood sooner than any others. When a growing tree is to be grafted into another, it should be planted for at least a year beforehand, near the subject on which it is proposed to graft it. The scion should be cut from the parent tree just before it is

used. For grafting during the dead season, the scions may be cut some time beforehand, but not until the sap has gone to rest. They may be kept in good condition until they are wanted by burying the ends about 4 inches in the ground, in the shade of a house or of an evergreen tree. Long branches should be buried deeper and laid in a slanting position in the trench. They will keep much longer if placed in an ice cellar, buried horizontally in fine sandy gravel such as is used for walks. Graft buds should be taken from the branch which produces them just before they are used. A scion should never be allowed to suffer by long exposure to the air or dampness. The cactus family furnishes individuals from which scions may be detached and exposed to the sun for several months without the least injury; but we are now occupied with woody plants, and not with hothouse or herbaceous kinds. Scions with the leaves removed may easily be sent considerable distances during the repose of the sap, provided they are kept cool. They should be wrapped in moss, and the end of each stuck into a potato, artichoke, &c. When they arrive at the end of their journey, they should be put into water for a few hours, and then laid in a shady place. If the bark is wrinkled, they should be entirely covered with soil in a trench and left thus buried for two or three weeks. The same precautions should be taken with shoots sent during the time of vegetation, either by post or other mode of speedy transport.

GRAFTING UNDER GLASS

General Directions.

Certain plants require to be propagated under the shelter of a cloche, frame, or greenhouse. Such are evergreen trees and shrubs, and tender, rare, or new plants. Evenness of growth, equability of temperature, and keeping the subjects

from exposure to the air or other adverse influences, very much promote the union of the graft. The stock is a young plant which has been potted and allowed to grow in the open air for about a season. When it is time to graft it, it is put under cover. There are, however, certain shrubs which may be grafted at the time when the stock is potted; such as the Holly, Rhododendrons, dwarf Biotas, and most shrubs the roots of which readily group themselves into a ball. The best seasons for grafting under glass are from January to March, and from July to September. Beyond the shelter of the greenhouse or other covering, no artificial heat from manure, hot-air or hot-water pipes will be required; and as the stocks are not exposed to the action of the sun, frost, or other atmospheric influences, the grafts will not need the protection of grafting-clay or wax. In times of great heat, the glass of the house, frame, or cloche is covered on the outside with a mixture of the colouring-stuff called "English Green" and whiting, or simply with whiting dissolved in water or milk; mats, canvas, or screens made with twigs or small branches of broom, heath, or birch may also be used for this purpose. These, if steeped in a solution of sulphate of copper, will not so soon decay.

Grafting Under the Cloche.

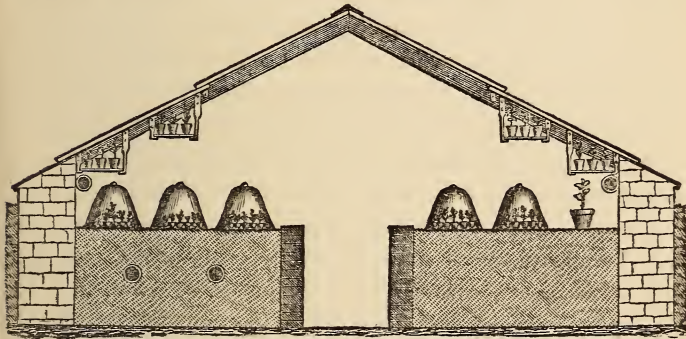
This is the most simple method of grafting under glass, no house or other shelter than that of the cloche being required. A quadrangular bed of river-sand is made sufficiently broad to contain two or three rows of ordinary cloches. In February or March, sometimes in July, the stocks are grafted in pots, and plunged in groups in the sand under the cloches. The rim of the cloche is sunk in the sand, so as to exclude the air completely from the plants, and they are left so for six weeks. By that time the union of the grafts will be perfected. The cloches are then gradually raised for

a week, after which they are removed altogether; but the young plants are kept shaded with canvas or other screens. These are at length removed altogether, before planting the subjects out. The stocks are raised in pots before-hand. They may also be sometimes grafted at the same time that they are potted. Evergreens, also, which can be taken up with the roots in a ball, are often grafted after they are taken up. They are then planted under cloches, in a compost of good soil, and not potted until two months afterwards, when the cloches are dispensed with. Autumn-grafting under the cloche does not succeed so well, and involves a greater amount of care and attention. During winter, the rows of cloches are covered with dead leaves and straw mats; but it is very rare that severe winters do not leave their marks behind them. The amateur who desires to try grafting under glass, may satisfy himself, at a trifling expense, by operating in spring with the cloche, and in open ground or nearly so.

Grafting in Frames.

The frame consists of a wooden box, set in cement or brickwork about 2 feet high, and sunk in the ground to one-half its depth. If the height of the stocks requires it, the soil should be excavated from the bottom to a suitable depth, leaving the height of the frame over-ground as it was. The frame may be about $4\frac{1}{2}$ feet wide, and should be covered with glazed lights. The interstices between the lights and the frame should be stuffed with moss, in order to exclude the air. At the bottom of the frame is placed a layer of sand, tan, cinders, or even of ordinary soil, in which the subjects are plunged as soon as they are grafted. August is the best time for grafting under glass. The stocks should be grafted in the propagating shed at that time, or from the latter part of July to the commencement of September, and placed

immediately in the frames. Spring is also a suitable time for this mode of grafting. As the perfect union of the parts does not take place sooner than five or six weeks after grafting, the air should be thoroughly excluded from the frame during that time. Then the lights should be slightly raised for a few hours every day, when the weather is warm. Should the sun be powerful, tender plants must be shaded with screens or canvas spread over the lights, or by whitewashing the glass. But during the first weeks the frames should be covered with straw mats.



Propagating-House.

Grafting in a House.

The propagating-house here represented is of very simple construction. It is sunk to about from 20 inches to $3\frac{1}{4}$ feet under the surface of the ground. The bottom is kept dry by a layer of 4 to 6 inches of sand and cinders. The outer walls are 16 inches thick; the height inside from floor to roof is $6\frac{1}{2}$ feet; and the glazed roof is about $4\frac{1}{2}$ feet wide from the top to the sides. Two raised beds, each 3 feet wide, are separated by a passage 28 inches wide, and in these beds the stocks are planted as soon as they are grafted. These beds are filled with tan, sand, cinders, or ordinary soil. Instead of

one of the beds there might be a shelf, which could be used for holding the potted stocks which are ready for grafting. When the beds are used for raising cuttings, or receiving plants that have been bud-grafted, or for some winter operations, a layer of dung-heap manure mixed with dead leaves should be applied. The leaves serve to maintain the heat in the manure, an object which also may be effected by a mixture of fragments of cotton-waste. Artificial heat is not required in grafting under glass. When the stocks are grafted, which may be done either inside or outside of the house, they should be arranged on the bed or shelf in groups, keeping similar kinds as much together as possible. They are then covered with cloches, which exclude the air, and under which they are kept for six or eight weeks. Every five or six days the condensed vapour on the inside of the cloche should be wiped off, and the cloche carefully replaced over the plants, so that the air may not enter. The omission of this precaution would be more dangerous than neglecting to wipe the condensed vapours from the interior of the cloche. During periods of great heat, the cloches should be covered with sheets of grey paper, and the glass of the house whitewashed. Conifers are more hardy than evergreens, and for them this will be superfluous. As soon as the union of the graft is complete, which will be in the space of six or eight weeks, the cloche is removed and the plant left without it for three or four weeks, but still under the shelter of the house; or, should the house be required for any other purpose, the plants may be removed at once to a frame and covered with the lights.

Treatment after Grafting under Glass.

After grafting, the subjects are left for six or eight weeks cut off from the external air. As soon as the union of the

parts has been established, the plants are still left under glass, but partially exposed to the air in the frame or house by removing the cloches. If the grafting has taken place in autumn, the plants already grafted in frames are left there, and those which have been grafted in the house are also put under frames, where they will remain during the winter. When spring comes, the lights are raised in the day-time; in the month of May the plants are removed into the open air, and should be placed at the north side of a building or evergreen hedge. If the grafting has been done in spring, the plants which have been grafted under cloches or frames, and which have been already partially exposed to the air, should be put out in the same way in the shade. Plants grafted in a house should be put for a month under a frame, the lights of which should be raised in times of great heat; after this they are put out for a while in a shady place before they are finally committed to the open ground. In nurseries, this shading quarter is formed by a row of evergreens with compact and well-clipped foliage. The Chinese *Arbor vitæ* (*Biota orientalis*) is generally used for this purpose, planted from east to west, so as to afford a full north aspect, and at a distance of two feet from each other. For stocks as tall as five or six feet, a row of trees planted at least six and a half feet from each other will afford an excellent shade. The higher the shading is required to be, the greater should be the distance between the trees which form it, in order to admit a free circulation of air. When the plants are placed in the shade they should be moved into larger pots, and should be plunged in groups in beds at the foot of the shading trees, where they are to remain a year or two in the same pots. When sufficiently grown they are again moved into larger pots. According to their nature, they may be subsequently planted permanently in shade, or in the open ground, or in the inter-

mediate position known as the *parasol*. The *parasol* is a row of deciduous trees planted similarly to the evergreen shading trees. Every time the plants are moved, whether in pots or not, their roots should be surrounded with a compost approaching in character the soil in which they are to be finally planted. Peat-soil mixed with river-sand is best for the first stages. Woody plants prefer a substantial kind of nutriment to manures that will ferment and whose action is temporary. Pots with longitudinal grooves in the sides answer well for raising trees and shrubs. After the grafted shrubs have thus gone through the different phases of treatment which finally conduct them to open-air growth, they thenceforward come under the treatment commonly used in the management of hardy plants.

METHODS OF GRAFTING.

These are numerous, and vary according to circumstances, being not unfrequently the result of chance or the fancy of the operator. From our own experience and observation we shall describe the modes which are most useful. By modifying them in one way or other the number may be increased; but all may be referred to the types which we shall describe, and may be employed with the same results. A systematic classification of them is difficult, on account of their number and the almost invisible lines of demarcation by which some of them are divided from each other. They may, however, be grouped into three great divisions, viz.:—Grafting by approach, or inarching; with detached scions; and with detached buds.

In the descriptive part, under each subdivision, we shall give the title by which each particular operation is known. We have arranged the subject in the following order:—

Grafting by Approach.

Group 1.—Method by veneering.

„ by inlaying.

English method.

Group 2.—Inarching with an eye.

„ with a branch.

Grafting with Detached Scions.

Group 1.—Side-grafting under the bark.

„ „ with a simple branch.

„ „ with a heeled branch.

„ „ in the alburnum.

„ „ with a straight cleft.

„ „ with an oblique cleft.

Group 2.—Crown-grafting.

Ordinary method.

Improved method.

Group 3.—Grafting *de précision*.

Veneering, common method.

„ in crown-grafting.

„ with strips of bark.

Crown-grafting by inlaying.

Side-grafting by inlaying.

Group 4.—Cleft-grafting, common single.

„ „ double.

„ oblique.

„ terminal.

„ „ woody.

„ „ herbaceous.

Group 5.—Whip-grafting, simple.

„ complex.

Saddle-grafting.

Group 6.—Mixed grafting.

Grafting with cuttings.

When the scion is a cutting.
 When the stock is a cutting.
 When both are cuttings.

Root-Grafting.

Of a plant on its own root.
 „ on the root of another plant.
 Grafting with fruit-buds.

Bud-Grafting (Budding).

Group 1.—Grafting with shield-buds.

Bud-grafting under the bark, or by inoculation.
 „ ordinary method.
 „ with a cross-shaped incision.
 „ with the incision reversed.
 „ by veneering.
 „ the combined or double method.

Group 2.—Flute-grafting.

„ common method.
 „ with strips of bark.

GRAFTING BY APPROACH.

GENERAL INSTRUCTIONS.

Grafting by approach is the most ancient of all the methods of grafting. From time immemorial nature has given examples of it in our forests, hedges, arbours, &c., where we find trees joined together by their branches, stems, or roots, from long-continued contact or rubbing. Grafting by approach then, consists in uniting two trees by their stems or branches, In certain cases, the shoot of a tree or plant is thus grafted on the parent stem or branch. The season for grafting by approach commences and ends with the flow of the sap, from March to September. The stock and the scion may be in the woody or the herbaceous state, the mode of operation being the

same in both. In grafting by approach, the scion is not stripped of its leaves, as in the other modes, because it remains attached to the parent plant while it is being joined to the stock. From both scion and stock a precisely similar portion of wood and bark is removed, so that the parts may fit exactly when they are put together. In order to promote their union, the graft is bandaged, and covered with grafting-wax. In the case of



Veneer-Grafting by Approach.

two trees being grafted together, a prop or stake is used. After they have continued to grow together for, at least, a year, when the union may be considered perfect, the part grafted on the other may be detached from the parent stem. The modes of grafting by approach may be divided into two classes:— First, those ordinary methods, in which the upper part of the

scion is retained after it is joined to the stock; and second, the process, named "inarching," in which the cut top of the scion is inserted under the bark of the stock.

Group I.—Ordinary Grafting by Approach.

The scion is a tree, or a branch of a tree, distinct from



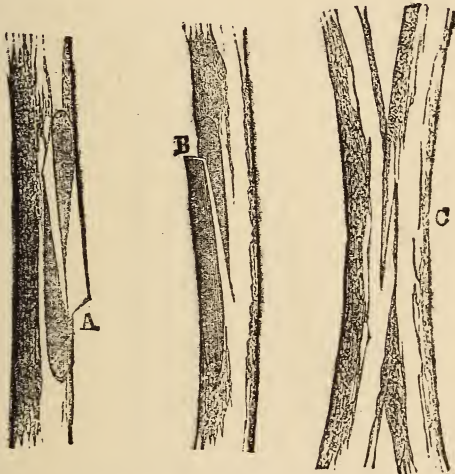
Approach-Grafting by Inlaying.

the stock or a branch belonging to the stock itself. The top of the scion is kept entire above the point of contact with the stock; however, if too long, it may be cut above the graft, leaving two or three eyes if it be a single shoot, and a length of four, eight, or twelve inches if it be a ramified branch. There are different ways of joining the

scion and stock, named after other modes of grafting, as by veneering, by inlaying, and by the English method.

Veneer-Grafting by Approach.

The scion A (fig. p. 41) has a portion of the bark and alburnum removed at *a*. In the stock (B) a flat-bottomed groove is made at *b*, reaching to the alburnum, and corresponding in dimensions to the part *a* of the scion. The *métro-greffe* will be useful here in adapting these two parts accurately to each other,



English Method of Approach-Grafting.

They are then joined together at C, bandaged, and covered with grafting-wax if necessary.

Approach-Grafting by Inlaying.

The scion D (fig. p. 42) is cut on both sides at *d*. The stock (E) is prepared to receive it by having an angular groove made

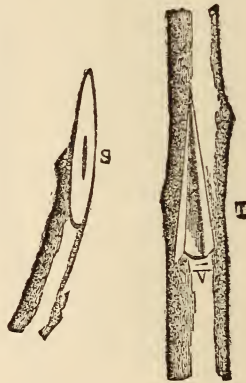
at *e*, into which the bevelled part *d* will fit accurately, and be inlaid, as shown at *F*.

English Method of Approach-Grafting.

In addition to bandaging, the parts may be still more firmly consolidated by means of corresponding tongues or notches (*A* and *B*) cut in each, so as to fit exactly into each other, *C* (fig. p. 43). If it is apprehended that the union of the parts will be tedious, the top of the stock is cut off at the time of grafting and the scion joined to its extremity. This is called the English method.

Group II.—Approach-Grafting by Inarching.

Although more particularly employed for restoring defective



Approach-Grafting by Inarching.

parts of plants and trees, this mode of grafting by approach is equally useful for multiplication. The proper time for it is from April to July. The chief difference between this and the preceding group consists in the cutting off the top of the scion, whether tree or branch, and the inoculation of the top so cut under the bark of the stock. The cutting of the scion is made under an eye or a shoot, so that one or other may be

set in the stock. This scion, having been topped and cut in the manner represented at S in our illustration (p 44), under the terminal bud or shoot, is grafted into the stock by means of a reversed T-shaped incision in the bark, as shown at V. The place of the incision is calculated from the length of the scion, which should be an inch or so longer, so that in inserting it into the incision it is first slightly bent, drawn back, and the point then allowed to slip under the bark. The two principal modes of inarching are only to be used during the flow of the sap. in spring or in summer.

Inarching with an Eye.

The eye being selected for the terminal bud, the scion is cut at the end with a flat splice-graft, as shown at S (p. 44). It is then inserted under the bark of the stock T, which is raised at V. We shall represent hereafter the same graft completed and beginning to vegetate. When the bark of the stock is thick, an incision is made with a double longitudinal cut, the intervening strip of bark is raised at one end, and the top of the scion is inserted under it. Neither the strip of bark nor the bandage should cover the eye of the scion.

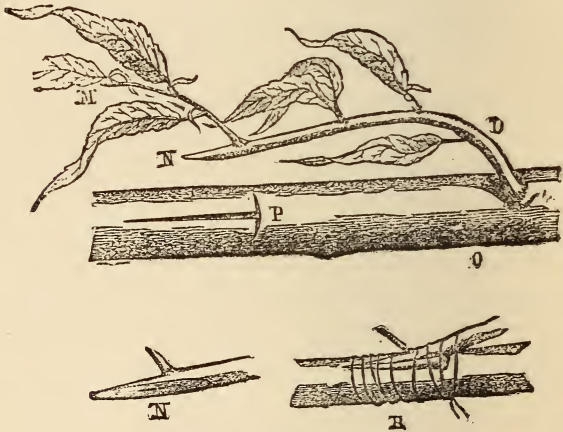
Inarching with a Branch.

The scion L (p. 46) bearing a lateral branch (M), is cut about an inch above it, in a sloping direction (N), on the side next the branch. Care should be taken not to cut the end too thin; and the leaves are not to be removed from either the branch or the scion. The stock is either a distinct ree or a branch (O) bearing the scion. The incision (P) is made in such a manner that the introduction of the scion is effected, as represented at R. The branch (M) may be left entire or cut down to two eyes, according to its length. It is called an "anticipated branch" if it has been produced in the

course of the year on the herbaceous scion, in which case the grafting would take place in summer. It is called a "branch" simply, if it has been developed in the spring on the woody scion, or in the preceding year on the main branch. In this case, the grafting would take place from April to June.

Treatment after Grafting by Approach.

The employment of two distinct subjects, so as to preserve a harmony of growth, necessitates the use of fastenings,



Inarching with a Branch.

supports, props, or hooks, in order to fix the grafted stems and branches as firmly as possible in the desired position. Should the bandage have penetrated the bark, it must be removed, and a fresh one put on if there is reason to think that the union of the parts is not completed. The final detachment of the graft requires the greatest care. It consists in separating the branch or stem which forms the scion from the parent plant as soon as it (the scion) can dispense with its support, and is the last operation in layering

and grafting by approach. It comprises two points:—first, cutting off the head of the stock above the graft; second, cutting the scion-branch or stem below the graft. It is prudent to proceed by degrees both in the entire operation and in its details, first cutting off the head of the stock and afterwards detaching the scion from the parent stem. In both cases this should be done by a series of successive cuttings, in order to avoid the reaction consequent on extensive mutilation.

Cutting off the Head of the Stock.

The operations for this purpose may commence a fortnight after grafting, if the graft appears to have succeeded. First, the extremities only of the principal branches are cut off. A week after this they are shortened down to 4 or 8 inches. When the union of the graft is certain, the stem is shortened in two or three cuttings, so as to leave a simple stump about 2 inches above the graft, and furnished, if possible, with small shoots to draw the sap. With subjects grafted in spring, this operation is performed about the end of summer; the cohesion of the parts will be perfect before winter. But if the grafting takes place later, we should confine ourselves before winter to shortening the branches of the head or the leading shoot as soon as the parts are perfectly united. The final cutting down to 4 inches above the graft should be postponed to the following spring, when the sap begins to flow. The heel or stump is retained for one season, to serve as a prop to which the scion is tied, and also that the shoots left upon it may draw up the sap. It is cut away entirely when the cohesion of the parts is considered perfect and the scion sufficiently vigorous to dispense with it. It would not be amiss to cover the wound with grafting-wax, and to continue the prop for some time longer. This succession

of cuttings is only applicable to those cases of grafting in which the stock has not been previously headed down, and when the part above the graft is to be replaced by the development of the scion.

Detachment of the Scion from the Parent Stem.

This is an important matter, as by it the scion is left to its own resources, the parent stem being no longer called upon to support it. We cannot, therefore, set about this operation with too much circumspection. In the first place, complete separation should not take place until the graft has attained one full season's growth. Some persons do not always observe this rule ; but we cannot recommend anyone to follow their example, and the grafter will find our opinion confirmed in the course of his practice. However, the scion should continue connected with the parent as long as its union with the stock is incomplete. The time of perfect cohesion may be judged of by the swelling which rises round the edges of the joining, and by the simultaneous growth of the two parts. In case of doubt, it is best to act prudently, and prepare the young tree to support itself without the help of the parent. This is done by making cuttings or incisions on the part which joins the parent to the stock. A single incision may suffice, but at the end of a week or a fortnight it should be made deeper. Instead of a single incision, the separation may be gradually effected by a succession of cuttings penetrating the bark and the wood, or of circular incisions or rings on the arm of the graft. These are begun at some distance from the point of contact with the stock, and are made deeper and nearer to the graft at each successive operation. At last the branch is cut clean off close to the graft, and the wound covered with grafting-wax.

Re-planting.

Should the new tree not find in the place where it has been grafted a sufficient supply of nutritive elements, it should, in almost every instance, be taken up and transplanted into another place, either in the nursery or where it is intended to stand permanently. It is better not to remove it until it has grown at least a year from the time of its detachment from the parent. It will thus have become inured to exist on its own resources, and will not have been subjected to several severe operations in quick succession. Should the separation have produced any deviation from the desired direction of growth in the grafted tree, a stake or prop should be used, which will keep in a straight line both the stock and the graft at the same time. A few longitudinal incisions on the elbows or curved parts aid the dilatation of the tissues, the free circulation of the sap, and the straightening of the stem; but trees newly transplanted should not be thus cut.

Propagation by Approach-Grafting.

In all cases it is best to have the scion and stock in close proximity to each other, as the work of grafting is thereby simplified. In well-kept nurseries, the parent-trees are planted in positions where grafting by approach is intended to be carried on, either before the stocks are planted, or at the same time. Should parent-trees and stocks, which are strong enough to be grafted at once, be planted, they should not be operated upon for at least a year. They will thus be better rooted, and the union of the graft will be more certain. Those parent-trees and stocks are selected which may be grafted with success, and are trained in a tall or branching form, in order to facilitate their junction at the time of grafting. The same parent may furnish scions to several stocks at the same or different times. The illustration exhibits

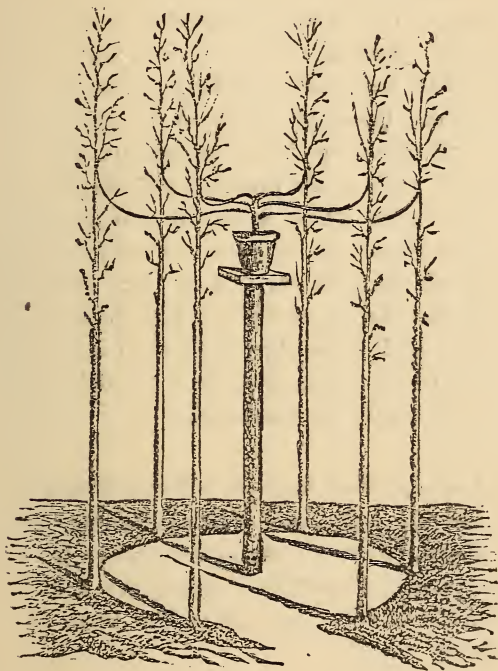
several methods of placing stocks of various sizes in proximity to a common parent-tree. Here the stock which is high enough is grafted in the upper part with a scion growing at the same elevation, while its neighbour, which is too high for the next scion, must be drawn towards the ground, in order to be brought into contact with it. Another is grafted close to the ground. Among the subjects in pots, some are placed on a simple or double stand, which raises them to the desired height; another is grafted with the pot buried in the soil,



Various modes of Grafting by Approach from a common parent-tree.

which may answer it better. The stocks being young and the scions sufficiently flexible, they can be brought together in places best suited for grafting them. In nurseries, small specimens of new trees are sometimes kept in pots. If it is desired to propagate them on tall stems, stocks of the required height are planted, and the parent-plant is elevated sufficiently by means of a stand. The following representation exhibits a specimen of this kind of work. In order to protect the parent

from the effects of prolonged drought, the pot should be placed inside a larger one, and the space between them filled with moss, which should be kept moist, or with fine sand, which is better for keeping cool. An example of a method diametrically opposite to the preceding is very often seen in



Grafting by Approach with the parent-plant elevated.

nurseries, in which the parent-tree is very strong and branching, while the extension of its roots and the shade of its foliage seldom allow young stocks to be planted around it. In order to propagate it, young stocks must be grown in

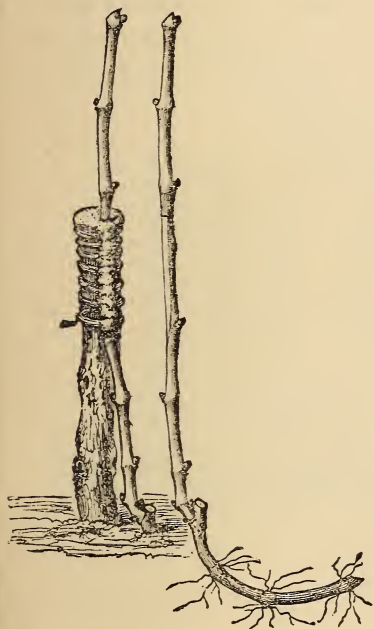
pots. In the second year of their growth they are placed among the branches of the parent-tree. For this purpose a stage with steps or shelves is erected, on which the stocks are placed within reach of different branches. The pots placed on each shelf are surrounded with a bed of moss, tan, sand, or other material, which will retain a moist coolness; for it will be difficult to water them, and rain and dew will be intercepted by the foliage. When a tree is intended to serve as a parent in grafting by approach, it is well to excite the sap to flow towards the scion-branches, especially at the time of grafting. Accordingly, the branches not used for grafting should be lopped or shortened without weakening the tree. This suppression of some of the branches will cause a greater flow of sap to the others which are to be used as scions. It also enables us to repeat the operation of grafting by approach every year with the same parent-tree. The shoots which are developed by the cutting of the branches which are not grafted will serve in their turn, should there be need of them, for scions the following season, just when the detachment of the previous year's grafts is commenced.

Grafting by Approach applied to the Restoring of Plants.

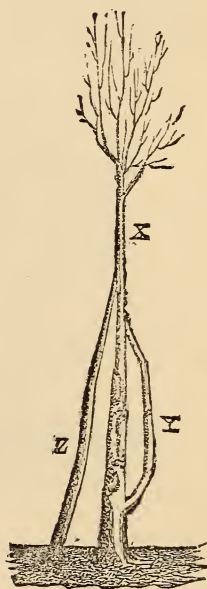
This is not the only method in use for the restoration of defective plants, but it is a valuable one when the object is to change the variety of the tree, to renew its stem, or to repair the want or loss of branches. Of each of these cases we give an example :—

1. *Changing the Variety.*—The vine is restored in this way. Alongside the stock which it is desired to change to another variety, is planted in winter a young vine well rooted and furnished with a thoroughly ripened shoot. When the time for grafting arrives, in April, the stock is cut down according

to the height of the new plant, and as low as possible. With the curved gouge, a longitudinal groove is made in the top of the stock, into which is inlaid the shoot of the young plant, slightly pared on the sides. It is then cut down to two or three eyes above the graft, after it has been bandaged and



Grafting the Vine by Approach,
to change the variety.

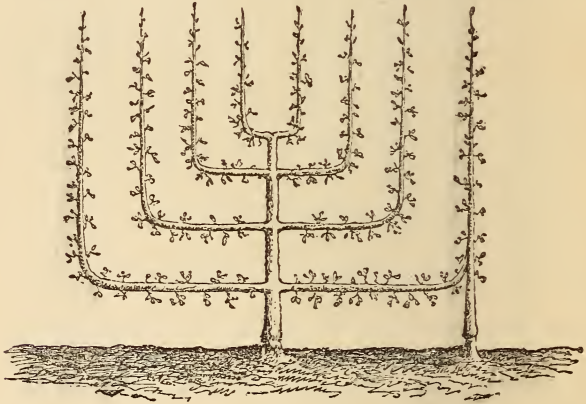


Grafting by Approach, to
renew a defective stem.

covered with grafting-wax. Instead of shortening the stock at once, it might be left until the graft has been perfectly united, and shortened in the following spring.

2. *Renewing the Stem.*—The subject (X) whose stem is cankered and which has “gourmand” branches at the base

can be repaired by means of these branches (Y) being inarched upon the stem above the diseased part. The flow of the sap, which has been interrupted by this, will thus be re-established. Should the diseased tree have no branches at the base, a stout stock (Z) is planted near it. After a year's good growth, the head of the stock (Z) is cut off and inarched into the stem of the other above the canker. Should a single tree not be sufficient for this restoration, a number are planted round and grafted into the old one in the same way, and when

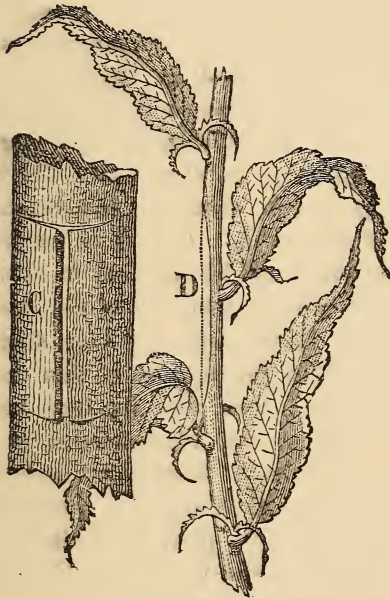


Restoration of a Main Branch by Approach-Grafting.

the graft is thoroughly established, the cankered base may be cut away.

3. *Restoration of Main Branches.*—In the training of fruit-trees to any particular form there will sometimes be gaps or vacancies where certain parts have not been able to develop themselves, or have disappeared. If a branch cannot be obtained by close pruning, incision, branch or bud-grafting, the neighbouring branches are made use of and trained in such a manner that the symmetry of the design may not

be deranged. But, as the branches do not always furnish shoots sufficiently vigorous for this purpose, a speedy method of repairing the partial loss of a branch is shown in the annexed illustration. Here a deficiency on one side of a chandelier palmette is supplied by planting a young tree near it into which the defective branch is grafted. It should



Peach-tree Grafted by Approach under the Bark.

be of the same or a similar kind as the old tree in habit and vigour; and, if the grafting is effected by inarching, it should not be done for a least a year after the planting of the young tree.

4. *Furnishing bare Branches.*—On trees of a certain age it is difficult to obtain, either by means of incision or bud or

branch grafting, fruiting branches on those parts which want them. It will be necessary then to employ the method of grafting by approach, that is, if the vacant places are near suitable branches. The Peach-tree, which is liable to lose its branches, usually bears shoots which can be easily grafted by approach on the bare spots; and the operation is performed in June and July with herbaceous shoots. When a vacancy exists which it is desirable to supply with a branch, in the beginning of summer an herbaceous shoot is taken and applied to the branch, where it is grafted by approach. The shoot is cut opposite to an eye, which is let into the incision in the branch, and the extremity will go on to develop itself. The result will be a good fruiting branch when the detachment takes place at least a year afterwards. Instead of making an incision in the main branch, it will be sufficient to raise the bark by a double T incision, if the condition of the sap allows it. In this is placed the shoot, which has been slightly cut at D, opposite an eye. The development of this shoot will facilitate the fork-pruning used with the fruit branches of the Peach. This method was recommended in 1829 by M. Leroy, gardener at Auteuil. Inarching is useful for furnishing branches with shoots, and an eye or a shoot may be grafted or budded into the bare part. Sometimes we sever in August the arms of grafts inserted in the month of June preceding. If there is no anticipative branch, one is excited to develop itself by pinching the shoot three weeks before grafting. When the young branch is developed, the leaf which springs from its base is partially pinched, in order to force the fruit-buds of the new branch to continue at the base. The pruning of the fruiting branch will be afterwards made easier by this operation. The vine is easily furnished with shoots on vacant parts by approach-grafting. It is best

to employ herbaceous shoots in May or June. The bark only of the stock should be cut, without removing any of the wood, especially if it is old; in which case, or when the scion is woody and not herbaceous, the detachment is effected by degrees in two years. In 1868 we applied successfully to the vine this method of inarching in order to fill up vacant spaces on the stems. The shoot, headed and pared under an eye, was let into the stem by a \perp incision. A month afterwards the union was complete, and the bud (A) grew vigorously. This was the first time, we believe, in which this mode of grafting was used with the vine.



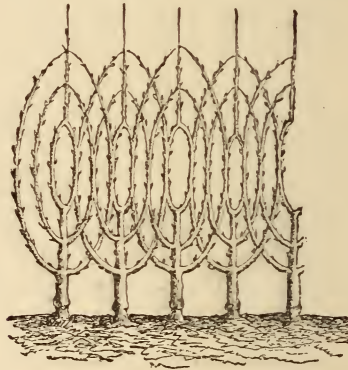
Vacant spaces on Vine-stems filled up by Grafting by Approach.

5. *To Preserve the Form of the Tree.*—When the advantages of approach-grafting are better appreciated, it will be more frequently used for preserving symmetry of form and equilibrium of growth in trees trained in particular forms and shapes, and will also simplify the labour of pruning, pinching, and tying up. We saw in the Horticultural Society's Garden at Mulhouse, a fine wall of peach-trees in an oblique cordon, joined at the top by approach-grafting. The heat of the sun and the gum had injured some of them so much that M. Menet (professor of gardening to the society) had been obliged to cut away the damaged stems to the

height of three and a quarter feet and burn them. The upper parts were left, and these continued to live and bear fruit, being fed by the sap of the neighbouring trees, on which the shoots had been grafted by approach. Horizontal cordons of apple-trees present the same result when the stems of any trees which have been grafted into the adjacent ones are cut away.

Approach-Grafting in Figure-Training.

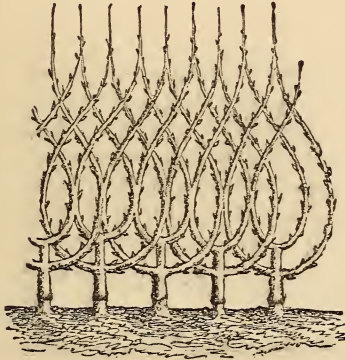
In order to show the happy results of grafting by approach,



Self-supporting Espalier formed by Approach-Grafting.

we have here figured some specimens of espaliers trained in the garden of M. Nallet, at Brunoy. The trainer, M. Forest, has employed grafting either to complete their construction or to preserve the equilibrium of growth. MM. Van Hulle and Burvenich described these trees, in 1867, in their reports to the Belgian Government. Annexed is a representation of an espalier of pear-trees, formed with small palmettes, the branches of which interlace and touch each other. The trees are grafted at the points of contact, in the centre of the design, where the branches touch back to back, and not where

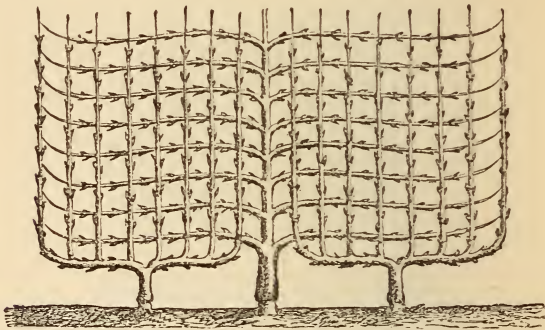
they cross and diverge. The slight curvature of the branches, which gives each tree an elliptical outline, is favourable to the development of fruiting branches ; the extremities are inarched into the leading shoot formed by the union of the branches of the third series. The next illustration is a variety of the preceding arrangement, and a preferable one. It requires only palmettes of two series, and the sinuous form of the branches permits long pruning, and maintains the fruit-spurs regular. The leading shoots are crossed in lozenge form, and are grafted



Self-supporting Espalier formed by Approach-Grafting.

by approach at the top. This charming design, which is less complicated than it appears, is produced with regularity if the outline has been previously traced with switches fastened to the trellis. In the third illustration a palmette and two chandeliers are united and support each other mutually. The extremities of the branches of the horizontal palmette are inarched into the outer branches of the chandeliers. It is better not to graft the branches where they cross each other. A group like this should be grown in the open ground, and not against a wall. The figure (p. 61) represents a palmette-

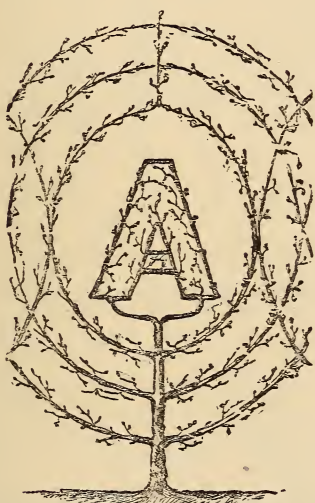
chandelier, of which the branches—following a regular curve, and grafted together at the ends—represent a target. In the centre, M. Forest has formed a letter by approach-grafting. A row of six such trees exhibits the name of M. Nallet. In designs of this kind we prefer that the letters should take the most prominent part, and not be merely accessory; and thus we have formed the name of our establishment in one of our borders. Each pear-tree forms one letter, so that in case of damage, the injury can be more speedily repaired than in the case of a tree which forms several letters. The



Combination of Palmette and Chandelier trees by Approach-Grafting.

different modes of grafting by approach are useful here. A similar design has been formed with peach-trees on a wall. The fruit gardens of M. Alexis Lepère, of Montreuil, and of others, contain handsome specimens of trees joined by approach-grafting, and representing inscriptions or designs accurately completed, according to the method of M. F. Simon, an amateur at Crécy-en-Brie. The representation (p. 62) shows two halves of peach-trees trained in the form of double U, or a small four-branched chandelier, by means of their sub-division, the arms of which are united at their ex-

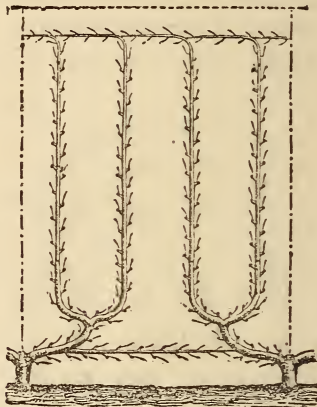
tremities by means of approach-grafting. We have also proved the good effect of approach-grafting in forming winged pyramids, vases, harps, &c., either isolated or on trellises, in the fruit garden of M. A. Mas, pomologist, of Bourg, and in the orchard of the Agricultural School, at Saulsaie (Ain), made by Verrier. The single cordon (improperly termed horizontal on sloping grounds), which is especially adapted to the apple-tree, should have the trees which compose it grafted one upon



Mode of forming Letters by Approach-Grafting.

another. The end of each is cut with a sloping or splice cut and inarched or inserted under the bark of the next tree at the bend. A continuous even line of small trees is thus obtained. It may happen that from want of vigour, or in consequence of an accident, one tree cannot reach its neighbour. In such a case we have recourse to the method of lengthening or joining shown in the figures on p. 63, which was communicated to us in 1860 by M. Jules Ricaud, of Beaune. The subject (A)

not being long enough to reach its neighbour (B), we take a well grown branch (C), of the current year if we operate in August, and of the preceding year if we graft in April. The base of this is cut with a double slope, and is introduced into the incision on A, which penetrates the alburnum, by the



Union by Approach-Grafting of Trees trained in the form of double U.

process of side cleft-grafting. The other extremity is cut with a notch in the part which will bear upon the other tree, in which a corresponding cutting is made. The parts, being



Cordons united by Approach-Grafting.

fitted into each other, are bandaged and covered with grafting-wax. The method of inarching might also be used here with equal advantage.



Mode of supplementing a Short Branch by Approach-Grafting (p. 61).

We have remarked that in bilateral cordons, that is, when the stem divides right and left in the form of a T, the parts join easily enough in grafting by approach or lengthening; but as the sap meets in two opposing currents, the same uniformity of growth is not obtained as with the unilateral cordon.

Use of Approach-Grafting for Increasing the size of Fruit.

This application of grafting by approach is not very common, as, in the first place, it demands some skill on the part of the operator, and, in the next, success does not always crown his



Grafting to increase the size of the Pear.

work. We have, however, more than once seen its successful results, and especially with M. G. Luizet, arboriculturist at Ecully, who in 1856 exhibited some fine specimens at Lyons at the inauguration of the Pomological Congress. About the month of June a young herbaceous branch is grafted by approach on the stalk of a pear, and bandaged with a woollen thread, which must not be drawn too tightly. If the branch continues to grow vigorously, the end of it is pinched; if it has ceased to increase in length, it is left as it is. The object is to secure a greater flow of nourishment to the fruit.

When the fruit has come on the branchlet a feeding scion may be inarched upon the branchlet, in addition to the scion on the fruit-stalk. We have tried this with success. With fruits which have too short or too slender stalks, like the apple or peach, we must confine ourselves to grafting by ordinary approach, or inarching the herbaceous branch on the fruiting



Grafting to increase the size of the Peach.

branch as near as possible to where the fruit of the branch will grow. The bandages should be tied so as to be easily opened without cutting them.

GRAFTING WITH DETACHED SCIONS.

General Directions.

The stock is a perfect plant, or almost so, for we sometimes use a branch-cutting or a piece of a root. It is grown either where it is to remain or in the nursery, or else it may be grown in a pot in order to be grafted under glass, with the air partially excluded. Perfect stocks are usually grafted where they are intended to remain; sometimes in the case of graftings made during the repose of the sap, the stocks are taken up

in order to graft them, and laid in a trench or under a shed. The scion is a branch or part of a branch, bearing at least one eye, and from two to six inches in length. The shorter scions are used in the case of kinds with closely-set buds or expensive varieties. In a cold climate they must be of a greater length. The scions may be taken from the parent plant, when the sap has gone to rest, for spring graftings; they should be kept then in the shade of a building or tree, with the ends buried in fine sand. If they are not required to be used until the sap begins to flow, they should be kept entirely covered with sand in a cool cellar. Evergreen scions should not be detached from the parent tree until immediately before they are grafted, and the leaves should be left on them. Deciduous kinds grafted in summer should be cut from the parent within twenty-four hours before grafting, and their leaves at once cut off. It will matter little to the success of the operation whether the upper bud of the scion be a terminal or a lateral one. A shoot, if too long, may be shortened, and, if required, may furnish several scions. In order to facilitate the joining and cohesion of the two parts, the scion is more or less cut at the base in a sloping direction or splice cut. It should also be so placed on the stock that a bud of the latter may be on a level with the graft, either opposite to it or on one side, in order to draw the sap, and thereby promote the cohesion of the parts. The different sections of branch-grafting are side-grafting, crown-grafting, grafting *de précision*, cleft-grafting, English method, and mixed grafting.

Section I.—Side-Grafting.

The term side-grafting might be applied to a vast number of processes of grafting in which the head of the stock is not cut away. But we have limited the term to those cases in which the scion is inserted into the side of the stem,

or on a branch of the stock, either between the bark and the alburnum, or into the alburnum itself, the bark in no case being removed.

Side-Grafting under the Bark.—General Directions.

When it is desired to graft a branch on the side of a stem and under the bark, the stock must be in a state of vegetation, and the operation is performed either in April or May, at the flow of the sap, when it is said to be done with a shooting bud; or from July to September, when it is termed a graft with a dormant bud. In the first case (with a shooting bud), we use scions of the previous year, which have been laid in at the north side of a wall or in a cellar to preserve their vitality, and, the sap being in motion at the time they are used, the graft will develop itself in the course of the same year. In the second case (with a dormant bud), in which the graft will not develop itself until the year following, scions of the current year are used, cut on the day of grafting. If they are deciduous kinds, the leaves are cut off. We have said before, that scions of evergreens should not be cut till the last moment, and are not to be stripped of their leaves. In both of these methods the tops of branches with a terminal bud form excellent scions. There are two systems of side-grafting under the bark, one in which the scion is simply a piece of a branch; in the other, it is a branch cut from the parent, with a heel or strip attached to the base.

Side-Grafting with a Simple Branch.

This process is valuable for the restoration of defective trees, in supplying branches where they are wanting, and for grafting a new variety on aged subjects. It is equally of use in propagating plants. The woody scion will answer better for insertion under old bark than the shield-bud commonly used.

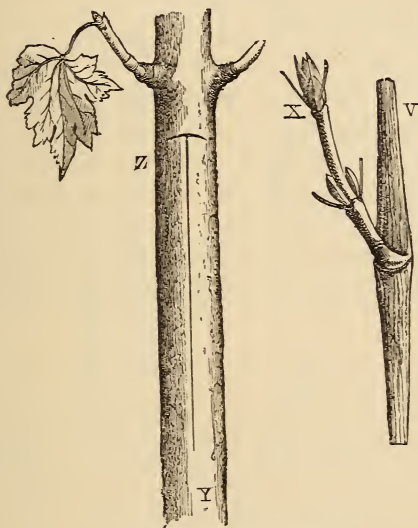
The scion in this case is a small branch, or a part of a branch, from four to eight inches long, having the lower part cut with a long splice-cut, the surface of which should be perfectly smooth, and cut thin to the bark at the point B. If it is desired to have a branch forming a wide angle with the stem of the stock, a bent or curved scion is selected; the convex part is cut and placed against the stock, while the top turned outwards will give the required inclination to the limb. With a perfectly straight scion one can contrive to have a shoot on



Side-Grafting with a Simple Branch.

the side opposite the cutting on the face which is united to the stock; this shoot, when developed, will form a branch almost perpendicular to the stem. In propagating certain trees, such as the beech, branched scions, two or three years old, are used, cut as we have described, with a splice cutting, rather thin towards the point. The scion having been prepared, we make on the stock two incisions forming a T through the bark, not penetrating the alburnum (C). The bark is then raised with

the spatula, and the scion slipped under it, so that the top of the splice-cut may be on a level with the transverse incision in the stock. It is then bandaged, and the air excluded from the cuttings by the application of grafting-clay or wax. Instead of a T incision, we might employ a plain bull's-eye opening into which the scion is slipped, or it would be equally easy to insert the scion under the bark by a sort of veneering.



Grafting with a Based Branch.

Grafting with a Based Branch.

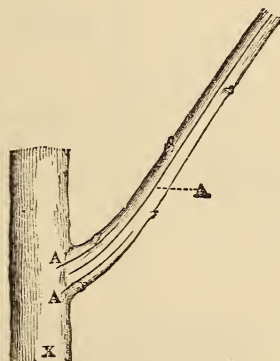
We have recourse to this method for the propagation of some plants, more especially the variegated maple. The proper season for this is in August or September, with a dormant bud. A short branch (X) is selected for the scion. Anticipative branches are also serviceable. The little branch

is detached with the grafting-knife from the branch on which it grows, but so as to preserve a strip of bark (V) above and below the insertion of the branch; the manner in which this is done has been already described. The woody fibres under the strip of bark (V) should not be removed; it would be dangerous to do so, and the surface should be merely smoothed down with the grafting-knife. On the stock (Y) a T-shaped incision (Z) is made, which goes no deeper than the bark; the lips of this are raised with the spatula and the heel (V) of the scion slipped under them. It is then bandaged with woollen thread or bast matting, like an ordinary shield-bud or a short branch-graft. It will be unnecessary to apply grafting-wax. In the restoration of fruit-trees, we have sometimes employed, under the name of scions, branches 20 inches long, with a heel 4 inches in length. By cutting off their leaves a week beforehand, and while they are still on the parent-tree, they are prepared for the separation. Covering them with grafting-clay as soon as they are grafted will prevent their drying up.

Treatment after Side-Grafting under the Bark.

In grafting with a dormant eye, with a view to propagation, the particular treatment will consist in heading down the stock, after winter, to four inches above the graft, and immediately tying up the top of the woody scion quite erect, in order to avoid a knee or bend at the graft. The first process (with a simple branch) when employed for purposes of restoration, does not require the amputation of the stock; but, in order to hasten the development of the graft, a notch is cut in the stock, about a quarter of an inch above the graft, in spring. The notch, in form of a crescent, about half an inch broad, is made with two cuts of the pruning-knife in the bark. An example of a similar operation has already been given. At

the same time the branches above the graft are pruned short. A thin stake is indispensable for fastening up the young graft. When the grafting is made with a shooting bud, at the flow of the sap, the scion should be covered with grafting-clay, to preserve it from the sun and the scorching winds. If, notwithstanding its speedy vegetation, it exhibits a tendency to remain puny, its growth may be accelerated by making small longitudinal incisions (A, A, A). By cutting the bark, the sap is induced to flow more freely under the dilated surface, and causes the branch to increase in thickness.



Incisions in a branch to increase its thickness.

Side-Grafting in the Alburnum.—General Directions.

This method is more specially adapted for evergreens; therefore it is more frequently adopted for grafting under glass, the season for which is in February and in August. If the same kinds are to be grafted in the open air, that should be done in April and in August. For evergreen scions, a branch of medium size, and furnished with a terminal bud, is to be preferred. It is to be cut from the tree at the moment of using it: none of the leaves are to be removed, except

those at the base; and, to keep it fresh, it should be placed in the shade with the end in a vessel of water or in sand. The stock is not headed down, and the leaves on the part destined



Side-Grafting with a Vertical Cleft.

to receive the scion are cut off at the stalk or in the middle. In order to insert the scion into the alburnum of the stock, the bark and outside layers of alburnum are removed,

directing the blade of the knife from above downwards, taking care not to penetrate to the pith. The scion is cut thin on both sides, if it is to be inserted at the top of the cleft, and cut in a wedge-shape if inserted in the side of the incision. Hence arise the following two sub-divisions:—

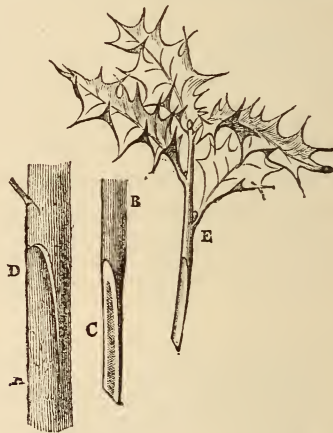
Side-Grafting with a Vertical Cleft.

The camellia scion A (p. 72) is cut for the half of its length on both sides (*a*), leaving on each side a strip of bark of equal width, and tapering gradually to the point. The stock (B) is cut, as at *b*, with one stroke of the grafting-knife, allowing the blade to penetrate as far as the alburnum. The scion (A) is introduced by its base (*a*), and then bandaged, as shown at C. Should the grafting be done in the open air, grafting-wax should be applied on both sides of the cleft, so as to fill any vacancies that may occur. With the camellia, and other hardwooded shrubs, the stock is maintained entire at the time of grafting; but the aucuba, the tissues of which are less dense, is cut down to within 4 or 8 inches above the graft at the time of the operation.

Side-Grafting with an Oblique Cleft.

The scion E (p. 74) is the top of a branch of holly. The lower part of it is represented at B with a sloping cut (C) on both sides and with the back of the slant much longer on the outside. An oblique incision (D) is made in the stock (A) by cutting through the bark and alburnum in a slanting direction with reference to the axis of the stock. The scion will thus be inclined at an angle, and its leaves will not be embarrassed by the stock. It may also be placed in an upright position by giving an oblique direction to the sloping cut. It should be bandaged with some elastic material. Some conifers are best grafted with the oblique incision; the wound does not enlarge so much as in the case of the vertical incision, and a slender

scion is more securely fixed in it. To the group of side-grafting we might add the method termed gimlet-grafting, in which a gimlet or drill is used to pierce an oblique hole from above downwards through the bark and alburnum without reaching the pith. The mouth of the hole is smoothed, and the end of the graft is cut round and pointed, so as to fit it properly. This method is seldom used; it should only be employed on old stocks, which do not exude gum, and when it is required to supply a branch to a very bare stem.



Side-Grafting with an oblique cleft.

Treatment after Side-Grafting in the Alburnum.

If the grafting has taken place in the month of April, the head of the stock should be gradually cut away, as soon as the cohesion of the parts seems to be assured, continuing the operation in proportion to the development of the graft. But if the grafting has occurred in autumn, the stock is cut, after winter, to within 4 or 6 inches of the graft, preserving on the heel the principal leaves and small branches, which

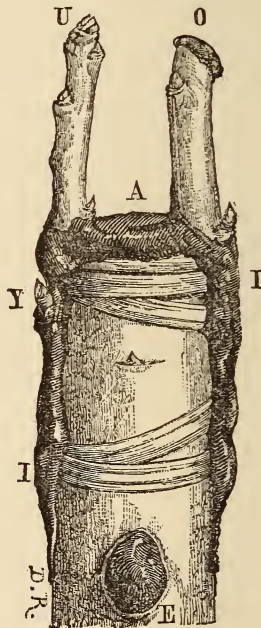
will be removed afterwards when the graft has developed its shoots. The heel, which serves at first as a prop for the young shoot, is to be cut off level with the graft, as soon as the young shoot shall have acquired sufficient strength to maintain itself.

Group II.—Crown-Grafting.—General Directions.

This method is suitable to a large number of trees and shrubs of various kinds. It is practised in spring, as soon as the bark is easily separated from the alburnum, but the precaution should be observed of preparing the stocks beforehand, and heading them down three or four weeks before grafting takes place. Formerly this operation was very often performed in autumn, several months before the usual time of grafting. When inserting the scions, the cuts, which have been more or less cicatrised, should be freshened with the pruning-knife. The scion branches are cut during winter, before the sap begins to flow, and placed in soil or sand, either in a cellar or at the north side of a wall, in a vertical or a horizontal position, and either half or entirely buried; the essential point is to keep them from vegetating, and to see that the bark does not dry up. The scions are pieces of branches from two to five inches long. The upper half should have two or three eyes; the lower half is cut with a flat sloping splice-cut, which should begin opposite to an eye, and end in a thin point. It should be so cut as to contain no pith, which would rather interfere with the process of cohesion, and on the whole should be of no great thickness. A small notch or shoulder cut in the upper part will serve to rest the scion better on the stock.

The scion is inserted into the top of the stock between the bark and the wood, the point being generally cut on both sides to facilitate its entrance; some operators, however, content

themselves with moistening the point with their lips. A small implement of wood or ivory is usually employed in preparing a place for the insertion of the scion. It has a long sloping point, which is introduced between the bark and the alburnum, and on being withdrawn the end of the scion is slipped into the opening. When this precaution is taken,



A Crown-Graft completed.

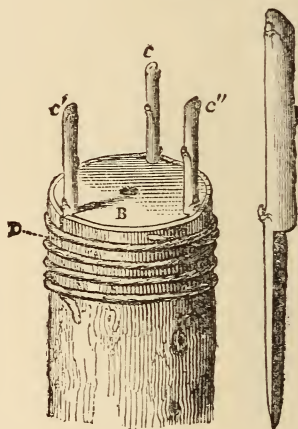
there is no fear of breaking slender scions nor of bursting the bark; however, the simple pressure of the hand will often suffice to fix the scion under the bark without previously raising it. The introduction of the scion is in most cases facilitated by the circulation of the sap which separates the

bark from the alburnum. However, it may happen that scions of large size will threaten to burst the tissues; in that case the best thing to do is to make a longitudinal cut in the bark with the grafting-knife at the moment of inserting the scion. The thicker the stock is, the greater the number of scions which may be placed upon it; however, to render the cohesion more complete, there should be a distance between them of at least two inches. A bandage, which should not be too tight, nor compress the bark too much, is necessary after the insertion of the scions. Grafting-wax is applied to the cuts, and to the bark of the stock where it covers the scions, in order to prevent rents. The adhering of the wax is facilitated by wiping off the sap which oozes from the cuts. Our illustration represents the head of a stock (which has been grafted, either by crown-grafting, or cleft-grafting, or inlaying, or veneering) bandaged and covered with grafting-wax. The wax is spread over the cut (A) on the head of the stock, where a branch has been removed (E), where the scion and stock are joined (I), and on the top of the shortened scion (O). The terminal bud (U) is not covered, nor the bud (Y) imbedded in the incision. Crown-grafting is, so to speak, indispensable in the case of large trees, on which a great number of scions may be grafted, in consideration of the amount of nourishment furnished by the roots.

Ordinary Crown-Grafting.

In the stock (B) we insert three scions (*c, c', c''*), which are as many as its diameter will allow of. It would be rather difficult to insert more without bursting the bark in at least one place by the increased tension. In the present case, that mischance is prevented by making a longitudinal incision (D), which not only facilitates the insertion of the scion *c'*, but also allows the others (*c* and *c''*) to be easily introduced without any danger of

bursting the bark of the stock. When a stock is grafted close to the ground, it will be no harm to earth it up as far as the upper buds of the graft. This will secure it from being dried up; and in certain kinds new roots will be formed on the incisions, which will promote rapidity of growth. It is not absolutely necessary to select scions of the current year's growth. Wood two years old, but fresh, has an equal chance of success, on the condition, be it understood, that it is furnished with eyes capable of being developed. In the case of old trees, there



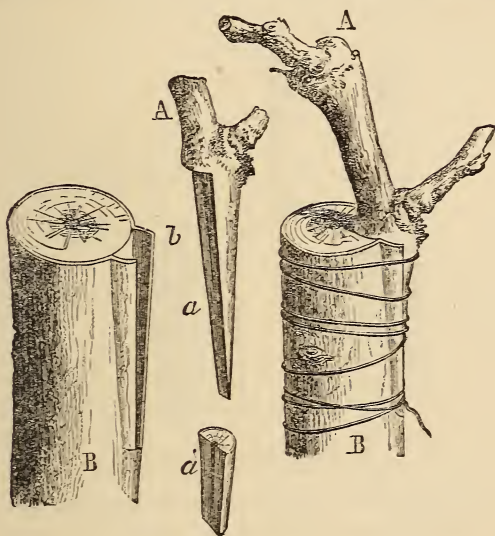
Ordinary Crown-Grafting.

need be no hesitation in selecting mixed scions, two years old in the part which is to be united to the stock, and one year old in the upper part which is to make the growth. The American Gleditschia, on which *G. Bujotii* and other kinds are grafted, requires to be treated in this way. Thus, the scion A (p. 79) is a branch two years old, bearing two shoots of the current year cut down to the length of an inch or so. A sloping cut (*a*) is made in the old wood, of which a section is given at *a*. It is

then placed on the stock (B), in which a simple incision (*b*) has been made. It will be necessary to raise the bark with the spatula of the grafting-knife, or some such implement, in consequence of the size of the scion and the want of elasticity in the bark of the *Gleditschia*.

Improved Crown-Grafting.

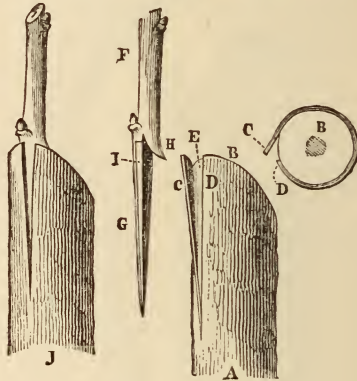
This method differs from the preceding in two essential



Crown-Grafting with a Scion two years old.

points:—1. The stock A (p. 80) being cut obliquely (as at B), the scion (F) is inserted on the top, with a tongue cut at an acute angle, and which fits accurately on the slope of the stock. 2. An incision must be made in the stock, and the bark raised with the spatula on one side only (C). The scion is then slipped in, so that the fresh cut on the inside may come into contact with the alburnum (E) and the bark (G) be covered by

the lip (C). The chances of success are increased by removing a small strip of bark (I) on the side of the scion, corresponding to the bark (D) of the stock, which will cover it. At J the work is shown completed before the application of the bandage and the grafting-wax. The section (B) of the stock exhibits the lip or portion of bark (C), which is raised from the wood, and the portion (D) which is not raised. These little alterations, which have been suggested by reflection and practice, and which are susceptible of great variation, have for their



Improved Crown-Grafting.

object the multiplication of points of contact in order to accelerate the cohesion of the graft. Professor Du Breuil has invented several of these improvements, and recommends them in his works. In the department of Isère, where grafting the walnut is more practised than anywhere else, M. Chaix, of Biviers, has for a long time used the modified method of crown-grafting which we have just described. He cuts the stock in a sloping direction, so that the oozing sap may not obstruct the cohesion of the graft. An angular notch is made in the scion, which fits on the top of the stock, and the

face of the longitudinal cut is made even to correspond with the surface of the stock where the bark is raised. The bark, it may be observed, is raised on one side only. In order to preserve the graft from the effects of heat and cold, he covers the cuts with clay, and then surrounds the graft with a band of bark 4 inches wide. In this way he operates on stocks thirty years old, and vouches for the success of the method.

Treatment after Crown-Grafting.

This is limited to—1. Keeping an eye on the bandage loosening it if it becomes too tight, and renewing it if the cohesion is not perfect. 2. Tying up the young shoots on rods or on a stake taller than the graft. 3. Removing any shoots or buds that may appear on the stock.

Group III.—Grafting de Précision.

Grafting *de précision*, or precise grafting, implies that the stock and scion are so accurately prepared and fitted to each other, that when they are put together they will coincide perfectly, without using any force, and without leaving any vacuum. The rigorous exactness which the operation demands, has led to the invention of special implements, such as the combined grafting knife and the *méto-greffe*. Spring is the proper season for precise grafting. It succeeds also in summer, if care is taken to select the woody part of young branches for scions, to shade them, and keep them from getting dried. Towards the end of summer, when the flow of the sap is diminishing, this method may also be employed, observing that the sap should be sufficiently active to produce immediate cohesion, but not so active as to cause an autumnal development of the buds. Experience accustoms one to perceive the moment when the sap begins to thicken, when the functions of the leaves are at an end. Under this new

title of "precise grafting," we class veneer-grafting and grafting by inlaying.

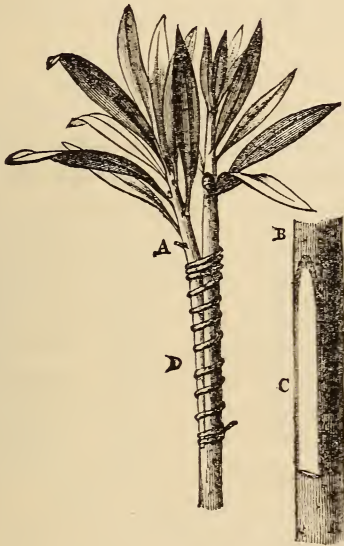
Veneer-Grafting.—General Directions.

This method is principally employed in grafting certain trees and evergreen shrubs, and for grafting under glass with the air excluded. Nurserymen and florists practise it in the open air or in the propagating house, in spring rather than in autumn, especially in the case of evergreens. A stock with the sap in a condition of moderate activity and a well-ripened scion are the two first essentials. The scion may be a shoot of the current year or of the preceding one, according as the grafting takes place in the autumn or in the spring. Its length varies from 2 to 6 inches, and it must be cut with a flat splice-cut without the least unevenness, in order to fit the stock exactly. If it is evergreen, the leaves are not removed, and it is not cut from the parent-tree until immediately before it is fixed. The *métro-greffe* here comes into requisition; with its help a cut is made in the stock the exact size of the splice-cut on the scion. Nothing then will obstruct the union of wood and bark. The two parts are put together without cleft or insertion, by simply applying the scion to the top or the side of the stock, under the bark, or with the bark removed, employing either one scion or several. Such are the various modes of branch veneer-grafting. We shall proceed to treat of them in detail, without speaking of veneer bud-grafting, which is described in the chapter on bud-grafting, as we are now engaged with the subject of grafting with detached branches only.

Ordinary Veneer-Grafting.

By this method a scion is brought into contact with the first layer of alburnum in the stock. The stock is not to be headed down beforehand. In the case of an evergreen, the

leaves on the part destined to receive the scion are cut off at the stalk or in the middle ; the scion also should not be cut from the parent-tree more than a day before it is used, and its leaves should not be removed. The scion having been cut with a straight, longitudinal section, its diameter is taken with the *méto-greffe*, which is then applied to the stock (B), and



Ordinary Veneer-Grafting (Rhododendron).

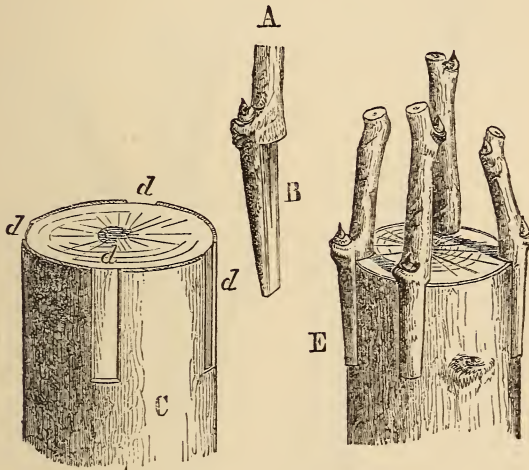
the dimensions of the section of the scion are traced with it. Nothing more remains to be done but to cut away the part between the two marks, to correspond exactly with the section of the scion, so that they may fit, as at D. First remove the bark, and, if that is not sufficient, cut the first layers of the alburnum (C). Instead of a *méto-greffe*, a grafting-knife or a common pruning-knife may be used. Place the scion against

the stock, and with the point of the knife mark out the outline of the section, and then cut away the bark and woody layers. The scion is fitted to it from time to time until the parts are accurately adjusted. A bandage of either woollen or cotton thread, closely wound on, is indispensable. Grafting-wax is not always necessary. Instead of a flat section on the stock and the scion, notches or tongues may be cut, which will fit into each other. This is the English method.

Veneer Crown-Grafting.

The scion is not cut with a sloping or splice cut. A notch at the top of the cut (B), such as is made in ordinary crown-grafting, will be useful to set the scion square on the stock (C). With the *métre-greffe* the diameter of the cut (B) is marked out at *d, d, d, d*, successively, where the scions are to be applied. As the double spatula has cutting edges, the bark will be divided; it is then removed, and the scions placed as shown at E. The application of the bandage and wax is indispensable. The bark only should be removed; the alburnum is not cut. A large tree is more easily grafted than a small one, because the latter presents a rather convex surface, and would necessitate the cutting of the alburnum in order to fit the scion in properly. With an old tree, the cortical layers of which are thick, the shifting of the scion under the bandage is to be apprehended. The way to remedy this is by leaving the cut part of the scion rather thick, or better still, by placing an intermediate substance between the bark of the scion and the bandage, for instance, the strip of bark which has been removed from the stock. These strips of bark may be turned down without removing them, and afterwards brought up on the backs of the scions before the bandage is applied. The two seasons suitable for this mode of grafting are March and April, when the sap begins to flow,

and September and October, just before it goes to rest. The treatment after grafting is the same as that which we have indicated in the case of ordinary crown-grafting. A grafter in our establishment, Louis Asselin, invented this method, but the process is so simple and reasonable that other practitioners must have tried it before him.

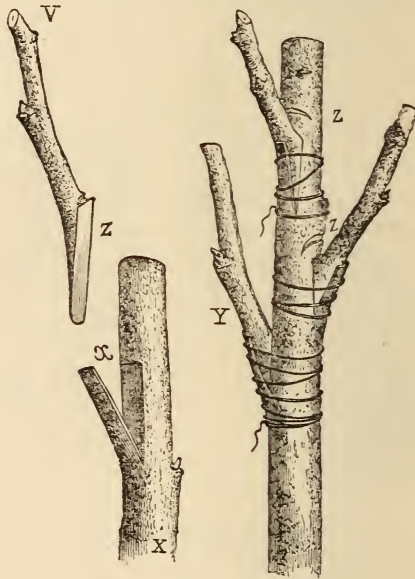


Veneer Crown-Grafting.

Veneering with Strips.

M. Trouillet, arboriculturist at Montreuil, communicated to us this mode of grafting. It has some resemblance to "side-grafting with a simple branch." We employ them both with equal success in restoring trees which have lost their branches. The proper seasons for operating by this method are in April with a shooting bud, and in August with a dormant bud. With the *méto-grefe* we cut the scion, on its rounded face, in a duck's-bill section. We measure the diameter of this, and

applying the implement to the stock (X), we cut the bark with the double spatula; then with the grafting-knife cutting across at the top of the two lines, we bend back the strip (X), fix the scion (V) in its place, and bring up the strip upon it, as shown at (Y). It is then bandaged, and grafting-wax applied to the crevices. In operating on strong or much-



Veneering with Strips,

branched trees, it is wise to cut notches (Z, Z), half an inch or so above the grafts. These, by arresting the flow of the sap, will divert it towards the new shoots.

Treatment after Veneer-Grafting.

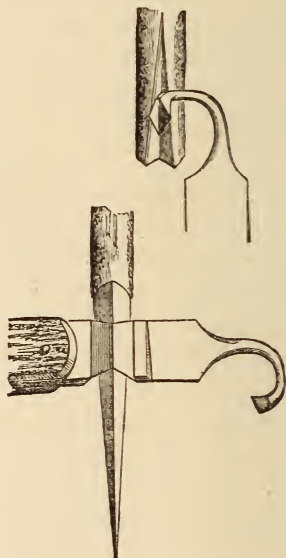
As the bandage is indispensable, the first care will be to prevent it becoming too tight, and it will require to be well

looked after. Soon after spring grafting, the stocks which have been side-grafted are headed down by degrees, leaving them at last a heel of four inches in length. With subjects grafted in the end of summer, the heading down of the stock is completed after winter. The heel serves for fastening up the scion in the early stages of its development. It is removed after a year's growth. If the object be to produce a lateral branch, the development of the scion is promoted by a notch (Z) made over the place of its insertion, and by cutting away the branches growing above it. A stake or prop is useful to fasten the young graft to.

Grafting by Inlaying.—General Directions.

Formerly known under the name of grafting *à la Pontoise*, this method was employed specially for the propagation of the orange-tree and certain shrubs; at the present day it is applied to a greater number of plants. The establishment of Simon-Louis, at Metz, has extended its use to almost all kinds of trees and shrubs. The principle of the operation is to inlay the scion, which is cut with a triangular face, in the stock so as to thoroughly exclude the air. The proper seasons are in spring when the sap begins to flow (although one may also graft in summer, using semi-herbaceous scions), and in August and September with woody scions. The time to be preferred is about the end of March and in April. The stock is prepared beforehand, or at the time of grafting, so that the scion may be placed on a fresh cut. For spring grafting, the scion-branches are cut in winter and kept in soil or sand in a shady place. It will also answer to cut them from the parent tree a few days before grafting. In summer grafting they should not be cut until immediately before they are wanted. The scion, which should have two or three eyes, is cut at the lower part with a wedge-like or triangular face, and is inlaid upon the stock in

an angular groove, corresponding to the triangular face of the scion. It is then bandaged, and the cuts are covered with grafting-wax. The preliminary operations are performed with a fine-edged pruning-knife and the ordinary grafting-knife; but greater rapidity and precision are secured by the use of the combined grafting-knife. Both ends of the tool are



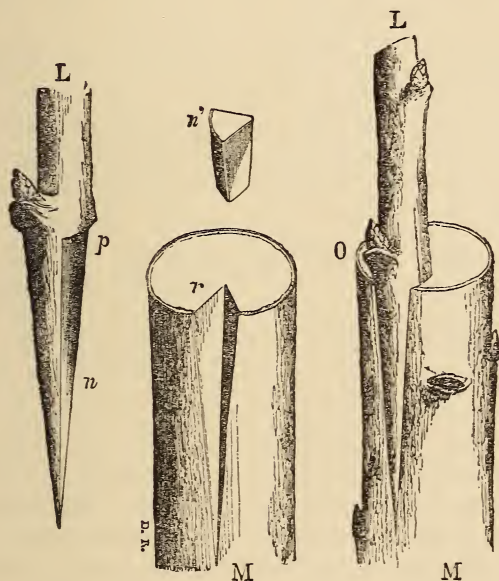
Inlaying with the combined Grafting-knife.

sharpened and set at the same angle, which gives a mathematical accuracy to the operation. It is immaterial whether the angle be rectilinear or curvilinear; the essential point is that it be identical in both parts of the implement. With common tools a groove with a blunt or square outline is often made; or it may have the contour of a trapezium, or any other figure; the only really important thing being that the scion be cut to

fit it accurately. Grafting by inlaying is performed on the crown of an amputated stock, and sometimes on the side of a stock not amputated.

Crown-Grafting by Inlaying.

Suppose first that we have not got a combined grafting-knife. The scion (L) is cut with a triangular face (*n*), of



Crown-Grafting by Inlaying.

which a section is given at *n'*. The notch (*p*) will serve as a shoulder to rest the scion on the head of the stock. The scion is then placed with the back of the triangular face against the stock (*M*), and the outline of it marked with the blade of a knife. The bark and wood are then cut away so as to form a wedge-shaped groove (*r*). The scion (*L*) is then

inlaid in the groove made in the stock (M) as shown at O. The operation is completed by applying the bandage and grafting-wax. It may be easily understood that the use of the combined grafting-knife will save all delay and uncertainty; and when a little dexterity is acquired in handling it, the operation of inlaying can be performed with great rapidity.

Side-Grafting by Inlaying.

This method is not so much employed as the preceding, because veneering, which resembles it very much, is far easier. Branches with knees or curves may be inlaid on a straight stem in the same way as a straight scion is grafted on a bent stem. Thus inlaid, the scion will possess greater firmness than if attached by veneering, especially if the stem of the stock be so rugged as to render the adjustment of the parts difficult.

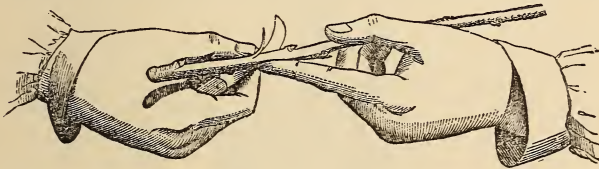
Treatment after Inlaying.

Should the scion be insufficiently secured on the stock, it should be bandaged firmly, using a broad rather than a narrow bandage, as less likely to become too tight. The immediate and continuous employment of a prop or stake, to which the graft is fastened, should not be neglected. Unless they are specially required, the pinching of the young shoots of the graft will accelerate the cohesion of the parts, as thereby a smaller surface is exposed to the action of high winds. In other respects, the treatment will be similar to that which we have directed in the case of ordinary side-grafting.

Group IV.—Cleft-Grafting.—General Directions.

This method is employed for propagating the greater part of woody deciduous trees and plants. The scion is a portion of a branch furnished with one eye or several. For a young

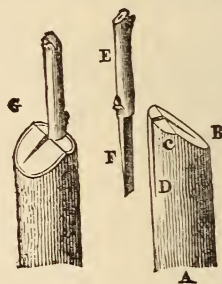
stock a short scion is to be preferred. If the stock is a large tree, in a cold but rich soil, and in a damp climate, scions with four or five eyes are preferable to shorter ones; while, on the other hand, in poor soil, and in a warm dry climate, short ones are best. Let us take a medium-sized one, with two or three buds and 3 or 4 inches in length. In preparing it, we cut the lower part on two sides, so as almost to resemble two sides of a triangle. We say *almost*, as the two sides do not meet in a sharp edge until near the point; a strip of bark being often left, which gradually widens from the point to the top of the cutting. Opposite this edge is the back of the cutting (which is not touched with the knife), commencing immediately under an eye, and ending in a point at the lower



Preparation of the Cleft-Graft.

extremity of the scion. In some cases we shall see that we can continue to have a bud on the back of the cutting; and in some modes of cleft-grafting the scion is cut with an even face on both sides, instead of being wedge-shaped or triangular in form. When it is desired to set the scion evenly on the stock, a small horizontal or oblique notch is cut on each side at the top of the sloping cut. The preparation of the scion is effected more easily by holding it extended along the forefinger of the left hand. With the grafting-knife in the right hand, it is cut and smoothed down on both sides; the least inequality or roughness would be an obstacle to its perfect coincidence with the stock; the point should be slightly

blunted, in order to facilitate its slipping in smoothly. We may remark, as a useful hint to beginners, that the operator has more power and command of his implement if he keeps his elbows close to his sides. Whether the stock be entire or provisionally headed down, it is finally cut at the moment of the operation at the place destined to receive the graft, in order that the grafting may be performed on a freshly-cut surface. When the saw or the sécateur is used for this purpose, the cut is smoothed down with the pruning-knife, so as to remove all inequalities from the surface. If the stem is of medium thickness, not more than one graft is made on it, and the cut is made in a slightly oblique direction; but if the strength of the stock requires several grafts, then the cut is



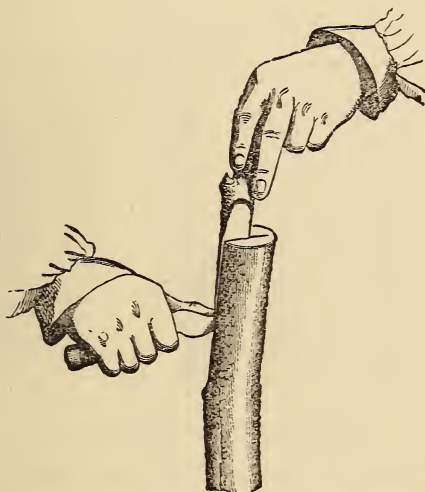
Ordinary Cleft-Grafting with a Single Scion.

made horizontally (for crown or cleft-grafting). Cleft-grafting is effected with one or several scions; the various processes consist in employing them either when woody or herbaceous—in spring, summer, or autumn—on the body of the tree, on the top, or at the angle of the branches.

Ordinary Cleft-Grafting.—With a Single Scion.

We have at our disposal a stock (A) of medium size. We cut it obliquely at B, the top (C) of the cut being smoothed horizontally; then inserting the point of the pruning-knife,

or the blade of the grafting-knife, we move it gently backwards and forwards, pressing on it moderately, until a vertical cleft (D) is made about the depth of the slanting cut of the scion. The skill of the grafter is displayed in not splitting the stock right across. Care should be taken that the bark and the first alburnum layers of the stock be divided in the same line as the cleft, and with a clean cut; if they should be divided irregularly, no attempt should be made to smooth



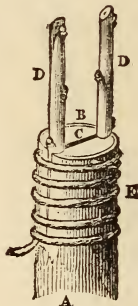
Insertion of the Scion in Cleft-Grafting.

down or remove the irregularities of the fracture. When the cleft is about two-thirds completed, we take the scion (E) in our other hand and insert it in the upper part of the orifice, pushing it downwards as the incision opens. The implement is withdrawn when the incision has proceeded so far that the scion can be finally lodged in its position by a push of the hand. The sloping cut (F) of the scion is so placed at G that

its bark may coincide with that of the stock without projecting or leaving much of a cavity on the inside if possible. If the stock has a thick bark, we should slightly incline the scion inwards in the cleft, so that the layers of bark and alburnum of both stock and scion may inevitably find some point of contact; for the union is effected by the contact of the generative layers of both parts, and not of the external layers of the bark. Mastic is necessary; bandaging not so much so.

With Two Scions.

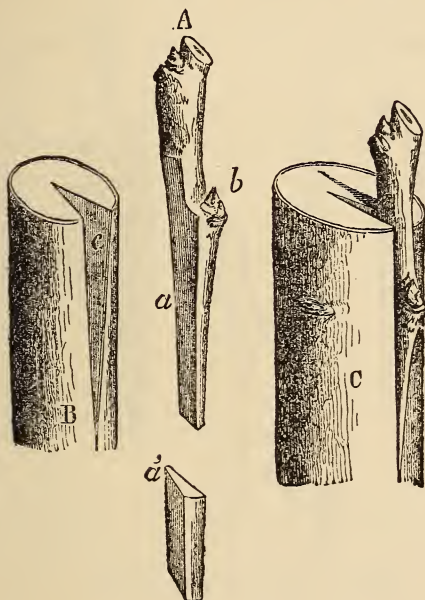
The stock (A), being larger, will take two scions. The



Cleft-Grafting with two Scions.

cut (B) is horizontal, and we split the stock right across at C. In order to do this, we place the blade of the pruning-knife or the grafting-chisel perpendicularly on the top of the stock, and press upon it with both hands. If the wood is tough, we must make use of a mallet. The scions are placed one by one in the mouth, or in a vessel containing damp moss. When the cleft is two-thirds completed, we withdraw the implement to one side, so as to keep the incision always half-open. We place one scion at the other side, and using the implement or the handle of the mallet as a lever, open the incision so as to

let in the scion completely. The insertion of the other scion is not more difficult; perhaps it will be necessary to introduce the blade of the implement into the cleft (C) at the centre of the cut, and open it a little, to facilitate the admission of the second scion. If the pressure of the implement should be disagreeable, a little wedge of box-wood might be temporarily



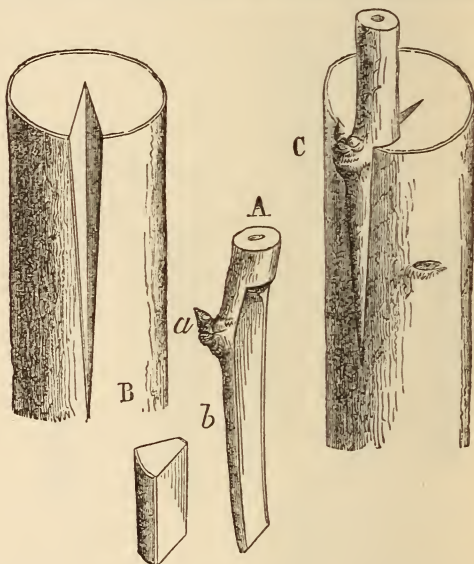
Cleft-Grafting with an Inserted Bud.

introduced into the middle of the cleft (C). This would permit us to insert both scions easily, without enlarging the cleft. Bandaging and mastic are necessary.

Cleft-Grafting with an Inserted Bud.

When more than two scions are to be employed, two parallel clefts are to be made, so as to leave the pith in the centre

untouched. A scion may then be inserted in each of the clefts. This might be termed double cleft-grafting, but the method of oblique cleft-grafting is to be preferred. This mode of grafting is based on the preparation of the scion. In cutting the scion (A) in the manner of the section (*a'*), we contrive to have on the back of the cut part (*a*) a bud (*b*),



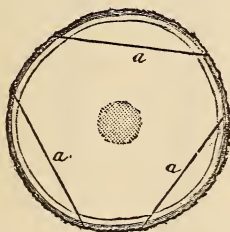
Cleft-Grafting with a Single Bud.

which will be inserted in the cleft (*c*) of the stock (B), as represented at C. From this will spring a vigorous scion, on which the wind will have no effect. It may be tied up against the upper part of the graft. Bandage and apply mastic. Our next illustration shows a scion (A), furnished with a single bud (*a*), which will be inserted in the cleft of the stock. At *b* is seen a section of the cut part of the scion; at B the cleft in the stock; and at C the scion finally inserted: Nothing

further remains to be done except to apply the mastic, taking care not to rub off or injure the bud (*a*). According to the manner in which the end of the scion is cut, the bud (*a*) may be placed level with the top of the stock, as shown at C, or lower down, as at C in the preceding illustration. The incision (B) in the stock shows that this process is equally applicable to grafting by inlaying. By this method valuable scions may be multiplied, since as many grafts may be formed as there are buds.

Oblique Cleft-Grafting.

Looking to its future development, a stock that is already pretty strong may be furnished with more than two grafts;



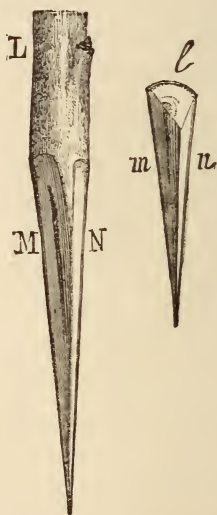
Section of the Stock.

but as we can place only two in one transverse cleft, we should have to make other clefts across the centre, the result of which would be to enfeeble the stock. To avoid this we can employ a method which will leave intact the heart of the tree, and at the same time allow us to augment the number of the grafts. The stock having been sawn across and smoothed down with the pruning-knife, we make several clefts at the side (*a, a, a*), which, to speak geometrically, are, with reference to the section of the cutting, chords in the circle, and not radii or diameters. In order that the scion (L) may be adapted to the incision in the stock, it must be cut obliquely,

so that while only one of the sides (M) slants towards the centre, the other (N) will only have the bark removed as far as the alburnum. In the other methods of ordinary cleft-grafting, those scions which have too much pith may always be cut in this way ; in that case the stock is cleft obliquely, and not diametrically, in order to spare the central part.

Seasons for Ordinary and Oblique Cleft-Grafting.

The principal seasons for cleft-grafting are spring and the



Mode of Cutting the Scion for Oblique Cleft-Grafting.

end of summer. In the south of France, where the winters are very mild, it is practised with success from the month of December. Towards the north they seldom commence before March or April. In those districts where growth is prolonged, the summer-grafting is very often done in the autumn. Thus

there are two distinct seasons, known in practice under the names of spring grafting and autumn grafting.

Spring Grafting.

March and April are the usual times for the first cleft-grafting. In warm countries it may begin earlier, as it may in the case of subjects of very early growth. The scion-branches, cut beforehand, are to be placed in soil, or in a vessel full of sand, and deposited at the north side of a building, or in the shade of a tree or bush. They may also be removed from the parent-tree at the time of grafting, provided the sap has not yet begun to flow in them. The stock should be headed down on the day of grafting. When this is done sooner, the cut has to be renewed, in order that the scions may be inserted upon a healthy and fresh surface. If there is any difference in the state of the sap of the two parts, the scion should not be so advanced as the stock. After grafting, should there be a continuance of great heat, the graft must be covered with moss, or a piece of paper twisted into a cap placed over and fastened to the stock.

Autumn Grafting.

Cleft-grafting in autumn or the end of summer is performed in the same way as in spring. Nothing is changed but the season. This period comprises the months of August, September, and October; but the moment should be seized when the sap is on the decline, the branches of the stock well ripened, the buds well formed, and the leaves, although still adhering, ready to fall. If grafted too soon, the scion might sprout, and this precocity in the end of the season would be fatal to it in winter, as it would be more exposed to the cold than if it had remained dormant. On the other hand, if grafted too late, the scion could no longer unite with the stock, on account of the disappearance of the

cambium, and when spring arrives it would be found to be withered. So we cannot lay down an invariable rule for the time proper for each species or variety; the condition of growth is the point on which success chiefly depends. Two neighbouring subjects of a similar species may demand a difference of three weeks in their autumn grafting. In this matter use is the best guide. Among the subjects grafted in autumn, the plum, and especially the wild cherry, are the better of it in this respect, that, their development in the following April being much earlier than if grafted in spring, they will have less to fear from the vicissitudes of the weather and the attacks of insects. The scions should be cut just before being used, stripped of their leaves at once, and have their ends placed in a vessel of water or in cool sand. In autumn grafting, cold mastics have this drawback, that their unctuousness suffers from the action of the frost, which penetrates to the tissues of the grafts. A warm composition which hardens at once should therefore be employed. However, a mastic which is too easily softened, or which does not harden sufficiently, can always be covered so as to protect it from the frost.

TERMINAL CLEFT-GRAFTING.

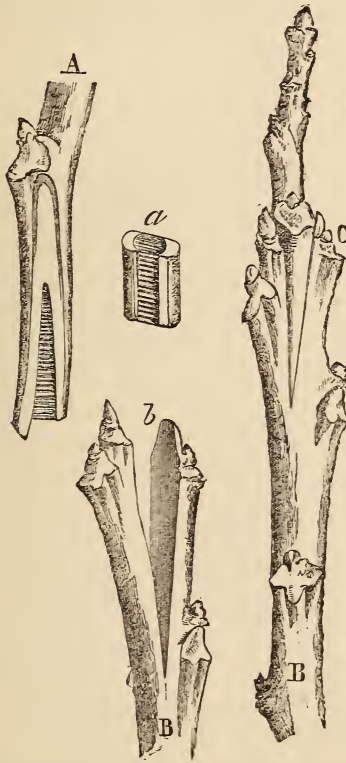
The modes of cleft-grafting which have been described are only terminal in a certain sense. In those which follow, the grafts are more especially applied to the top of a stock not headed down, and are inserted with a terminal eye.

Terminal Woody Grafting.

The season for performing this operation is in spring, before the flow of the sap. We have employed this method with the walnut-tree and the fir.

Terminal Grafting of the Walnut-tree.

The scion (A) is cut with a regular double slope (*a*); the stock (B) is cleft in the middle of its terminal bud, moderately, so that the introduction of the scion may complete it.



Terminal Grafting of the Walnut-Tree.

The stock and scion are then bound firmly together with a bandage at the top and bottom of the cleft, and the tying is allowed to remain until the scion begins to sprout. At this

period, the shoots of the stock are to be pinched, but not cut off altogether. They will continue to draw the sap towards the graft. This kind of grafting has succeeded better with us under glass than in the open air; however, we have thought it better to mention it, as it has succeeded with the air excluded, and also because it may be tried on other plants.

Terminal Grafting of the Pine.

The varieties of the pine, *Piceas*, *Abies*, &c., of which the stem increases every year by a whorl of branches and a leading shoot not branched, may be propagated by means of this method, which is practised in the open air in April and May, when the buds of the pine begin to swell. The scion (A), taken from the top of a branch, is a shoot of the preceding year crowned with its terminal buds. It is cut on both sides in a slightly slanting direction, as at *a*, and introduced into the top of the shoot (C) of the stock (B) in a longitudinal cleft made between two buds of the crown at their junction near the central bud; this cleft may be partial or entire (*b*). The insertion having been made (as at *d*), it is bandaged with wool or cotton and covered with mastic; the graft is then surrounded with a sheet of paper, in order to preserve it, when it begins to sprout, from the action of the sun and hot winds. At the same time the shoots of the upper whorl of the stock are cut to half their length; the slender ones may be bent downwards. The object of this precaution is to divert a larger supply of sap to the graft. No part of the stock except the upper whorl is to be thus cut. Even afterwards the branches of the stock must not be too closely pruned. If they extend too much, a moderate pinching in summer will suffice to check them. The stock may be grafted at any age, and either in the open air or under

glass with the air excluded. The trees which result from this mode of grafting will have all the appearance of having been raised from seed. Of course, it will be better to graft them when young, if a longer enjoyment of their habit and foliage is desired. In the nurseries about Metz this mode



Terminal Grafting of the Pine.

of grafting is successfully practised in the open air, in July and August, when the scion and the leading shoot of the stock are passing from the herbaceous to the woody state, and present sufficient consistence to allow of this mode of grafting being performed.

Terminal Herbaceous Grafting.

We have used this method chiefly with the pine, but we have every reason to believe that it will answer other members of the Conifer family equally well. When the sap first begins to flow in May and June, and the young shoots of the pine are already an inch or two long, and before the new leaves are developed, is the proper time for grafting. The scion (C) is one of these young shoots in an almost rudimentary state, with a bud at its extremity; it is taken from a branch of the parent tree, it does not matter whether from the top or the sides. It



Terminal Herbaceous Grafting.

is cut with a sharp knife on both sides, in an even, sloping direction. This must be carefully done, on account of the delicate texture of the wood. The stock is cut off at the top of the leading shoot, immediately below the group of terminal buds. The leaves around the top (B) are removed, except a few which are left to attract the flow of the sap. The cleft is made either right across, or partially, according to the difference between the diameter of the stock and that of the scion. The scion is inserted rather deeply into this cleft, so

that the top of the cut part may be a little below the level of the top of the stock, and the bark should coincide with that of the stock on one side at least. A prop or a stake will be necessary to support the graft for a year or two. It is bandaged with wool, and the cuts exposed to the air must be covered with mastic; a paper cap is placed over the graft, and kept there until the scion has begun to sprout. The stock will not afterwards require any clipping, disbudding, or pinching of its branches. The Forest of Fontainebleau affords examples of *Pinus Laricio* which were thus grafted on *Pinus sylvestris* forty years ago, and the trees are as fine as if they had been raised from seed. For twenty years past M. Jules Barotte, of Brachay (Haute-Marne), has converted by this method thousands of *Pinus sylvestris* into *P. austriaca* and *P. Laricio*. He operates in the open ground or in the forest, grafts the subjects on young leading shoots at the height of two or three feet from the ground, and never covers his grafts with paper caps, as they do in the nurseries.

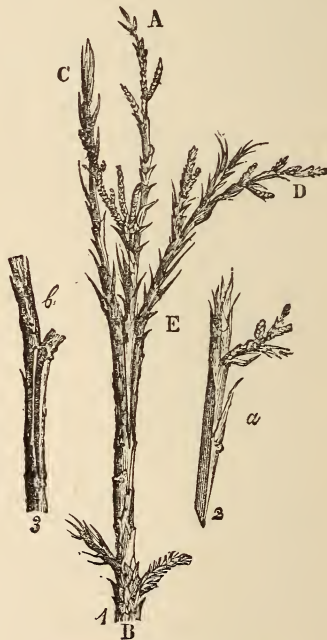
Cleft-Grafting in Forkings.

In this method the scion is inserted into the stock at the point where a branch forks from the stem, or where two branches fork with each other. It is easy to produce this forking by a suitable pruning of the stem or branch at any time, or by making an incision over a bud, which will develop into a branch and form a forking. The scion is cut into a triangular wedge and inserted into the stock at the junction of the two branches; these branches are to be gradually shortened as the graft develops itself. Conifers, the beech, the vine, and the oak, are the kinds which succeed best under this method.

Fork-Grafting of Conifers.

Amongst resinous trees, the kinds which ramify on the

young leading shoot, the varieties of Biota, Chamæcyparissus, cypress, juniper, Retinospora, Thuja and Thujopsis, may be propagated by this method. The scion (A) is inserted into the stock (B) at the point of junction (E) of the branch (D) with the leading shoot (C); the lower part (*a*) of the scion is cut on both sides, so as to have the internal part narrower than the outside and cut perfectly clean and level. A partial cleft is made in



Fork-Grafting of Conifers.

the top of the stock, at the place (*b*) of forking; the scion is inserted here, bandaged, covered with mastic, and surrounded with a leaf of whitey-brown paper. For this somewhat delicate work, a blade like that of a penknife will be most convenient. Spring is the proper season for the operation. The sap must

be attracted to the graft by shortening the branches of the stock, which are beneath the graft; their ends only need be cut off. An extensive lopping or clipping would be disastrous, and should never be resorted to in the case of young Conifers.

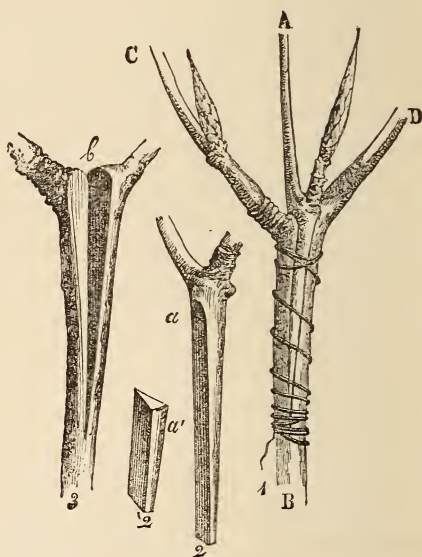
Fork-Grafting of the Beech.

The scion A (p. 108) is let into the stock (B) at the angle where the two branches (C and D) meet. The lower part (*a*) of the scion is cut into a thin wedge, of which *a'* is a section. The cleft (*b*) of the stock should not extend further than two-thirds of the diameter of the tree, so that the scion may be held firmly; however, it must also be bandaged and covered with mastic. If, instead of a cleft, a channel or groove were made, such as our illustration (*b*) seems to indicate, it would be merely additional labour without increasing the probability of success. The branches (C and D) are to be cut pretty long; they may be shortened afterwards as the scion develops itself, so that the two stumps may be removed in the following autumn, supposing the grafting to have taken place in March or April. The oak may also be grafted in this way. M. P. de Mortellet has for a long time propagated by this method the oaks of America upon those of Europe. We have also succeeded with the European walnut upon the American species. Perhaps the chestnut and other hard-wooded trees may be thus grafted with equal success.

Fork-Grafting of the Vine.

This mode of grafting is performed over-ground in the forking of two branches. The scion, prepared with a sloping cut on both sides, is introduced into the stock by means of a partial cleft opened at the junction of two branches. These two branches are cut down to within about a foot from the main stem; and in summer the shoots which spring from them

are to be pinched, but not cut away, with the object of drawing the sap towards the graft. After a year's growth the two branches are to be cut off level with the graft. The proper time for operating is in autumn, when the sap is about to decline, although there is a chance of succeeding in spring. The bandaging should be strong, and kept on for a long time, as the wood of the vine has a tendency to split. This method,



Fork-Grafting of the Beech.

recommended by M. Boisselot, of Nantes, enables us to change the nature of a vine-stock by inserting at its forkings scions of the variety which we wish to propagate; or we may thus bring together several varieties on the same stem.

Treatment after Cleft-Grafting.

We have already, under the different modes of cleft-grafting,

indicated the special treatment which they demand, and we have now only to generalise our principal directions. Keep a constant watch on the bandages. As they develop themselves, the scions must be tied up to stakes, poles, or props of some kind. The simplest way is to attach a flexible rod by its two ends to the stock, arranging it in whatever manner the



Mode of tying up and securing the Graft on a tall Standard.



Mode of tying up several Grafts on the same Stock.

young shoots may be most conveniently fastened to it. Remove all buds from extraneous shoots of the stock; the stronger the stock, and the more distant these shoots are from the graft, the more rigorously should this rule be carried out. Any insects which have taken up their abode in the fissures

of the graft or under the bandages should be looked after and dislodged. A cleft-graft which has missed may be replaced by a crown-graft, a shield-bud, or a cleft-graft with an herbaceous branch.

English Grafting.—General Directions.

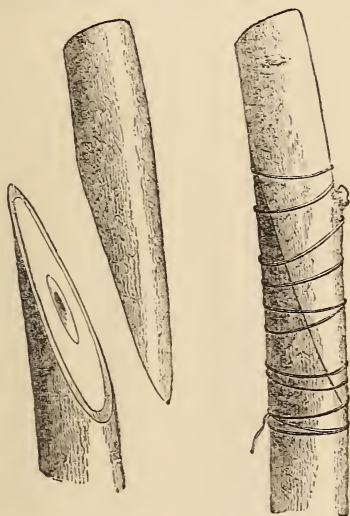
The stock and the scion are usually of the same diameter. They are cut with a slant in opposite directions, but at the same angle, so as to fit exactly when brought together. Their points of contact are sometimes increased in number by a series of notches or tongues which fit into each other. The stock is headed down to receive the graft. A rather large stock may have two grafts. The scion is a portion of a well-grown branch with from two to four eyes. This method is applicable to most plants. In the establishment of M. André Leroy, at Angers, hardly any other system is employed, but in other establishments it is only used with stocks of small diameter. The proper season for grafting in this way is in March and April; the operation would also succeed in August and September, when the flow of the sap begins to decline. There are numberless ways of practising grafting after the English fashion, but we shall confine ourselves to three or four of the most distinct.

Ordinary Splice-Grafting.

Next to bud-grafting, this method is the most suitable for apricot trees. The stock and the scion, which are of the same diameter, are cut with a sloping or splice cut perfectly smooth and even, in order to prevent the exudation of gum, which is always fatal to the union of the parts. The two parts are then fitted together as exactly as possible, and bound with a pliant bandage of wool, Sparganium, or lime-bark. The use of a stake or prop should not be neglected, and care must be taken to ease the bandaging, if it should become too tight.

Tongue-Grafting.

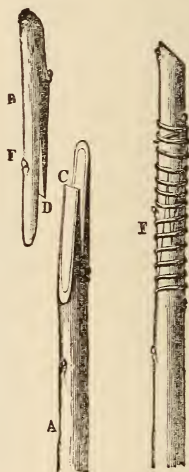
This is the method most commonly used, and is a sort of carpenter's graft. The scion (B) is cut with a very long sloping or splice cut; in this a long notch (D) is cut for about two-thirds of its length, so as to have a bud (E) at the end of it. This notch is to be made quite smooth, and should be made in two clean cuts of the pruning-knife. The stock (A)



Ordinary Splice-Grafting.

is treated in the same way, so as to have a notch corresponding to that of the scion, which should fit into it accurately. The point (D) is then inserted into the notch at C, and the parts are pressed into each other. As the ends of the graft are more likely to become loose than the centre, the bandages should be more carefully attended to at these points. The operation is completed by the application of mastic. Should the scion have a smaller diameter than the

stock, it should be drawn to one side of the cut, so that the bark of both stock and scion may coincide on one side at least. In the next page we give another form of English grafting, which we think should be called the *thunderbolt* method. Presenting great solidity of plan, it affords a double security in the two slanting notches of the scion (A) and of the stock (B) both finally united at C. The bud (at *d*) on the back of the scion has been properly left opposite the notch.



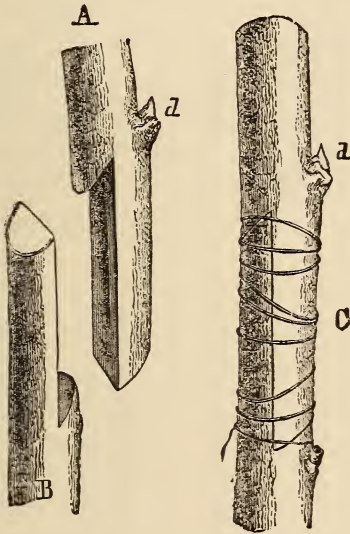
Tongue-Grafting.

Its object is to attract the flow of the sap to the graft. We may here mention the old-fashioned system of "whip-grafting," employed in England in the case of some kinds of trees in preference to budding, on account of the inclemency of the climate. The stock is headed down and cut on one side only to receive the scion, which is cut with a long splice-cut and partially cleft or notched; the graft is

then covered with grafting-wax as far as the terminal bud of the scion.

Saddle-Grafting.

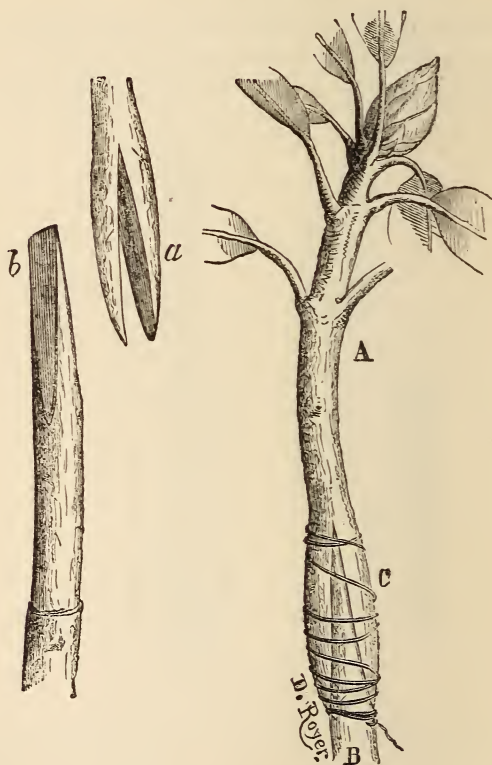
The stock B (p. 114) is cut at the top with a slanting cut on both sides (b). The scion (A) is opened or cleft at its base (a) and placed saddle-wise on the stock (B) which is embraced



Grafting with a notched Splice.

by it (as at C). It is then bandaged. This method comes more properly under the head of grafting under glass; in that case, mastic is unnecessary. In May 1867 we saw at the Exhibition at Versailles a charming collection of Rhododendrons obtained in this way by M. Bertin, junr. The scions, which were taken from flowering branches, had produced bouquets of bloom at once. It would, therefore, be very easy to get

together in a small space a miniature collection of this plant in flower. We have also seen this process employed in the multiplication of camellias by M. Marie at Moulins.



Saddle-Grafting.

Treatment after English Grafting.

The more intimately the two parts are fitted to and hooked into each other the less necessity there will be for the use of a prop or stake, yet, as it is better to err on the side of

precaution, we should employ a stake or pole of a length proportioned to the probable development of the shoots. It is very possible that the bandage may become too tight, for, as the parts are of the same diameter, the stock will be a young and consequently a vigorous subject. Should this occur, the bandage must be untied, and not cut, as there is danger of the knife penetrating the joining of the graft.

Group VI.—Mixed Grafting.

We give this name to those modes of grafting which, without having any determinate character, resemble other methods either in the manner of preparing the scion, or uniting it with the stock. Such are cutting-grafting, layer-grafting, root-grafting, and grafting with fruit-buds.

Cutting-Grafting.

In order to propagate various kinds of trees or shrubs, which succeed as cuttings, and not so well when grafted in the ordinary way, we have recourse to a mixed process, the base of which is the employment of a scion or a stock in the condition of a cutting. The new roots which spring from the cutting strengthen the graft by supplying it with additional vital elements. It is, so to speak, half grafting by approach, and often a case of root-grafting. Sometimes the scion is the cutting and sometimes the stock, and occasionally both are cuttings united by grafting. Adepts in grafting, they say, should succeed in grafting a scion of orange-tree on the midrib of a leaf of a citron-tree which has been newly slipped!

Grafting with a Cutting for the Scion.

In this method the scion only is a cutting, the stock is a tree which has been at least a year planted. It may be left

entire or headed down at the time of grafting: and may be grafted either close to the ground or at some distance from it, under the surface of the soil or above it.

Cutting-Grafting on a Low Stem.

There are two principal methods based on the previous



Cutting-Grafting.

amputation of the stem or otherwise. Here the stock is shortened to within 4 inches or 8 inches from the neck. We then take a scion-branch of sufficient length that when its extremity is buried in the soil as a cutting, close to the stock, it may be grafted on the stock, and have a couple of buds

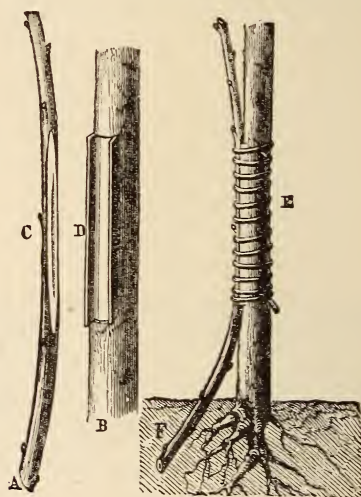
above the graft. The stock is channelled with the gouge and the bark is removed from that part of the scion which is to be placed in the groove. They are then bandaged and covered with mastic. When a vine is grafted in this way, the soil is heaped up about it so as to cover the graft. When the stem of the vine is young, or if it is furnished with vigorous shoots at the base, we have recourse to *layer-grafting*. A small trench or hole is made (B), in which the shoot is to be layered; the shoot to be grafted is then cut down to the third



Layer-Grafting,

eye (as at A). The other shoots of the same stock are removed, or cut short or grafted in the same way. The scion is grafted at A in the English fashion, then cut so as to leave two or three eyes over-ground, and fastened to a stake. Should the stock offer any resistance it can be pegged down in the bottom of the trench with a forked stick. The hole or trench (B) should then be filled with good free soil, which will facilitate the production of the new roots. Instead of previously shortening the stock

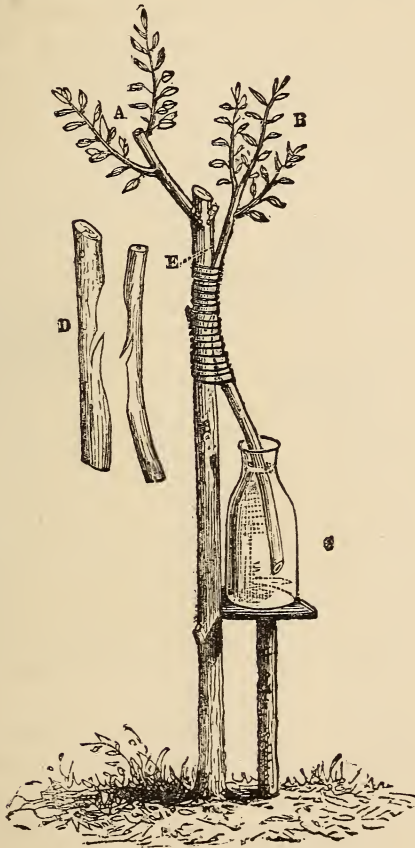
it may be grafted entire, so that it may not be mutilated to no purpose, should the graft miss. The scion (A) is cut as at C; the stock (B) is prepared to receive it by making three incisions in the bark and raising it (as at D). The two parts are then brought together (as at E) in the same way as in grafting by approach; the scion having its base (F) buried, in order to form roots, or merely for the purpose of keeping it alive. The graft is bandaged and covered with mastic or grafting-



Layer-Grafting (another method).

wax. When the operation is performed in spring the upper part of the stock is to be gradually removed in the course of the same year. We begin to do this in a week after grafting by cutting away some of the branches, and repeat the operation at intervals during the summer, in proportion as we see the shoots of the graft develop themselves. The process is finally completed by the removal of the stump in the following

year. If the separation of the lower part of the scion from the ground can be dispensed with, its chances of a lengthened existence will be doubled. If it is necessary, however, it is



Cutting-Grafting on a tall Stock,

best accomplished gradually by successive annular incisions, which will by degrees accustom it to draw its sustenance entirely from the stock.

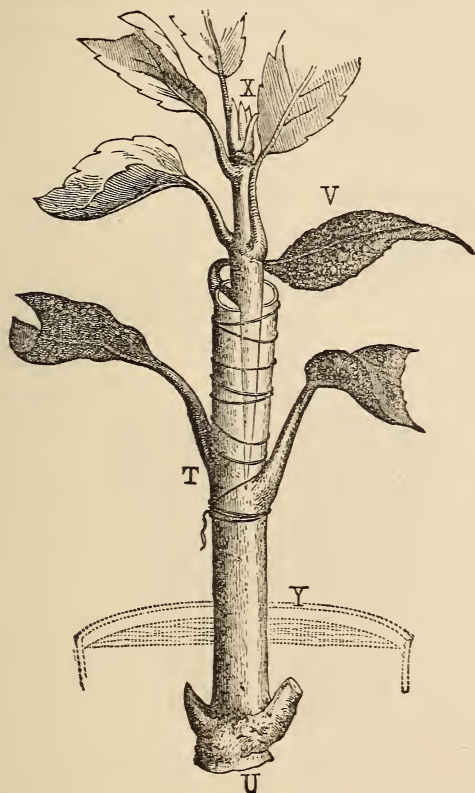
Cutting-Grafting on a Tall Stock.

If the scion is not long enough to be at the same time planted as a cutting and grafted at a certain height on the stock, we make good the deficiency by using a vessel filled with earth, or a bottle of water raised to the required height, and receiving the lower part of the scion. Cool sand is much better for this purpose than vegetable mould, as it is not so liable to become dry. Should the grafting take place during the period of vegetation, while the sap is flowing, we should prefer using a vessel of water (C), at the bottom of which should be a layer of powdered charcoal, in order to prevent the decomposition of the water, which otherwise must be renewed frequently. The scion (B) should be stripped of its leaves; in the case of deciduous subjects, these should be cut off close to the stalk; in evergreens it will be sufficient to cut the half of each leaf away. The graft, which is made either by veneering or in the English fashion, should be covered with grafting-clay, and shaded with paper. The removal of the upper part of the stock, which is begun in summer by gradually cutting away the branches (A) and the top of the main stem, should not be completed (as at E) until after the growth of the year following. At the same time the heel of the scion should be cut away level at its junction with the stock, the office of the auxiliary sand or water having now ended.

Grafting on a Stock which is a Cutting.

The stock (T) is a portion of an *Aucuba japonica* prepared as a cutting; the lower part is cut under a bud, and the top is furnished with one bud and one leaf (V) just opposite the place destined to receive the scion. The leaves on the buried part are cut down to the stalk, and the others have half the blade cut away. The scion (X) is taken from the variety which it is desired to propagate. It is cut and inserted in the top of the

stock in the manner described in cleft-grafting or inlaying. It should be bound with a pliant, broad, and flat bandage. Under glass mastic is unnecessary. The stock thus grafted is



Grafting on a Cutting (*Aucuba*).

planted in a cutting-pot (Y), and placed under a cloche or bell-glass in heat until the stock produces roots and the scion begins to sprout. Air is then given by removing the cloche,

and in a short time it is placed on a shelf in the house. It is gradually hardened off under a frame and shade. The aucuba, orange-tree, camellia, and *Euonymus japonicus* may be propagated in this way. Grafts in the condition of saplings, as the poplar and willow, also come under this class.



Grafting with two Cuttings (Aucuba).

Grafting with two Cuttings.

This mode of grafting, which is used with the aucuba and similar plants, consists in the union of two cuttings as stock and scion, both forming roots which promote their mutual cohesion and growth. The stock is a portion of the plant pre-

pared in all respects as if for a cutting. It is cut clean at L and K, the leaves at the base are cut down to the stalk, and those at the top through the middle of the blade. The scion (I) is cut equally on both sides in a sloping direction, as if for side-grafting in the alburnum. It is then inserted in a cleft in the top of the stock, and the graft is bandaged with a pliant fastening. The subject thus grafted is then potted and placed under a cloche in the propagating house. Before long, roots will be formed simultaneously by the stock (at L) and by the scion (at M), from which the graft will derive an increased amount of vigour. After at least a year's growth, the upper part of the stock between K and the graft is cut away; but it is better to retain the rooted part of the stock, instead of severing it from the graft. The natural roots of the latter, being nearer the surface of the soil, always eventually starve out and supersede the roots beneath them, so that they never spread.

Root-Grafting.

Many plants which are difficult of propagation may be multiplied by grafting a branch on a portion of root either their own or that of another plant; whence arise two subdivisions:—

1. Grafting a Plant on its own Roots.

It is probable that woody species, for the grafting of which no allied species can be found, can be propagated by grafting their branches on their own roots. Dr. Loiseau, of Montmartre, who had begun some experiments on this subject, died before completing his investigations. We shall, however, mention some methods which have been admitted into practice.

Root-Grafting by Approach.

In 1867, M. Grasideou, gardener to the Botanic Garden at Montpellier, more fortunate than his predecessors, succeeded

in grafting a rare Mexican shrub—*Convolvulus macranthus* (*Ipomœa murucoides*), of which there was only a single specimen in the establishment. The branches not severed from the plant were grafted by approach on portions of the root during the flow of the sap; the portion of the root which was grafted was not quite severed from the parent-plant, and was planted in a small pot filled with soil. In a month the union of the parts was completed. A few weeks afterwards the portion of root was detached from the parent-plant, and subsequently the branch grafted upon it was also gradually severed. These grafts have prospered and reproduced several specimens of the original plant.

Root-Grafting by Veneering.

A portion of root is prepared by making an incision with a notch at the top. The scion is similarly prepared by making a corresponding tongue at the upper part of the sloping cut. They are then placed together, so that the tongue of the scion will fit into the notch in the root, and bandaged without using mastic. The branching extremities of the root are cut away, and the graft is planted in a half-shady place in a sloping position in the trench, and covered with good soil up to the upper bud of the scion.

Root-Grafting by the English Method.

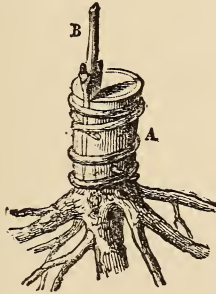
In this case the diameter of the scion is larger than that of the root. The base of the scion is cleft, and the upper part of the root cut in a sloping direction on both sides. The cleft part of the scion is then placed on the top of the root, as in *saddle-grafting*. The graft is bandaged with wool, and planted in a shady place in a light compost. Should the root be a long one, it is better to lay it in an inclined direction in the soil rather than to plant it upright, as growth is sooner promoted in the former position.

2. *Grafting on a Separate Root.*

In contra-distinction to the methods just enumerated, in which the stock is the root of the plant which is to be grafted, in the present mode the stock and scion are taken from different plants. The stock is either a portion of a root proper or a stem cut down close to the root, but not below the neck.

Grafting on a Fragment of a Root.

The bignonia, the tree pæony, and the wistaria should be grafted in spring before the flow of the sap, or in August,



A fragment of a Root grafted (Bignonia).

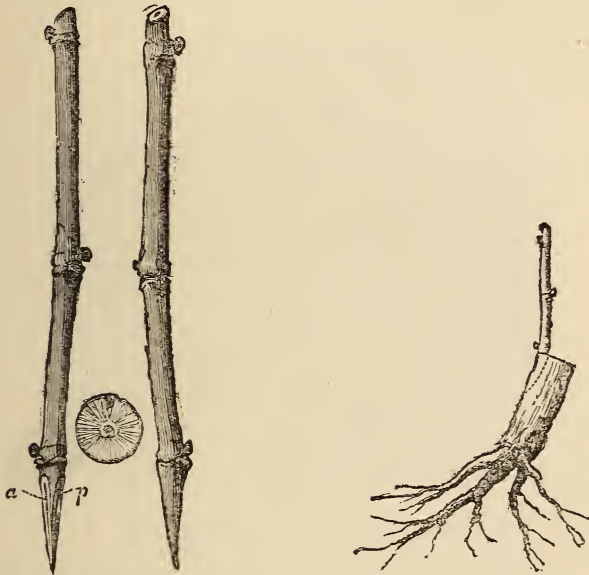
when it has gone to rest. We have read that the Chinese graft these plants in October. The tubers or cuttings from the roots are taken before the sap begins to flow, and laid in a trench. As soon as the buds begin to swell, the time for grafting has arrived. The scion (B) is taken from a shoot of the previous year. It is cut with a thin, wedge-like extremity, and inserted into the stock (A) either by cleft-grafting or inlaying. The graft is only slightly bandaged or not at all; mastic is not required. The subjects grafted are then potted and placed under glass, so as to have the air

excluded. If it is apprehended that drops of condensed vapour may find their way into the cleft of the graft, the pots should be plunged in a sloping direction under the light or cloche. As soon as the scion has begun to shoot, air should be admitted by degrees. As the cut part of the scion is not entirely inserted in the cleft, and as the stock is completely buried below the level of the soil, the graft will throw out fibres and thus come upon its own roots. Suckers may be prevented from rising by the removal of the upper part of the roots which serve for stocks, and by destroying the latent buds.

Grafting on the Neck of the Root.

The clematis is usually grafted under glass, on the neck or on a separate root, with herbaceous scions not stripped of their leaves, and cut from the parent plant just when the buds begin to swell. The stocks after grafting are potted, and placed under a cloche, with the air excluded. They remain there until new roots appear around the ball, and the buds of the scion begin to shoot. The hollyhock succeeds in the open air grafted close to the ground. But this subject has the disadvantage of sending out above the graft too many exhausting branches. This may be in part remedied by inserting the scion in the shortened stem just above the neck, or by grafting on a secondary root. After grafting they are planted out in ordinary soil. The manner in which the hollyhock grows intimates that it need not be grafted very early in the season; and as cold damp winters are injurious to the scion-branches, these should be detached from the parent plant before winter, and buried completely up to the moment of using them in grafting. The walnut succeeds when grafted on a young plant close to the ground. The neck is laid bare and cleft-grafted; then the soil is heaped up around it as far as the uppermost bud of the scion. On account of the softness of the tissues of

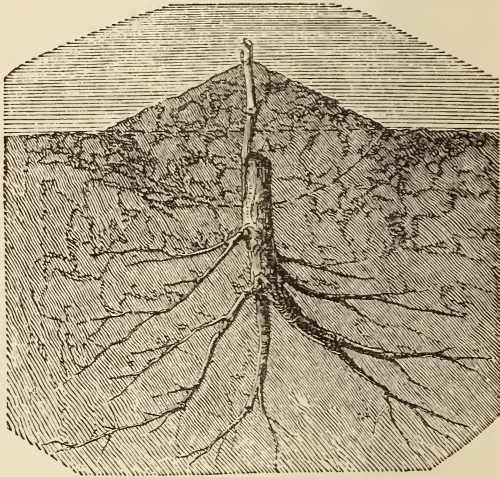
the walnut-tree, the scion is cut obliquely, and the stock is also cleft obliquely, as we have explained under the head of oblique cleft-grafting. If it is desired to avoid cutting the pith of the scion, the bark on two sides may be pared off, and the scion then inserted into the stock, which has been prepared to receive it by the process of inlaying. A scion of two years' growth will prove sufficiently hardy. The magnolia is grafted



Vine-Grafting near the root.

by inlaying on the neck of the root in July or August. The subjects grafted are placed under a frame for a month, then repotted and removed to the north side of a wall or other shelter. The vine, of which we have already spoken under the head of cutting-grafting, can also be grafted by this method as well as in the English fashion, on the neck of the root before

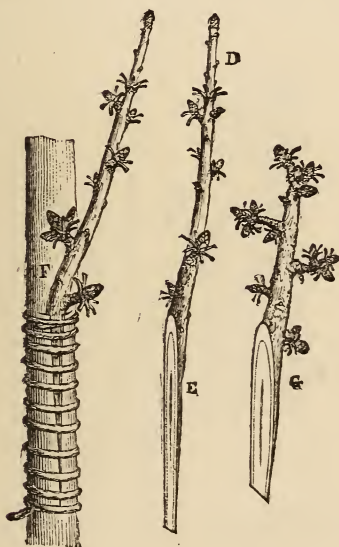
the sap begins to flow, either in February, in southern districts, or in March and April in later parts of the country. Cleft-grafting is most frequently employed in vineyards. The neck of the root is laid bare, and the stem cut off about 4 inches below the surface of the soil. The more scaly the stem is, the lower it should be cut, in order to reach a sound place for the graft. The scions are shoots with two or three eyes, cut beforehand, well-ripened, and kept in the ground in shade. They



Vine-graft completed and earthed up.

are cut obliquely (*a, p*) and inserted into the stock with the aid of the chisel or grafting-knife. If the stock is not cleft quite across there will be no necessity for bandaging. The application of grafting-wax to the cut is not absolutely necessary. The addition of a stake or prop, and the heaping up of the soil as far as the highest bud of the scion, complete the operation. When the operation is carried on in a vineyard on a large scale, a workman with a small mattock lays bare the soil

at the base of the stems of the vines which have been previously disbranched. The grafter then follows, freshens the cutting of the stock, and inserts the scions, of which he carries a supply already prepared in a basket of fresh moss. A third workman covers the graft with clay or *onguent de St. Fiacre*, fixes the prop, and heaps up vegetable mould over the graft. In the summer, the disbudding of the shoots which issue from



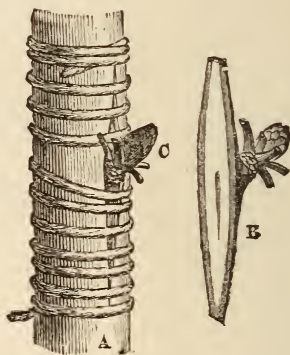
Grafting with scions bearing fruit-buds.

the stock and the tying up of the shoots from the graft must not be overlooked.

Grafting with Fruit-buds.

This interesting operation, which is more especially applied to the pear-tree, has a double object. 1. The utilising of

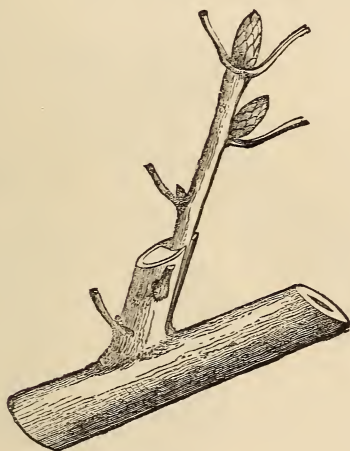
superfluous fruit-buds. 2. To render fruitful a vigorous subject which does not possess fruit-bearing qualities. About the month of August, the fruit-buds of one subject which has too many are grafted on another which is deficient in them; and, in the following year, the buds which have been thus grafted flower and bear fruit much better than if they had remained on the parent-tree. The operation should take place when the sap begins to decline: yet, as we have to do with trees of a certain age, we should take care not to graft



Grafting with a simple fruit-bud.

too late. A very vigorous tree or a *gourmand* branch is best of all for this kind of grafting. Fructification thus forced upon them will subdue them and bring them to bear fruit of themselves. We may thus also have several varieties of fruit on the same tree, which however is perhaps neither an advantage nor the reverse. The scions are taken by preference from those trees which are usually too heavily laden with fruit, and the fruit-buds which are destined to fall at the next pruning will answer exactly for grafting purposes. The scions are cut from the parent-tree just before using them; their leaves

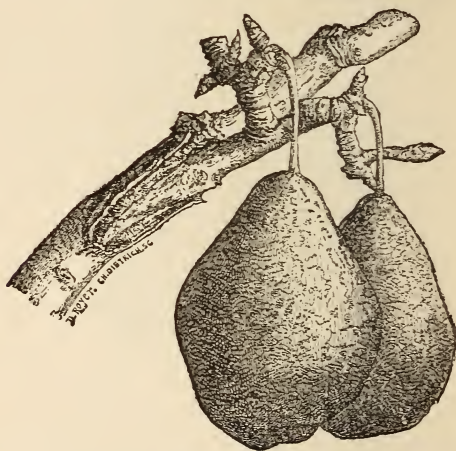
must be removed at once, and the scions themselves kept in a cool place in a vessel of water or in damp moss. The scions are generally prepared in the manner already described under the heads of side-grafting with a simple branch or one with a heel, and veneer-grafting with straps. A skilful operator will know how to use them in different processes. The figure (p. 129) shows two scions prepared (E and G). The sloping cuts are made on the back and at the base. The stock (F) has been



Grafting with a fruiting-spur.

prepared with a T incision, and the scion (D) inserted under the raised bark. Sometimes the bark at the head of the T is pared away to facilitate the insertion of the scion. A scion which appears rather long should not be thrown away: all that is necessary is to make the sloping cut longer, even to the extent of half the length of the scion; in this way some fruit-buds on the back of the scion may be inlaid in the incision made in the stock. Frequently the scion is an

exceedingly short branch or even a simple fruit-bud. It should be cut off with a strip of bark and alburnum B (p. 130) an inch or two in length attached. Care should be taken not to remove the woody part at the base; it should be merely smoothed down so as to ensure its cohesion; it is then inserted (at C) into the T incision in the stock (A). It should be bandaged rather tightly throughout, and the points of junction covered with clay, mastic, or the leaf of a tree, should any part of the tissues remain exposed. The bandage should not



Result of grafting with a fruit-bud.

be removed before the fruit has set in the beginning of the following summer. Should there be any fruiting-spurs ready for grafting when the sap is not very abundant, it will be best to employ cleft-grafting, inlaying, or crown-grafting. On shoots and simple but vigorous branches success is more certain in autumn than in spring, but the best time is from July to September with side-grafting under the bark. The process of veneering with strips might also be advantageously

used. The Pear-tree is best adapted for this operation. Very fertile and large-fruited varieties, such as Beurré Clairgeau, William, Colmar, d'Aremberg, &c., yield splendid crops by this method. The fruit-buds preserve their fruit-bearing properties. The figure (p. 132) shows the result in 1867 of a graft made in 1860, and for seven years it has constantly borne fruit. We have proved the advantage of this process during twenty years' experience of fruit-bud grafting in our schools of fruit-culture. We are indebted for it to M. Gabriel Luizet of Ecully, to whom belongs the credit of having first made it commonly known, although it had been invented for some time before he brought it into practice.

BUD-GRAFTING OR BUDDING.

General Remarks.

In England the term "grafting" is practically restricted to those operations in which the scion used is a portion of a shoot or branch. When the scion is merely a bud, the process is known under the specific name of "budding"—a term which, although sanctioned by long and general usage amongst us, is less accurate than the French term "bud-grafting" (*greffage par œil*), by which it is properly described as a sub-division or branch of the art of grafting. An eye or bud, accompanied by a certain portion of bark, detached from a branch, is the scion in this mode of grafting. The strip of bark attached to the eye should comprehend the entire thickness of the cortical layer as far as the alburnum exclusively. If the operator cannot remove it with exactness at this point, it will be better to cut a small portion of the wood with it than to want the smallest part of the inner bark. The portion of bark may be either of a tubular form or like a shield; whence the terms shield-bud grafting and flute-grafting. The stock is a growing tree or shrub. The

introduction of the scion is effected by inserting it under the raised bark of the stock at a time when the condition of the sap allows it to be easily detached from the alburnum. Any branches which might interfere with the operation should have been cut off some time previously, so that the course of the sap may not be checked by doing so at the time of grafting.

Group I.—Shield-bud Grafting.

The term shield-bud has arisen from the form of the strip of bark which is attached to the bud-graft. The shape of it, however, is variable; it may be oval, square, triangular, obtuse, &c., but in any form it is called a shield-bud. The buds are taken from shoots of the current year, if the operation is performed in summer; and from shoots of the previous year, if the budding is done in spring. Shoots of a medium size are preferable to very strong or very weak ones. The eyes should be well formed and not opened. There are two sub-divisions of this mode of grafting, according to the manner of inserting the bud:—1. By inoculation, or under the bark of the stock. 2. By veneering, or removing a portion of the bark, and putting the bud in its place.

Shield-budding by Inoculation.—General Directions.

The stock should not be budded unless the sap is flowing. This may be ascertained by raising the bark with the grafting-knife. If the state of the sap is satisfactory, the bark will detach itself easily, without tearing, and exhibit a slight moisture underneath, which will promote the union of the bud and stock. It is of considerable importance that both parts should be in an equal condition of growth; but should there be any difference, it is better to have the stock in a more advanced state of sap than the bud. The shoots from which the buds are taken should also be in a state of sap and

be sufficiently woody. Their condition as regards the sap is ascertained in the same way as that of the stock, and the wood is shown to be properly ripened by the well-pronounced colour of the outer bark, by the formation of the terminal bud, and by the elasticity of the tissues under the pressure of the finger. Shoots rather advanced in maturity are to be preferred to those which are in a completely herbaceous stage of growth; however, it is better to have them in the condition mentioned above.

Ordinary Shield-Budding.

Of all the methods this is the most extensively used in nurseries and gardens.

Preparation of the Scions.

The shoots, having been selected according to the foregoing directions, are prepared by rejecting whatever is useless for budding. In the first place, we may observe that the eyes in the middle of the shoot are generally the most suitable for use in shield-budding; those at the base and top have often the defect of being imperfect, herbaceous, blind, or too much disposed to fruit. The bud to be selected should be well formed, neither latent nor a fruit bud, nor damaged in any way. Shoots of forced growth, and those which have too great a tendency to produce flowers, do not afford suitable eyes for budding purposes. If, however, there is a deficiency of good buds, one may employ doubtful ones, using two instead of one, or one good bud and one doubtful one on the same stock. There are some shoots which appear uncertain, but which turn out well with the help of pinching. Overgrown spurred shoots are not to be despised, nor are those which are covered with an abundance of leaves. The pear branch (A) having been selected, the extremities (B and C), which are useless, are cut off, and the leaves cut down on

their stalks to within about half an inch from the axillary eye of each (as shown at D'). The stipules are also pinched off. The scions thus prepared are to be immediately placed in the shade in a cool place, with their lower extremities plunged in a vessel containing water or damp moss. They should not be



Preparation of the Scion for Shield-budding.

left in the water more than five or six hours, unless they are in a very dry condition, when they may be left in it for a day, with the ends only in the water, in a shady place, and then for a night placed in the grass or moss, in order to restore the

natural moisture which they may have lost. The nurseryman, who prepares in the evening scions to be used next day, leaves them all night in cool grass or in a damp cloth. Should water not be at hand, the scions should be buried entirely in soil until they are required for use. They should not, however, be left unused for more than twenty-four hours. Scions of evergreens should not be stripped of their leaves; these should



Removing the Bud.

merely be cut off through the middle of the blade, although even this is not absolutely necessary.

Removing the Bud.

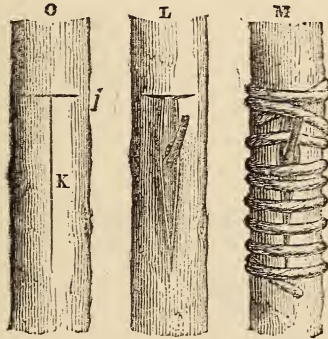
The shoot is held in one hand and the grafting-knife in the other. The bark is then cut through about half an inch or so above and below the bud (as at *f, f, E*). Then holding the shoot, as shown in the illustration, the blade of the knife is

inserted just above the upper incision, and driven in a slanting direction as far as the alburnum; then carried along towards the lower incision, following the course of the dotted line (*g, g, F*), and observing the bending at *g'* just under the bud. In consequence of the first two incisions (*f' f'*), the bud comes out, as shown at *H*, cut clean at both ends. At the back there is no wood except under the bud: this little woody tube is its *germ*, so to speak, and, without it, it would not grow. Should there be a splinter of alburnum attached above and below it, it should be seized by the upper end and pulled off smartly; if taken by the lower end, there is danger of tearing off the germ along with it, and the bud, if deprived of this, will not grow. Nevertheless, if the sap of the stock is in full flow, there will be no harm in leaving a small particle of wood under the bark of the shield-bud; it will help to render the union of the parts more intimate. A skilful operator seldom or never removes this little piece of alburnum, as he knows that by doing so he would run the risk of injuring the bud or of exposing it too long to the air. When he has an abundant supply of scions, he does not hesitate to throw away any bud that happens to have been removed in a doubtful condition, and use another in its stead. Scarcely will he lose time in trimming squarely the ends that may have been cut irregularly. Some operators proceed in a different way, among whom M. Edouard André holds the scion-branch head downwards, and removes the bud by passing the knife in a direction contrary to that which has been described. The strip of bark, having the form of an antique shield, square at the top and narrow at the base, is easily inserted into the stock.

Insertion of the Bud.

The bud having been detached from the shoot, the bark of the stock is opened by making two incisions with the grafting-

knife in the shape of a T, to the full depth of the bark; then, with the ivory spatula of the implement, the edges of the longitudinal incision (K) are raised at its point of junction with the incision (*j*). At the same time, the other hand, holding the bud by the stalk, slips it into the incision as quickly as possible, so that the parts underneath may not suffer from exposure to the air. Care should be taken not to remove the bud from its parent-shoot until at the moment when it is to be inserted in the stock, and also that no foreign



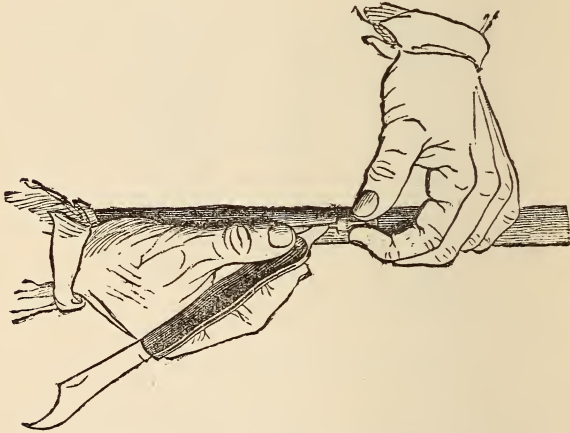
Inserting and Tying the Bud.

body be allowed to introduce itself at the same time into the incision. The inserted bud is represented at L.

Bandaging the Bud.

The best bandages for shield-budding are wool, cotton, and leaves of Typha or Sparganium. We have already mentioned, in the chapter on bandages, how they are prepared, so as to be pliant when they are used. The bandage is wound in a spiral manner round the stock (as at M), commencing at the upper part, as by doing so we avoid the danger of raising the bud and displacing it from the incision, which is very likely

to occur, especially when the buds are large and broad. One end of the bandage is placed on the horizontal incision of the T, round which two or three turns are made. It is then wound in close spiral turns about the graft as far as the bottom of the vertical incision. The end of the bandage is passed through the second last turn, and fastened securely. The parts to be most firmly tied are at the top and bottom of the incision, and just above and below the bud. The tightness of the bandage must, however, be within certain limits; it must



Opening the bark for insertion of the Bud.

not go so far as to bruise or fray the bark, and will be sufficiently attained, if the bandage is not moved by passing the finger over it.

Preservatives against Dryness.

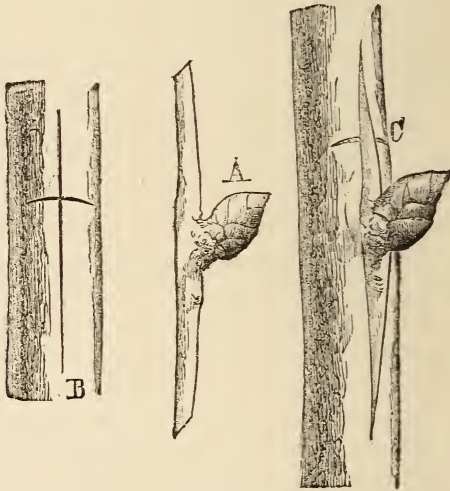
In addition to the bandage, the leaf of a tree is placed over the grafted part, when the stock is grown against a wall in the full sunshine. Mastic is never used in shield-bud grafting. The only case in which it might be used is when the bandage

is likely to become loose; then the application of mastic would serve to keep it in position, and preserve the graft from the action of the atmosphere. When the vine is shield-budded, soil should be heaped up about the stock. The operation should be performed about the end of July, and the soil kept about the graft for a fortnight. We have known Mr. J. Gagnerot, of Beaune, to operate in this way with complete success since 1865.

Shield-budding in Nurseries.

In large establishments, shield-budding is a matter which requires continued attention. It is necessary to know when to seize the moment favourable for grafting each species, and for operating in different parts of the grounds, as well as to keep an eye on the scion-branches of rare kinds, in order to utilise them at the proper time. Great heats accelerate or retard the flow of the sap, and rain incommodes the workmen; advantage must therefore be taken of favourable days to have the work carried on rapidly. Generally it is performed by two men, a grafter and a bandager. Besides these, a workman goes on in advance, clearing and preparing the stocks. The principal prepares the scions, classifies them, does the numbering, and enters the work in the register of the establishment. A skilful grafter can keep two bandagers busy, but it is better that he should do the bandaging himself, for two bandagers are likely to pass over some of the buds without securing them, and in that case of course they are lost. It is also a good plan never to leave a row of subjects just budded without glancing over them to ascertain that they are all budded and properly bandaged. A hundred bud-grafts per hour is the average work of a good grafter. Of course with rose-trees, apricots, or chestnuts, the scions of which are spiny, or angular, or highly-developed, progress is not so rapid as with

apple-trees, peach-trees, or lilacs. Tall standards are not so quickly budded as low ones, although in the case of the latter, both grafter and bandager have often to stoop considerably at their work. First-class grafters in our establishment have reached the number of 250 bud-grafts per hour, (and even 300 with the Doucin apple stock planted at intervals of a foot); but a performance like this is quite unusual, and we may add, hazardous to the ultimate success of the grafts;



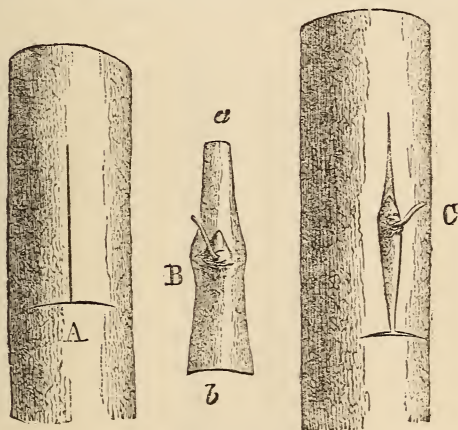
Budding with a Cross-shaped Incision. (Chestnut.)

we do not therefore recommend it. It is better to proceed more slowly and to act with precaution. We may also observe that our nurserymen do not entrust the office of grafter to any but steady workmen, who have served a regular apprenticeship as bandagers, and who are sufficiently experienced in the work of grafting.

Budding with a Cross-shaped Incision.

If the buds on the scion shoot should be rather large for

the diameter of the stock, for example those of the service-tree or of the chestnut (A), they will not be properly held in the incision unless it is made in the form of a cross, which is made with two cuts of the knife, instead of the T form: the upper part of the bark belonging to the bud is slipped into the upper part of the incision (B), and is there held fast in a firm manner, which could not be secured by the ordinary process. The bandage is applied, beginning either at the



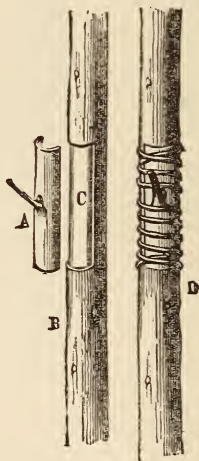
Inverted T Budding.

middle of the incision (C), and finishing at both ends, or beginning at the top, and taking care to close the bark well.

Budding with a Reversed Incision.

When the sap of the stock is in excess, as with maples in cold districts or with orange-trees in warm ones, there is danger of the superabundant fluid smothering the bud. This is counteracted by making the incision in the bark of the stock upside down (\perp instead of T). In the incision (A) the insertion of the graft-bud (B) is made from below upwards

(as at C). The bark of the bud (B) is cut with a point at the upper part (*a*) to facilitate its insertion, and the lower part is cut square (as at *b*) to correspond with the horizontal incision in the stock: it is thus held properly in position. Of course it is merely the incision in the stock which is reversed; the bud being always inserted in the usual manner. The bandage is applied first at the lower part of the incision and worked up to the upper part, where it is fastened off. If applied in any other way, the bud is liable to be displaced.



Veneer Shield-Budding.

Veneer Shield-budding.

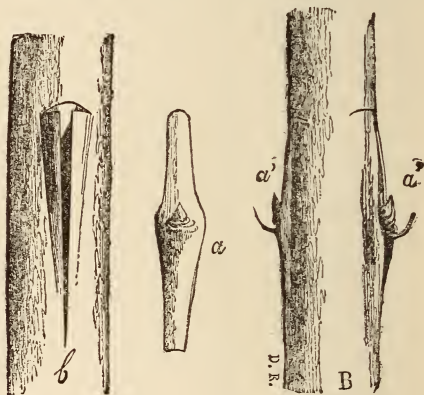
This method is sometimes employed when the sap of the stock does not flow sufficiently freely for inoculating the bud under the bark. When the stock is comparatively small in diameter, or has a thick bark difficult to be raised, or when the scion-shoot is curved and has the buds crowded closely together, it will be best to insert the bud by veneering. The

bud (A) is removed by the ordinary process, or by one more primitive. The four sides of the strip of bark connected with the bud are first marked out with the grafting-knife; the leaf-stalk at the bud is then taken by the base, and by a skilful movement of the hand the whole is detached from the branch. Should there be any fear of injuring the bud, the operation may be facilitated by slipping the end of an ivory spatula under the bark. This is preferable to using thread or hair, as recommended by ancient authors. The bud (A) is placed on the stock (B), where it is intended to be grafted. With the point of the grafting-knife, the outline of the strip of bark is traced on the stock. The bark within this outline is then removed (as at C), and the bark of the bud put in its place. It is then carefully bandaged (as at D) with cotton or wool. The *métro-greffe* might be used here with advantage, both in removing the bud and also the bark of the stock. This method is intermediate between ordinary shield-budding and flute-grafting. By increasing the width of the strip of bark attached to the bud, we obtain the annular or ring-shaped strip for flute-grafting.

Double-Budding.

An operator may be the most skilful of grafters, but no one can infallibly warrant the success of an operation. When a graft misses there is a year lost and sometimes a stock sacrificed. It is well then to double the chances of success whenever the supply of buds will permit, and when the stock is of sufficient size for this purpose. Two buds (a' , a') are inserted opposite each other, or, if the stock is very strong, three and even four may be used. These buds being inserted at the same level, one bandage will suffice for all. As the insertion of the bud (a) in the incision (b) has to be repeated on the other side of the same stem, care must be taken not to

force the upper part of the incision too much, for fear of making a circular rent. As the proper development of a tree does not require several grafts, as soon as they have taken, one only should be retained and all the others suppressed, pinching them at first in order to utilise them in a supplementary way. However, if it is required to form a fan or a double palmette, two opposite shoots, resulting from the



Double-budding,

insertion of two buds, should be retained. Double budding is applicable to different methods of shield-budding, whether by inoculation or by veneering. Simple or double shield-budding may be used with branches which it is desired to propagate as cuttings, when the stock succeeds better as a cutting than the scion; or else in the case of a variety which does not do well when branch-grafted, but which succeeds when shield-budded. This is grafting with shield-budded scions. For instance, the varieties of the apricot and peach, which succeed with difficulty when branch-grafted, may be shield-budded in summer on plum scions (as at C, C, C,

C, C, C). In the following spring, the plum branch is divided (as at B, B) into portions, each bearing engrafted buds of peach or apricot, which are then grafted on a plum stock, either by cleft-grafting, or in the English way, or by inlaying. The plum scion unites with the plum stock, and by extirpating any plum buds which make their appearance on the



Result of Double-budding.



Shield-budding Plum scions.

former, none but the inserted buds of peach or apricot will be developed upon it. This mixed process is not without value when it is required to graft large stocks which are unsuited for shield-budding with kinds which do not take well when branch-grafted.

Proper Season for Shield-Budding.

Shield-budding is possible whenever the sap of the stock is flowing, but two distinct periods are most suitable for this operation: 1. In spring, when the sap begins to flow, and when the immediate growth of the graft is desired. This is grafting with a pushing bud. 2. In the course of the summer, and when the graft is not required to sprout until the following spring. This is grafting with a dormant bud. The second method is by far the best, and, moreover, most commonly adopted.

Shield-Budding with a Pushing Bud.

This mode should be practised at the commencement of the year's growth, so that the graft may develop itself sufficiently and ripen its wood before winter. By this method the cultivator hastens the multiplication of rare kinds of plants. By it he obtains at once suitable specimens for market, and these will also supply him in the course of the summer with scion-branches for the late grafting with dormant buds. The method, however, should not be abused by too late grafting, as the forced growth which results from it may seriously affect the stock which has been thus grafted. The scion-branches are cut from the parent tree some time before the flow of the sap; they are then buried at the north side of a wall their entire length in a trench, and 3 or 4 inches under the surface. When the state of the sap in the stock is such as to allow the bark to be easily detached, the scions are taken up, and their buds shield-grafted by the ordinary methods. As the leaves will have fallen off, the absence of a footstalk will render the handling of the buds less easy in detaching them. The rose-tree, which is readily grafted in this way, furnishes very early in the season young scion-branches, which should be prepared, stripped of their leaves, and used at once as we have before indicated. Let us again repeat that shield-budding

with a pushing bud should not be deferred to a late period; too many gardeners and amateurs err in this respect with their roses. The peach-tree succeeds better with this method than with winter branch-grafting; but it does still better when shield-budded with a dormant bud. As we shall see presently, the stock, when grafted with a pushing bud, is to be gradually headed down, commencing to do so a week after grafting, in order to promote the growth of the scion.

Shield-Budding with a Dormant Bud.

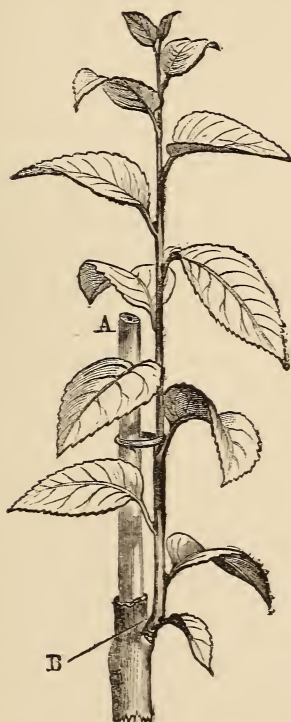
A dormant bud does not sprout before the spring which follows the time of its insertion. The months of June, July, August, and September are the proper times for inoculating a dormant bud. The exact moment for operating depends on the state of the sap in the stock. The older stocks, whose growth ceases early, should be grafted first; after them the young and vigorous ones. Bearing this distinction in mind, tall standards should be grafted earlier than low ones; a stock of the current year's growth later than one of former years; the plum-tree and the wild cherry earlier than the Sainte-Lucie and the almond tree; the pear on its own roots and the hawthorn sooner than the quince and the apple; maples and ash trees later than chestnuts and lilacs. If it is apprehended that the sap of the stock will cease to flow before the scions are sufficiently ripened, the tops of the latter should be pinched a fortnight beforehand, in order to accelerate their ripening, and the nearer the time of grafting the shorter are they to be pinched. However, if pinched too short and too soon, the latent eyes of the scions will shoot and branch before the time of ripening, and the scions will consequently be useless. On the other hand, the vegetative powers of the stock may be prolonged by the aid of waterings and stirring the soil around the roots. Thus, retarded in the one subject and accelerated in the other,

the sap at last comes into something like a condition of harmony or equality in both stock and scion. Stirring up the soil around the roots a few days before grafting tends to promote the activity of the sap; repeating the operation the day after will serve to maintain the growth and favour the union of the graft. It would not be prudent to bud when the sap is too abundant, as it would smother the bud. Failure need not be feared if the operator waits till the sap has lost somewhat of its activity, when the bark no longer detaches itself freely from the wood, and the mornings become cool. In shield-budding, from the middle of August to the middle of September, kinds which vegetate to a late period of the season, care must be taken to assist the union of the graft by tying the branches of the stock together at the time of grafting. As soon as the grafting is completed, the ends of these branches are cut off for one-third of their length; the flow of the sap will thereby be arrested, and the union of the graft will be the result. Subjects of a luxuriant habit of growth should be treated in this manner. Two or three weeks after budding, the subjects should be gone over, and, where the buds have missed, the stocks should be rebudded. The failures are easily recognised by their black or wrinkled bark. But, as the sap has by this time almost ceased to flow, the last currents of it, so to speak, must be sought at the neck of the lateral branch, or on the stem under the base of a vigorous branch. Certain kinds of roses succeed best with this late budding.

Treatment after Budding.

Those stocks which are rich in sap when budded late should have the ends of the branches lopped or clipped if they are in a shady position, or if the mass of their leafy branches prevents a free circulation of air around the graft. If this were done with vigorous stocks, budded earlier, there would be danger

of causing them to shoot prematurely, and in their case it will be sufficient to tie their branches together, or to bend the budded branches and fasten them to the stem of the stock. Grafts that are too tightly bandaged must be relieved by



The young scion tied up to the stump or heel of the stock.

cutting or untying the bandage. If the union of the graft is not complete, the bandages should be renewed, or the old one retained after being loosened. It is better to wait until the winter is over before removing the bandages from grafts that

are likely to suffer from the cold. Those stocks that have suffered from tightening of the bandages should have some of their largest top branches shortened with the sécateur or the pruning-knife. The heading-down of stocks budded with a pushing bud should be commenced a week after budding, and the branches should be cut away successively, and also the stem to about 4 inches above the graft as soon as the union of the parts is ascertained. In the case of subjects budded with a dormant bud, the stock is to be amputated as soon as the frosts are over, and before vegetation has commenced, by a single cutting about 4 inches above the graft. This stump of 4 inches serves for tying up the young graft, and is to be cut away at the end of the summer following (at the place indicated by the line B), first operating on those subjects which are slow to heal, and those stocks which differ most in kind from their grafts. In this work the saw, the ordinary pruning-knife, and the stump cutter are used. Stakes or props should be continued for a few years.

Flute-Grafting.—General Directions.

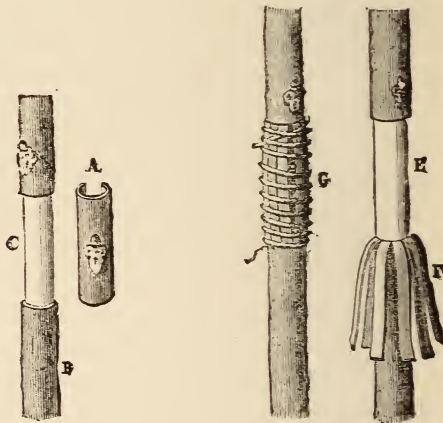
The name of flute or whistle-grafting has been given to this method in consequence of the resemblance which exists between the manner in which the bud is detached and the means employed in making rustic flutes with tubes of bark taken from a branch in full sap. At present this mode is not much used in nurseries. Although it has been superseded by more expeditious methods, some persons still use it in propagating the varieties of the walnut, the chestnut, the mulberry, the fig, and the cherry. The season for flute-grafting is in spring, when the sap has begun to flow. It can also be carried on towards the end of summer, before the new generative layers are dried up by the cessation of vegetation. There are two principal methods of flute-grafting, in both of

which the scion is prepared in the same manner. The scion (A) is a portion of bark of a tubular form, furnished with at least one bud. It is detached from the scion-branch by making, in the first place, a circular incision with the grafting-knife about an inch above the bud, and another at the same distance below it. These two incisions mark the length of the scion. A longitudinal incision is then made from one to the other on the side of the branch opposite the bud. The base of the leaf-stalk attached to the bud is then seized between the finger and thumb, and the portion of bark included between the incisions dexterously detached. Should there be any apprehension of tearing the fibres—commonly called the germ or root—of the bud, the bark may be raised with the spatula of the grafting-knife. The scion is then applied to the stock in the place of a cylinder of bark of the same length, which is removed at the same time. The operation is best performed in calm weather, in order to avoid injuring the internal layers of the subjects by exposure. The practice of trimming the stock beforehand, with the view of promoting the union of the graft, is a faulty one. It is more rational to graft first, and to head down the stock afterwards when the union of the parts is ascertained. A stock in a young and herbaceous state is better adapted for flute-grafting than one which is old or hardened; and a stock which is very large should be grafted on its branches rather than on the stem. When strips of bark are used to fill up any vacancies not covered by the scion, it is seldom required to apply mastic to the joinings.

Ordinary Flute-Grafting.

The scion (A) is applied to a stock (B), which has not been previously headed down, in the place of a cylinder or pipe of bark of the same length, and which has been removed in the same way. It is placed so that

its bud may be exactly underneath a bud on the stock. This bud will attract the sap to the graft, and thereby promote its taking. It is then bandaged, and cold mastic applied to any exposed parts of the joinings. Should the diameter of the scion exceed that of the stock, that is easily remedied by cutting off from the scion a longitudinal strip of bark equal in width to the difference. On the other hand, should the dimensions of the tube of the scion not correspond with those of



Ordinary Flute-Grafting.

Flute-Grafting with strips.

the stock, the deficiency is made good by leaving on the latter a strip of bark of sufficient width to fill up the space not covered by the tube of the scion; or, if the bark of the stock has been taken off in a complete ring, a strip of bark of suitable size can be inlaid on the bare part.

Flute-Grafting with Strips.

The scion having been prepared as in the preceding case, the bark of the stock is cut in longitudinal strips

(F) attached by their bases. When the scion is quite prepared, these are turned down, and the scion is at once placed on (at E). The strips of bark are then brought up over it (as at G) and the whole bound round with a bandage. This process permits us to detach the scion without leaving the wound on the stock too long open, and also to prepare the stock before the scion has had time to flag. These strips also serve to cover bare places that occur when the scions are not wide enough. We practise a mode of flute-grafting with double strips. In this the stock is amputated, and both stock and scion are of the same diameter. The bark of both is cut in strips and turned back, and the wood that was under the strips of either stock or scion is cut away. The scion and stock are then placed end to end, and the strips of bark brought back over each and bandaged. This method is quite original.

Treatment after Flute-Grafting.

As in every kind of grafting, the bandaging must be looked after, and not allowed to become too tight, and a prop or stake higher than the graft must be affixed. If the head of the stock is overloaded with branches, some of them must be cut away. The manner in which the stock is finally headed down depends on the nature of the graft: if it has been made with a pushing bud, the stock is cut away by degrees down to four inches from the graft—not commencing to do so, however, until the union of the parts is ascertained; if the grafting has taken place in the course of the summer, the heading down of the stock is deferred until the following spring, when it is performed by a single cutting

COMPLEMENTARY OPERATIONS OF GRAFTING.—In describing the various modes of grafting, we have briefly indicated the most important courses of after treatment to be pursued in

each case. We shall now take a general review of this subject.

Attention to Bandages.

Care must be taken to watch the bandage, that it may not become too tight on the graft. Should it have penetrated the bark, in consequence of the increased growth of the stock, the graft must be relieved by cutting the bandage. One stroke of the grafting-knife across the bandage, on the side opposite the bud-graft or the joinings of the bark, will suffice. The bandage, thus severed, is allowed to fall of itself. In a case of incipient strangulation, the bandage need not be cut; if the graft has been only recently made, and the lateness of the season prevents an immediate extension of the evil, the cutting of the bandage may be deferred, or it may be cut partially; or, if entirely removed, a fresh one should be put in its place. In a case of decided strangulation, the bandage should be cut at the top and bottom, then unrolled, carefully drawing it out of the swellings which it has caused in the bark. The smallest portion of it left behind in these parts may prove hurtful to the graft. Should over-tightness occur during the growth of the graft, care should be taken to fasten the young branches to stakes, in order to avoid ruptures. If the union of the graft is not perfect, or if it is likely to be injured by the weather, a new bandage should be applied, or the old one replaced on the graft. It is better to remove a bandage in autumn than in winter, in order that the bark and points of union may be gradually hardened off. The bandage should be retained until spring on grafts that are likely to suffer from the cold, and it should also be retained for a longer period on grafts made with fruit-buds. For the first few days after grafting, we are likely to find that many bandages have become loose. These must be secured afresh;

and, at the same time, any defects where mastic has been applied should be made good. This first inspection will also be a proper time for replacing grafts that have missed, and or removing the paper caps and pads of moss which were placed on the grafts to protect them from drought.

Heading down the Stock.

Plants grafted by cleft-grafting, crown-grafting, or in-laying are always amputated beforehand. Trees grafted by approach both have the stock headed down and the scion separated from the parent tree, with the view of concentrating the sap in the stock and the scion when both are united. These operations have been fully described at page 29. Stocks grafted laterally—shield-budded, veneered, side-grafted, or flute-grafted—may be headed down either at once or after the winter. If the graft is made with a pushing bud—that is, made early enough in the season to allow the scion time to shoot well before winter—the heading down of the stock should be commenced a week after grafting by cutting off the ends of the principal branches and the extremity of the leading shoot. A week after this, they are to be cut still shorter, and so on successively in proportion as the scion develops itself, till a distance of four inches above the graft is reached. A few shoots should be left on the stump to attract the sap to the graft. If, on the other hand, the graft is made with a dormant bud—that is, if the scion is not required to shoot before the following spring—we wait until winter is over, and then amputate the stock, at a single cutting, four inches above the graft. When there are grafts on several branches, each branch is to be cut in the same way as if it were a grafted stem. The stump above the graft is often called the “heel.” It may be cut shorter than four inches if the scion be furnished with doubtful or feeble eyes.

If there are any branches on the heel, they should be cut off, except a couple of shoots or buds, which should be left for the purpose of drawing the sap to the graft. It is quite wrong to strip it of its bark, as is done by some. If the buds of the scion appear doubtful, making another branch-graft above the first one will be a wise precaution.

Disbudding the Graft.

When vegetation has commenced, this must be done closely. Later on, we must act more carefully. The buds or shoots of the stock between the graft and the ground must be removed with the pruning-knife or pinched off. A few might be retained on feeble stems, or only in places which appear weak, and these are to be pinched so that they may draw the sap without absorbing it. Those shoots that make their appearance on the stump about the graft must be rigorously cut away; above the graft, one or two are to be retained to draw the sap, and these are also to be pinched. They are to be retained for a longer time in the case of those kinds of plants in which the stump dries up quickly, such as the Maple and the Cytisus. In such cases it will be time enough to remove the stump when the scion is able to do without its help. The operation is to be repeated as often as any shoots not belonging to the graft make their appearance. In the case of thin poor subjects, we should act more moderately in the suppression of the shoots, and abstain from it altogether when the scion-shoot persists in remaining inactive; but in certain kinds (the rose for instance), if the heel is cut off level with a graft which is unusually dormant, there would be a chance of forcing the slow growth, or of causing fresh shoots to spring from the stock, which, might be budded afterwards. This short cutting of the stump is a decisive operation. Those stocks which are crown-

grafted on a stem previously amputated, should be disbudded between the graft and the ground, both on the stem and on the grafted branches. Here and there a few small shoots may be left to draw sap to the graft or to weak parts. At all seasons, suckers and subterranean shoots, which would impoverish the graft, should be rigorously extirpated. In disbudding around the graft, very great care should be taken not to touch the buds of the graft, either with the hand or with any tool.

Destruction of Insects.

While the process of disbudding is going on, a sharp look-out should be kept after insects, which, moreover, require attention at all seasons, as they are a permanent pest. They are to be met with inside of rolled-up leaves; in chinks of cuts, under bandages, and on the stakes. They chiefly attack the buds of the graft. If they are allowed to have their own way, so much the worse for the young graft. Repeated inspections should be made at various hours, no matter what the weather may be. These pests are most active in spring. Some are most destructive during rain, others in time of great heat; some in the morning, others in the evening, and others, again, at full noon. Caterpillars, larvæ of various kinds, aphides, weevils, spiders, ants, snails, slugs, flies, butterflies, cockchafers, &c, should be mercilessly crushed. The Pear-tree bug, gall-flies, and aphides are destroyed by waterings of soap-suds or tobacco-water, or by applying insecticide powder; and the woolly bug by rubbing the infected parts with oil, or whitewashing them with lime. Such preparations as the last-named should be applied to the scion before it forms buds, or when it is sufficiently developed. When the sap begins to flow, it will be too soon or too late. We have before mentioned that the soaking of stakes, frames, straw-mats, nets, &c., in a solution of

sulphate of copper secures them admirably from the attacks of vermin.

Staking the Graft.

In the case of stocks which have been headed down so as to leave a stump, as soon as the shoots of the



Mode of tying up and securing the Graft on a tall Standard.

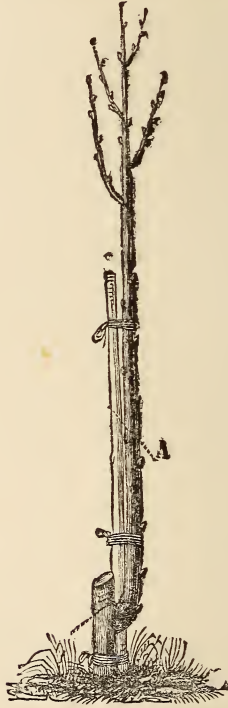


Mode of tying up several Grafts on the same Stock.

graft attain the length of 4 inches, they should be fastened up to the stump. Later on, a stake or prop must be employed. In the case of a young stock which has been crown-grafted, a flexible rod (A), fastened to the stem by both ends, may be used for tying up the shoots (B, B) of the graft. If there are

several scions on the same stem, each of them will require a support, such as a lath or a small rod more or less branched. Subjects grafted on a low stock should be provided with a prop of a length suited to the probable development of the graft. For example, the Hollyhock, which produces only a couple of short branches, has hardly any need of a prop; whereas the *Robinia Decaisneana*, although grafted close to the ground, will require a tall prop, as in the first year it may produce shoots nearly 10 feet long. In nurseries, the laths and rods are kept on the grafted stocks for a year at least. If the trees are to be sent to a distance, the fastenings of these are renewed as soon as the trees are taken up, in order to protect the graft when being packed. The illustration on p. 151 shows how the shoot from a shield-bud is fastened to the stump of the stock. In the case of those where the stump is not sufficiently long, a prop is added, (see next page) which is first fastened to the neck of the stock and then to the shoot of the graft. Those subjects which are in danger of coming off at the graft, and which have largely-developed seems liable to be swayed about by the wind, will require a prop from the first. The young shoots of the graft are tied up with rushes. Rods and props are fastened to the stock with at least two osiers; a single osier or several fastenings of rushes or straw would not be sufficiently firm. When the shoot of the graft becomes woody, it may be tied with young osiers, lime-bark, bast-mat, leaves of *Typha*, or damp straw. The tying should be carefully done, without squeezing the branch too much, fraying the bark, or bruising the leaves. The props should rather be planed round than made of flat split wood. Their durability is increased by soaking them in a solution of sulphate of copper. They should be placed on the north side of the tree, so as not to intercept the rays of the sun. A prop attached to a tree with

a tall stem should always be higher than the place of the graft. A prop which is too short to support the graft exposes it still more to be broken off by the wind, and the tree would be better without it ; but it is by far the best course to



Mode of staking the Graft.

support both stock and graft against storms by fastening them to a prop which will sustain both. Small pads of moss or bark should be placed between the prop and the stock under the fastenings, to prevent the fraying of the bark in exposed positions. When storms occur, double vigilance is needed

and if the grafts are too much swayed about by the wind, additional props should be applied, and the longest branches trimmed and some of their leaves removed; care should be taken that the fastenings of the props do not become too tight round the stock, which would both wound it and expose it to the chance of ruptures. During the period of growth, the direction of the sap should be regulated, if there is occasion to do so, by pinching those shoots which push too vigorously in proportion to the rest. If the pinching is likely to make them branch, it will be sufficient to cut the leaves partially, and to tie up the strong shoots closely, leaving more freedom of action to the weak ones. At the same time the useless shoots which spring from the swelling of the graft should be cut away.

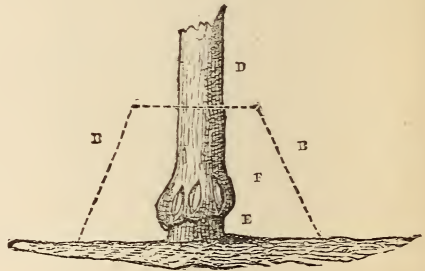
Suppression of the Heel.

After one year's growth the heel of the graft should be cut away. If left longer, it will die and infect the stock with decay. If it is cut when the sap is on the decline, the wound soon heals, and the swelling at the junction of the graft soon disappears. However, in the case of a graft of feeble growth, there would be no danger in retaining the heel for two years. In nurseries, the heel is removed in August and September, after the work of shield-budding is over. Those subjects whose scions are least allied in kind to their stocks are first operated on: for example, when two different species are united by grafting, as the pear on the quince, the cherry on the Mahaleb, the apricot on the plum, and the peach on the almond. The heel is cut in a slanting direction (as indicated by the line (B) in the figure at page 151), beginning opposite the base of the scion and ending just above its uppermost point of union with the stock. Should the heel be thick and dry, the saw should be used and the cutting smoothed

down with the pruning-knife. In ordinary cases the stump-cutter, which is worked with both hands, is most convenient. In removing the stump, care should be taken not to bruise the graft with the implement employed. A small stump may be taken off with the sécateur, and the cut afterwards smoothed down with the pruning-knife, guiding the blade so as not to injure the graft. The application of clay or mastic to the wound will assist it to heal. Together with removing the heel or stump, other provisional grafts on the same stem may be cut away, if the shoots of a single graft will furnish the tree sufficiently.



Incisions to reduce the swelling of the Graft.



Mode of bringing on its own roots a Pear-tree grafted on Quince.

Reduction of the Swelling of the Graft.

If a prominent swelling (A) happens to rise, at the time when the graft begins to grow, to the detriment of the free circulation of the sap, we endeavour to reduce it by making longitudinal incisions, in spring, beginning at the upper part of the swelling (C), and continuing them down the stock (B). The discharge of cambium through these openings dilates the generative layers, and assists their normal growth. These incisions are made with one stroke of the grafting-knife. They should

be continued down the entire length of the stock, and renewed in the course of the season or in the following spring if the deformity continues.

By a similar process, in order to promote the vigour of the tree, we utilise the swelling of the pear when grafted on the quince. The pear-tree (D), which is disproportionally larger than the stock on which it has been grafted, has become deficient in vigour and fertility. As a remedy for this, small longitudinal incisions are made in the swelling (F); good soil is then heaped up around it (as at B, B), kept moist by watering, and covered with straw, litter, or tan. Instead of soil, river sand may be used, as this does not soon become dry, and maintains a constant coolness. Before long, rootlets will issue from the fissures in the swelling (F): these will soon become roots, and convey a direct supply of nutriment to the tree. The pear-tree (D), thus brought upon its own roots, will acquire fresh vigour, while the quince-stock (E) will be superseded, and finally disappear along with its roots.

TREES, SHRUBS, AND BUSHES THAT MAY BE MULTIPLIED BY GRAFTING.

It is not sufficient to know how to graft; it is necessary also to know what plants are adapted for grafting, the kind of stock and the mode of operating suited for each case. These will be described in this chapter, which is devoted to an enumeration of the principal trees and shrubs which grow in the climate of France. The methods of grafting are given in the order of their relative importance. The mode of reproducing the stock is also indicated, and some observations, the result of experience, are added. We say nothing of the dwarf cherry, the Deutzias, willows, Alaternus, fig-trees, gooseberries and currants, pomegranates, hazels, &c., the varieties of which are

sometimes fancifully intergrafted with each other in order to obtain particular forms. The natural way to propagate these is by seed, cuttings, or layers. Every year new varieties or sub-varieties of woody plants make their appearance. These may be grafted by the methods indicated for analogous species.

The Apricot.

Stock.—St. Julien plum; black damson (from seed); Myrobalan plum (from cuttings). In the south of France they use as stocks the apricot on its own roots and the almond-tree (from seed). In England the Brussels stock is used for this purpose, and in Holland the kind called *gross-pflaum*. *Mode of Grafting.*—Shield-budding (in July and August); simple English method (in March and April); either close to the ground or as standards.

Remarks.—Scions of medium size, and taken from branches well exposed to the air, are to be preferred. The buds at the base which are badly developed should be rejected, and those at the top are difficult to be grafted as shield-buds. When about to shield-bud the Myrobalan plum, the branches of the stock should be tied up together, and, when the graft is made, the ends of these branches should be cut off. The bandage should be removed in autumn, otherwise not before the frosts are past. Aphides and snails should be destroyed. Tie up the shoots to props carefully from time to time. Cut off the heel before winter. As the simple English graft (p. 111) has neither notch nor tongue, the bandage and prop must be retained for a considerable time. Cleft-grafting or inlaying previously shield-budded branches of the plum on the apricot (p. 147) is useful in some cases when the stock is too gross to be grafted in the English way. When it is desired to obtain a tall standard apricot on a low plum stock, the latter should

be first grafted close to the ground with some variety of plum allied to the apricot, such as Reine-Claude de Bavay, St. Catherine, or some vigorous stock which will serve as an intermediate stem, in at least two years' time, on which to graft the apricot.

White Beam Tree—*Cratægus Azerolus*.

Stock.—White hawthorn (from seed). *Mode of Grafting*.—Shield-budding (in July); cleft-grafting or inlaying (March and April); close to the ground.

Remarks.—Graft close to the ground to avoid the deformity of the stock being of smaller diameter than the graft, and also to prevent the growth of shoots on the stock, which would impoverish the scion. Reject all badly-developed buds at the base of the scion-shoots, and also those at the top which have too great a tendency to flowering.

Hollyhock.

Stock.—Single-flowered Hollyhock (from seed or cuttings). *Mode of Grafting*.—Cleft-grafting; English method; inlaying; crown-grafting on the neck of the root (in April); close to the ground.

Remarks.—The scions having been prepared beforehand are to be buried in dry sand, and not very deeply, as they are liable to rot. They should also be sheltered from frost. Graft close to the ground, or better, under the surface, which will prevent suckers springing from the neck of the stock. If the stocks are taken up before being grafted they should be cut off at the level of the neck (see page 126).

Almond Tree.

Stock.—Hard-shelled almond; plum tree (from seed). *Mode of Grafting*.—Shield-budding (in August); cleft-grafting (in March); close to the ground or as standards.

Remarks.—Shield-budding close to the ground is to be preferred when the stock or branch is a year old; a month before grafting, the branches about the part to be budded should be cut away. The other branches of the young almond stock should be tied together at the time of grafting. In the plum quarters of the nursery which have been grafted with varieties of plums any grafts which have missed may be replaced by a variety of almonds, unless it is desired to try the original plum graft a second time. The appearance of the trees is so different that a mistake cannot be made when the time comes for transplanting them.

Chinese Plum—*Amygdalopsis*.

Stock.—Plum-tree (from seed) and the Myrobalan plum (from cuttings). The scion is not so long-lived on the almond-tree.
Mode of Grafting.—Shield-budding (in summer); close to the ground or as standards.

Remarks.—Always graft rather late in the season, using the St. Julien plum-tree as a stock for the subjects first grafted, and the Myrobalan plum for the later ones. For low standards, stocks of small diameter should be selected; shield-budding succeeds well on cuttings struck in the previous spring. If the sap is over-abundant, the bud should be inserted in a reversed incision, and the branches of the stock trimmed and shortened. For grafting on the stem, stocks of medium size are to be preferred. A thick stock should be shield-budded on its young side-branches. Of these two kinds of ornamental plum-trees, the Chinese plum succeeds best when branch-grafted, and the *Amygdalopsis* (also called *Prunus triloba* and *P. japonica*) when bud-grafted. The young shoots of the graft should be pinched as soon as they have grown a foot long; this will cause them to branch, and they will also flower longer in consequence.

Araucaria.

Stock.—*Araucaria imbricata* or the Chilian species (*Colymbea imbricata*) (from seed). *Mode of Grafting.*—Side-grafting with an oblique cleft; veneering (in February and August, under glass); close to the ground.

Remarks.—The genus *Araucaria* is sub-divided into *Colymbea*, *Eutacta*, and *Dammara*. *Colymbea imbricata* and the Brazilian species, *Eutacta excelsa* and *E. Cunninghamii*, make excellent stocks for most kinds of *Araucarias*. When there is a deficiency of stocks, varieties may be multiplied by planting their leading shoots as cuttings; however, as the cutting of the leading shoot limits the number of branches which will afterwards be produced, and as the success of cuttings is not to be depended on so much as that of grafts, it is much better in the first instance to plant cuttings of the side-branches and, later on, to graft these cuttings with scions taken from the upper part of the tree, and which have pushed from the axils of the upper whorl of branches in consequence of the pruning of the side-branches.

Arbutus.

Stock.—*Arbutus pyrenaica* (from seed). *Mode of Grafting.*—Veneering (in February and September, under glass); close to the ground.

Remarks.—Choose young stocks about two years old, as the operation succeeds better when the tissues are tender. Place the subjects, when grafted, under a cloche or frame, and exclude the air for two months, which will assist the union of the grafts. After this harden them off by degrees.

Hawthorn.

Stock.—White Hawthorn (from seed). *Mode of Grafting.*—Shield-budding (in July); cleft-grafting (in March); close to the ground, and sometimes as standards.

Remarks.—In shield-budding, use stocks of medium thickness. The grafts are made near the ground to avoid the numerous shoots which spring from the stem of the stock. Well-developed stocks may be used as tall standards for choice varieties with spreading or weeping branches. In such cases the shoots on the stem of the stock should be carefully removed.

Aucuba.

Stock.—*Aucuba japonica* (from cuttings). *Mode of Grafting.*—Veneering, side cleft-grafting in the alburnum, with the stock as a cutting (p. 121); with both stock and scion as cuttings (p. 122) from October to February, under glass; close to the ground.

Remarks.—When stocks are scarce or wanting, prepare cuttings of *Aucuba japonica*; at the same time cleft-graft them on the crown or side with the variety to be propagated, place them under a cloche. The graft becomes united while the cutting is forming roots. This shrub being dioecious, all the branches of male stocks, with the exception of one, might be grafted with female scions, and on female shrubs one male branch might be similarly introduced. In this way every plant might be ornamented with berries. The *Garrya* may be successfully cleft-grafted or veneered upon the *Aucuba*.

Alder.

Stock.—*Alnus glutinosa* (from seed). *Mode of Grafting.*—By approach (p. 42); crown-grafting; cleft-grafting (in March and April); close to the ground, or as standards.

Remarks.—Grafting with detached scions also succeeds when the scions are two years old. The wood of the stock should be at least two years old at the place where it is amputated when headed down.

Azalea.

Stock.—Common Azalea (from seed). *Mode of Grafting.*—Veneering; cleft-grafting (from July to September); close to the ground, or as standards.

Remarks.—The grafts should be placed under glass, with the air excluded, in the propagating-house, and the cloches kept carefully closed for two months—a period which is absolutely necessary to the success of the grafts. Young plants, which should have been thinly sown, are to be dis-budded. They are kept entire for grafting; if they are very slender, the tops should be pinched when grafting. The stocks should be potted beforehand; in an emergency they might, however, be potted just before grafting, without any risk of failure. Cleft-grafting or inlaying in the open air in spring often gives good results. Care should be taken to retain a bud on the stock opposite the graft.

Colutea.

Stock.—Common Colutea (from seed). *Mode of Grafting.*—Shield-budding (in August); English method (in March); close to the ground.

Remarks.—In winter, select tolerably weak plants, and set them in ordinary soil, a moderate condition of growth being most favourable to the union of the graft. Destroy snails, which are very fond of this plant.

Eriobotrya japonica.

Stock.—Common Quince, or Quince of Angers (from cuttings with a heel, or hillock layers). *Mode of Grafting.*—Cleft-grafting (in April); close to the ground.

Remarks.—A scion taken from a branch of two years' growth is to be preferred to one taken from a branch of the current year. If the graft is made in the open air, the leaves of the scion should be cut down to the stalk, and the graft

protected from the air until it shoots. If grafted under glass, the leaves are to be retained, but partially clipped. Graft close to the ground. Branch-grafting or budding in the open air exposes the young plant too much to the frost.

Bignonia.

Stock.—A portion of the root of *Bignonia virginica*. *Mode of Grafting.*—Cleft-grafting, or inlaying on the root (in April and May (see p. 125)).

Remarks.—The pieces of root should be about 4 inches in length. When grafted, they should be planted so that they may be covered with soil up to the highest bud on the scion. An early growth may be promoted by the use of a cloche or frame.

Birch.

Stock.—The common Birch (from seed). *Mode of Grafting.*—Side-grafting with a simple branch (in August); by approach (during the season of growth) (see p. 41); close to the ground, or as standards.

Remarks.—The Birch may also be propagated by grafting under glass. In the open air it sometimes succeeds when shield-budded. M. André Leroy practises shield-budding with *Betula laciniata*, and cleft-grafting with *B. tristis*.

Camellia.

Stock.—Single-flowered *Camellia* (from seed or cuttings). *Mode of Grafting.*—Veneering; side cleft-grafting (from July to September); by approach; ordinary cleft-grafting (in April); close to the ground.

Remarks.—Stocks which have been side-grafted, (p. 72) veneered, or cleft-grafted, should be placed under cloches or frames to which air should not be admitted for five weeks, or until the union of the graft has been ascertained. The stock is to be headed down later on when the graft has sprouted. The stocks

may be raised either from seed or cuttings. In an emergency, a cutting may be used for a stock. In winter gardens and localities where the *Camellia* grows in the open air, it may be grafted by approach, and even by ordinary cleft-grafting.

Caragana.

Stock.—*Caragana arborescens* (from seed). *Mode of Grafting.*—Cleft-grafting; inlaying (in March and April); close to the ground or as standards.

Remarks.—As the stock is very vigorous in comparison with the varieties which are grafted upon it, it should be transplanted in the winter which precedes the grafting. Slender-branched varieties should be grafted at the height fixed for the branching. Attend to the removal of extraneous shoots, and destroy snails.

Catalpa.

Stock.—*Catalpa japonica* (from seed). *Mode of Grafting.*—Cleft-grafting (in April); crown-grafting (in May); close to the ground, or as standards.

Remarks.—Select scions the wood of which is fully two years old at the base. They should be cut a very short time before using them, and placed in dry sand. The *Catalpa* may also be shield-budded in August.

Ceanothus.

Stock.—*Ceanothus americana* (from seed). *Mode of Grafting.*—Cleft-grafting on a piece of root (in March and April, if grafted in the open air; in January and February, if under glass).

Remarks.—In selecting portions of root for stocks, be careful to preserve the fibrous roots at the end. Clip the leaves of the scion through the middle. Place the grafts under cloches or frames; the union of the parts is effected in five or six weeks.

Cedar.

Stock.—*Cedrus atlantica* or *C. Libani* (from seed). *Mode of Grafting.* — Side-veneering; oblique cleft-grafting (in February and April, under glass); close to the ground.

Remarks.—Take the scions from the tops of lateral branches. Two months after grafting, the grafts may be uncovered and gradually hardened off. The *Cedrus atlantica* forms a vigorous stock on which to graft varieties of itself, or of *C. Deodara* or *C. Libani*.

The Cherry.

Stock.—The wild cherry; *C. Mahaleb*; or the cherry on its own roots (from seed). *Mode of Grafting.*—Shield-budding (in summer); flute-grafting; crown-grafting (in spring); cleft-grafting; inlaying (in autumn); close to the ground on the *Mahaleb*; as a standard on the wild cherry.

Remarks.—The red fruited wild cherry is better adapted for shield-budding than the black-fruited kind. It should be grafted as a standard and not close to the ground, and the operation should take place when the sap is beginning to decline. It may also be cleft-grafted towards the end of summer, before the sap disappears. Grafting succeeds best on the wild cherry when it is in a position well exposed to the air; for this reason it is planted on the edges of the walks in nurseries. The wild cherry may also be grafted in June. It is grafted in Belgium with a pushing bud, or crown-grafted, or side-grafted with a simple branch. Scions should be selected which are half-woody at the base of the fresh shoots, and the grafts covered with clay or a paper cap. The *Mahaleb* or *St. Lucie* cherry grows in dry soil. It should be shield-budded in preference to any other way, and close to the ground instead of on a tall stem. If the variety to be propagated cannot of itself form a sufficient stem, recourse must be had to the intermediary process, viz., graft on the *Mahaleb*, close to the

ground, a vigorous variety, such as the Bigarreau or Black-heart. When this shall have made a stem in at least two years' time from the grafting, it is to be crown-grafted with the less vigorous variety. The St. Lucie stock should be of medium thickness, and, when a year old, is shield-budded at 4 inches from the ground. A warm day near the end of the budding season should be chosen for the operation. It retains its sap sufficiently long to necessitate the trimming and shortening of the branches at the time of grafting.

A fortnight afterwards inspect the bandages, and also see if any grafts have missed. Head down the stock after the frosts are over. Cut away the heel before the fall of the leaves. The weeping and variegated varieties of the Mahaleb are grafted on the common Mahaleb at the height which is desired for the branches.

The cherry on its own roots (raised from pips) is vigorous, and adapted for various modes of grafting; however, as a stock it is not so much used as the other kinds.

Eleagnus.

Stock.—*Eleagnus reflexa* (from cuttings). *Mode of Grafting.*—Veneering; oblique side-cleft-grafting (in autumn); close to the ground.

Remarks.—The grafts should be placed under cloches or frames in the propagating-house. Six weeks afterwards they should be uncovered and gradually hardened off.

Chamæcyparis—Retinospora—Thujobsis.

Stock.—*Cupressus Lawsoniana*; *Biota* or *Thuja sinensis*; *Thuja canadensis* or *occidentalis* (from seed). *Mode of Grafting.*—Veneering; side-grafting with a straight or oblique cleft (in February and September); cleft-grafting in the forkings of the branches (in April and May); close to the ground or as standards.

Remarks.—Veneering and side-grafting should be done under glass; the union of the graft is perfect in about six weeks. Cleft-grafting in the forkings of the branches (see p. 106) is performed in the open air. Sub-varieties are grafted on their type.

Chamæcyparis Boursierii (vulg. *Cupressus Lawsoniana*), *C. Nutkaensis* (vulg. *Thujopsis borealis*), and *Biota orientalis* are used as stocks for trees of similar habit and character. The *Retinosporas*, which are dwarfer shrubs, according to the classification of M. Carrière, are to be grafted on the *Biota*. *Thujopsis dolobrata* and *T. læte-virens*, which are also of only moderate height in our gardens, should be grafted on the *Biota*, or, better still, on the *Thuja*.

Edible Chestnut.

Stock.—Common chestnut (from seed). *Mode of Grafting*—Cleft-grafting; in the forkings of the branches; in the English fashion (in April); crown-grafting; flute-grafting (in May); close to the ground, or as standards.

Remarks.—The chestnut also succeeds when grafted on young oak plants which have been sown where they are to remain permanently, or which have been freshly transplanted. They should be grafted by ordinary cleft-grafting, or in the forkings of the branches. When the sap commences to flow, they may be branch-grafted on the sides under the bark (see p. 68.) It is then preferable to graft close to the ground. The chestnut de Lyon is also shield-budded on the common chestnut.

The Oak.

Stock.—*Quercus robur pedunculata* for the indigenous varieties; *Quercus Cerris* for the American kinds (from seed); *Quercus Ilex* for the evergreen varieties. *Mode of Grafting.*—Cleft-grafting; in the forkings of the branches (see p. 107);

in the English way (in March and April); by approach (during the season of growth); close to the ground, or as standards.

Remarks.—Deciduous kinds should be grafted on the common Oak, either by cleft-grafting, or in the forkings of the branches, in spring, in the open air, or by side-grafting in autumn under glass. Evergreen varieties should be grafted on *Quercus Ilex* or *Q. Cerris* by cleft-grafting or side-grafting, either in July under glass, or in April in the open air. The leaves of the scions should be cut off.

Chænomeles.

Stock.—*Pyrus* or *Cydonia japonica* (from seed or root-cuttings). *Mode of Grafting.*—Shield-budding (in summer in the open air); cleft-grafting (in winter under glass); veneering; close to the ground.

Remarks.—The early vegetation of this shrub indicates an early time for grafting. Use for scions those shoots that are not too hard; the grafts will take all the better for doing so. Although this is a deciduous subject, it is best to retain a couple of leaves on the scion. Cleft-grafting is performed in January and February, and the grafts are to be placed under a cloche or frame. Although sheltered in this way, it will be necessary to apply mastic to the grafts. Veneering is performed in August, so that the union of the graft may take place by the time the sap ceases to flow. Shield-budding in the open air is perhaps the best mode of propagating this shrub. We have succeeded in this way with *C. rosea umbiliculata*.

Clematis.

Stock.—Piece of the root of the blue-flowered clematis. *Mode of Grafting.*—Cleft-grafting on a fragment of root (in May). (See page 126.)

Remarks.—In preparing the fragment of root as a stock, be

careful to preserve the fibrous roots which issue from its extremities. The scions should be young shoots of the current year. About four leaves may be left upon them. After grafting, the subjects are placed under a cloche or frame, with the air excluded, and kept there till the union of the grafts is proved by the shooting of the scions. They are then gradually hardened off, as directed in the chapter on "Grafting under Glass."

The Quince.

Stock.—Common quince; quince of Angers (from cuttings with a heel or hillock-layers). *Mode of Grafting.*—Shield-budding (in July and August). Cutting-grafting; cleft-grafting; the English method (in March); close to the ground.

Remarks.—Shield-budding is performed on young stocks, and not until the sap begins to decline. Should the stock be of vigorous growth, its branches should be tied up as soon as the graft is made. When the scion has made a shoot, it should be fastened up against the heel or against a prop, as, if left to itself, it would most probably break off at the graft. The heel should be cut off before the fall of the leaves. In the Dutch nurseries, and also in some French ones, we have seen the quince grafted on the hawthorn, both close to the ground and as half-standards.

Cornel Tree.

Stock.—*Cornus mas* (from seed). *Mode of Grafting.*—Side-branch-grafting (see p. 68) under the bark (in July); close to the ground, or as standards.

Remarks.—For scions use shoots 3 or 4 inches long, having at the base wood of two years old; also be careful not to graft too late, as the sap of the cornel-tree soon goes to rest.

Cotoneaster.

Stock.—White hawthorn (from seed). *Mode of Grafting.*—

Shield-budding; side-grafting with a simple branch (in summer); cleft-grafting; inlaying (in March and April); close to the ground.

Remarks.—Graft very close to the ground—below the surface rather than above it. Choose for scions well-ripened branches. Disbud rigorously. Cotoneasters grafted as standards do not live long.

Cryptomeria.

Stock.—*Cryptomeria japonica*. *Mode of Grafting.*—Veneering; oblique side-cleft-grafting (in February or August, under glass).

Remarks.—For stocks use tolerably young plants which have been raised in pots. Two months after grafting begin to harden them off.

Cypress.

Stock.—*Cupressus pyramidalis*; *Biota* (from seed). *Mode of Grafting.*—Veneering; side-cleft-grafting (from February to September); cleft-grafting in the forkings of the branches (in April); close to the ground or as standards.

Remarks.—The air must be excluded when the plant is veneer-grafted; the union of the parts is complete at the end of two months. In side-grafting the stock may be cleft obliquely (see p. 74). Grafting in the forkings of the branches (see p. 106) succeeds in the open air; the operation is performed in the place where a branch forks from the leading shoot of the previous year.

Cytisus.

Stock.—*Cytisus alpina* (from seed). *Mode of Grafting.*—Shield-budding (in July and August); cleft-grafting; the English method; inlaying (in March and April); close to the ground or as standards.

Remarks.—Slender-wooded kinds, such as *C. purpurea*, *rosea*, *alba*, *carnea*, *nigra*, *elegans*, and *trifolia* seldom succeed

in any other way than by cleft-grafting, in consequence of the slenderness of the scions. The scion should be grafted at the height where it is desired the branches should spring from the stock, as these kinds form a branching head without growing much higher. Strong-wooded kinds, such as *C. Adami*, *biflorus*, *odorans*, *grandiflorus*, *sessiliflorus*, and *quercifolius* are propagated by shield-budding as well as by the English method, cleft-grafting, and inlaying. The branches of these are so vigorous that when grafted close to the ground they will rise into tall standards. When the *Cytisus* is amputated for cleft-grafting or inlaying, it is absolutely necessary to retain a bud at the top of the stock either opposite to or on the same side as the graft, for the purpose of drawing the sap to the scion. Also, when disbudding in spring, a few shoots should be retained on the heel and pinched down to two leaves; these are to be quite cut away when the shoot of the graft is strong enough and at the period of the decline of the sap. Destroy snails.

Maple.

Stock.—Species and type-varieties of the maples to be propagated (from seed). *Mode of Grafting*.—Ordinary shield-budding; shield-budding with a reversed incision; branch-grafting with a heel (in August); close to the ground or as standards.

Remarks.—The very vigorous kinds of maple are shield-budded with a reversed incision (see p. 143). The branches of the stock should be cut short as soon as it is budded. The *Acer marmoratum* is grafted by shield-budding the anticipative branches, or rather by side-grafting with branches furnished with a base (see p. 69). This base, which is a strip of bark, may be as much as 6 inches long if necessary. As the heel of the stock has the disadvantage of drying up very quickly, it will be necessary to retain for

the first months of growth a few herbaceous branches on this heel to draw up the sap; they should be pinched down to three buds, and when the graft has grown strong enough they may be suppressed altogether. The varieties of *Acer palmatum* from Japan should be grafted by cleft-grafting or veneered on the type (*Acer polymorphum*), which is multiplied by layers. The operation should be performed under glass and the air excluded.

Gleditschia.

Stock.—*Gleditschia americana* (from seed). *Mode of Grafting.*—Crown-grafting (in April); close to the ground or as standards.

Remarks.—Select for scions branches whose wood at the base is two years old (see p. 79). The scion will consequently be a portion of last year's wood in the upper part, and of the previous year's growth at the base. The point of junction of the different year's growth should be about the middle of the scion.

Ash.

Stock.—Common ash (from seed). *Mode of Grafting.*—Shield-budding (in July); cleft-grafting; the English method (in March and April); close to the ground or as standards.

Remarks.—Reject the buds at the base of the branches; they do not develop readily. After budding, the tops of the scion-shoots may be utilised by side-grafting them under the bark (see p. 68). When the graft begins to sprout, the stock should be closely disbudded, but a few leafy shoots should be retained here and there to draw and keep up the flow of the sap.

Euonymus.

Stock.—*Euonymus europæus* (from seed) for the deciduous varieties; *Euonymus japonicus* (from cuttings) for the evergreen kinds. *Mode of Grafting.*—Side branch-grafting;

venering; shield-budding (in June and July); close to the ground or as standards.

Remarks.—In winter the evergreen kinds may be cleft-grafted, veneered, or inlaid, under glass. If rooted stocks are not obtainable, cuttings of branches may be used instead. Rooted plants may also be taken up and grafted, then transplanted under a frame or cloche, excluding the air; these need not be potted.

Cercis.

Stock.—Common Cercis (from seed). *Mode of Grafting.*—Ordinary shield-budding, or with the incision reversed (in August); close to the ground or as standards.

Remarks.—As soon as the budding is completed, the branches of the stock should be tied up together and the ends cut off. There would also be no harm in clearing the branches moderately of their leaves. Keep the bandage round the bud during the winter, to preserve it from the action of the frost.

Broom.

Stock.—Cytisus alpinus for the white Genista multiflora—Genista hispanica (from seed), for the other varieties. *Mode of Grafting.*—Cleft-grafting (in March and April); close to the ground, or as standards.

Remarks.—Select for scions branches of the current year's growth, with a heel of two years old. For grafting on the Cytisus, choose stocks of medium thickness, and retain a bud at the top when amputating them. Destroy snails; they are most frequently found in the neighbourhood of leguminous shrubs and plants.

Juniper.

Stock.—Virginian Juniper (from seed). *Mode of Grafting.*—Venering (in February and September). Cleft-grafting in the

forkings of branches (in April) (see p. 106); close to the ground, and as standards.

Remarks.—Graft by veneering or oblique side-cleft grafting, under a cloche or frame, excluding the air, and using well-rooted young plants for stocks. The union of the graft will be complete in six or eight weeks. Grafting in the forkings of the branches is performed in the open air in spring on the leading-shoot of the stock (see page).

Salisburia.

Stock.—Salisburia biloba (from seed or cuttings). *Mode of Grafting.*—Cleft-grafting (in March or April, in the open air); veneering; side cleft-grafting (in September, under glass); Close to the ground, or as standards.

Remarks.—The Salisburia being a dicecious Conifer, grafting affords the means of uniting both sexes on the same stem, and causing it to bear fruit.

Wistaria.

Stock.—A portion of the root of Wistaria sinensis. *Mode of Grafting.*—Cleft-grafting or inlaying on the root (in April and May.)

Remarks.—Select for stocks pieces of root about 4 inches long; graft them by cleft-grafting or inlaying. After grafting, plant them under a frame, taking care to cover the grafted roots completely. Later on they can be hardened off. Entire stocks, grafted at the neck, may also be used with equal success.

Beech.

Stock.—Common beech (from seed). *Mode of Grafting.*—Cleft-grafting in the forkings of the branch (in March and April) (see p. 108); side branch-grafting under the bark (in June and July); close to the ground, or as standards.

Remarks.—The scions inserted under the bark (see p. 68) are simple branches of the present year, or better, ramified branches two years old. The sloping cut should be very thin towards the point, as far as the inner bark. The young wood of the stock is better for grafting than that portion which is old; and, moreover, the operation should be performed sufficiently early in the season to secure a good flow of sap. Grafting in the forkings of the branches is described at page 107. Shield-budding in July sometimes succeeds with the beech, and, better still, grafting by approach in spring.

Holly.

Stock.—Common Holly (from seed). *Mode of Grafting.*—Shield-budding (in May and August); oblique side cleft-grafting (see p. 74); veneering (in April and September); close to the ground, or as standards.

Remarks.—Shield-budding is performed in the open air with a pushing bud in May, with a dormant bud in August. The leaf which accompanies the bud is cut down on its stalk. Autumn grafts are made under a cloche, in the greenhouse, or under a cool frame. The leaves are left on the scion, and the air should be excluded from the grafted stock for about three months, to secure the success of the graft. The operation succeeds perfectly well when the stock is potted at the time of grafting.

Yew—Cephalotaxus—Torreya.

Stock.—Yew, Cephalotaxus, Torreya, according to the species to be propagated (from seed or cuttings). *Mode of Grafting.*—Veneering (in February and September, under glass); close to the ground.

Remarks.—Stocks may be formed by planting cuttings of branches, and these are afterwards to be grafted with young shoots which spring from the amputated head of the parent

tree in the uppermost whorl of branches. This process is employed when certain varieties are to be propagated, and when stocks raised from seed are not to be had. The same tree then will supply stocks from its lateral branches used as cuttings, and scions from the shoots which grow from its amputated head.

Laurel.

Stock.—The type of the varieties or sub-varieties to be propagated (from seed or cuttings). *Mode of Grafting.*—Veneering (in February or the end of July, under glass).

Remarks.—The varieties of the common laurel, bay-tree, rose-laurel (*Nerium Oleander*), and *laurustinus*, of different families, being easily multiplied by cuttings, grafting is seldom employed except to propagate the different forms of the Portugal laurel, which are not so readily raised from cuttings. For stocks, young plants with as few branches as possible should be selected. The stock should not be headed down at the time of grafting; it will be sufficient to pot it at that time. It should be kept under glass for six or eight weeks before exposing it to the air.

Libocedrus.

Stock.—*Thuja sinensis* (from seed). *Mode of Grafting.*—Veneering; oblique side cleft-grafting (in February and August, under glass).

Remarks.—The treatment indicated for the last subject is also to be pursued in this case. It frequently happens in France that the *Libocedrus* when grafted is more vigorous than when raised from seed.

Ivy.

Stock.—Common Ivy (best raised from cuttings). *Mode of Grafting.*—Veneering (in September and October); close to the ground.

Remarks.—By choosing for scions the ends of branches which have flowered of the varieties called the Irish ivy and Rægneriana, we obtain tree ivies which do not climb. The grafted stocks are placed under glass, with the air excluded, for about two months, when the union of the parts will be completed.

Lilac.

Stock.—Lilac of Marly (from seed). When grafted on the ash or privet it does not live long. *Mode of Crafting.*—Shield-budding with a dormant bud (in July), with a pushing bud (in April); ordinary inlaying or cleft-grafting (in March), with herbaceous branches (in June); close to the ground or as a standard.

Remarks.—Choose for stocks young plants raised from seed, as they are less likely to send up suckers. Graft at the neck, or at different heights on the stem when the plant is vigorous. Take every measure to prevent the growth of suckers, by first destroying the latent buds on the roots before planting. Should any spring up afterwards, clear away the soil around the root, and cut them off at their base. Prepare the scion-branches by cutting off the base, which develops imperfectly, and the top, which is too much disposed to flower. The varieties with slender wood, such as S. Varin, Sauget, Persica, and sinensis carnea, should be crown-grafted on tall standards of Lilac of Marly, or some vigorous kind, by the intermediate process; while strong-wooded kinds, such as S. de Trianon, Charles X., Gloire de Moulins, carnea, duplex, Ville de Troyes, Philemon, virginal, &c., may be grafted close to the ground; they soon shoot up and form a stem. The varieties Josikæa and Emodi, whose habit is somewhat similar to that of the Chionanthus, may succeed on the ash.

Magnolia.

Stock.—Magnolia discolor (from seed and layers) for the deciduous kinds; Magnolia grandiflora (from seed and sometimes from layers) for the evergreen kinds. *Mode of Grafting.*—Veneering; side-cleft-grafting in the alburnum; inlaying on the neck of the root (from July to September, see page 127); by approach (in April and July); close to the ground or as standards.

Remarks.—Side-cleft-grafting with a branch which penetrates to the alburnum, at the neck of a stock not headed down, is practised in July and August. The subject grafted being placed under a double-lighted frame, the union of the graft will be complete in a month. Subjects veneer-grafted should be treated in the same way. If grafted later in the season they will require to remain a longer time under glass. Grafting by approach, in which the union is more tedious, is used with vigorous subjects. The severing of the parts should not commence until the following spring, and should be accomplished by several consecutive cuttings before the winter.

Horse-Chestnut—Pavia.

Stock.—Horse-chestnut (from seed). *Mode of Grafting.*—Shield-budding with a cross-like incision (in July, see p. 142); cleft-grafting (in March); flute-grafting; crown-grafting (in April); close to the ground or as standards.

Remarks.—All these modes of grafting should be performed early in the season. Reject the buds at the base of the scion-branches. The tops of the shoots with a terminal bud are suitable for crown-grafting. Tie up the young graft-shoots firmly against the heel and the prop or stake, otherwise their own weight or the force of the wind may break them off. In grafting the Pavia, choose scions more vigorous relatively than the stocks. Accelerate the growth of stocks

for tall standards by suppressing the rudimentary or stipulary buds which accompany the terminal bud of the leading shoot; by doing so, the subsequent lopping of the branches will also be simplified.

Larch.

Stock.—European or American larch (from seed). *Mode of Grafting.*—Veneering (in August); cleft-grafting; side-grafting in the alburnum (in April); close to the ground or as standards.

Remarks.—Plants veneer-grafted in autumn are placed under glass with the air excluded. Cleft-grafting and side-grafting are performed in the open air on the leading-shoot, when the swelling of the buds announces the first flow of the sap. The graft should be covered for some time with a paper-cap or cone. The weeping larch may be grafted by approach on a tall standard (see p. 51).

Bird-Cherry—Prunus Padus.

Stock.—Bird-cherry (from seed). *Mode of Grafting.*—Shield-budding; side-grafting with a branch under the bark (in July); cleft-grafting (in March); close to the ground or as standards.

Remarks.—The ends of the scion branches, which have the buds close together, are utilised in summer by employing them as simple branches for side-grafting (p. 68), and in spring for cleft-grafting.

Mulberry-tree.

Stock.—White mulberry (from seed). *Mode of Grafting.*—Shield-budding (in August); flute-grafting (in April); close to the ground, or as standards.

Remarks.—Budding succeeds best on the mulberry in warm districts, where it is performed as early as midsummer. Budding with a pushing bud (in April) is also successfully

employed, the scion branches being previously preserved by burying them in sand.

The Medlar.

Stock.—White hawthorn (from seed). *Mode of Grafting.*—Shield-budding (in July); cleft-grafting (in April); close to the ground.

Remarks.—Graft as close to the ground as possible, in order to avoid the growth of numerous thorn-branches on the stock. Choose those scions whose buds are prominent or well-formed. Do not delay too long the heading down of the stock after budding. Accelerate the growth of the graft by a vigorous disbudding of the stock, especially when the growing season begins. Stake or prop constantly.

Negundo.

Stock.—Negundo fraxinifolia (from seed). *Mode of Grafting.*—Ordinary shield-budding, or with the incision reversed (in the end of August); close to the ground, or as standards.

Remarks.—In choosing scions of the Negundo variegata, select vigorous branches which have become somewhat white, but which preserve at the same time a green tinge on the bark and leaves. Those branches whose leaves are too white perish after grafting, and involve the loss of the tree. Young stocks are to be preferred. When it is required to obtain bushes of Negundo variegata, small plants are put out in a nursery-bed at short distances from each other, and are shield-budded when a year old.

The Walnut.

Stock.—European walnut (from seed). *Mode of Grafting.*—Improved crown-grafting (p. 80); flute-grafting (in April and May, p. 154); oblique side cleft-grafting; ordinary cleft-grafting at the neck (see p. 126); at the forkings of the branches; on a

terminal bud (see p. 101); oblique cleft-grafting (in March and April); by approach (from April to July); close to the ground, or as standards.

Remarks.—The scion should be cut as much as possible obliquely across the pith, so that it may be exposed on one side only of the cutting (see p. 98). A scion, whose base consists of wood of two years' growth will be found to answer well, and also one furnished with a terminal bud. A stock grafted near the ground should always have the soil heaped up around it as far as the uppermost bud of the scion. Grafting by approach is more suited for fancy varieties of the walnut than for trees which are required to furnish serviceable wood. Never graft early-growing kinds on those of later vegetation. The varieties of American walnut may be grafted on their type. We have succeeded in cleft-grafting, in the forkings of the branches, the European walnut on the American as tall standards. In this way we may derive a twofold profit from the timber of the stem and the fruit produced by the graft.

Olive-tree.

Stock.—Common olive (from seed). *Mode of Grafting.*—Cleft-grafting (in February and March); crown-grafting (in March and April); shield-budding (from May to September); close to the ground, or as standards.

Remarks.—In the south of France young wild olive-trees are shield-budded on their lateral branches; old trees are crown-grafted close to the ground, and the soil heaped up around the graft. M. F. Sahut, cultivator, of Montpellier, recommends veneer shield-budding with strips of bark for the restoration of old olive-trees. In this process the chances of success are multiplied if an annular incision is made above the bud.

Orange-tree.

Stock.—Sour orange (Bigaradier); citron (from seed). *Mode of Grafting.*—Shield-budding with a dormant bud (from July to September); with a pushing bud (from April to June); veneering; inlaying; cleft-grafting (in September); close to the ground, or as standards.

Remarks.—Shield-budding in the open air is only practised in warm countries, where the operation is carried on precisely as described in our chapter on that method. Double shield-budding (see p. 145) is also employed, and in southern countries, Italy for example, budding with a reversed incision (see p. 143) is in vogue. Branch-grafting by inlaying, which is the method used in more temperate climes, is performed under glass in September on plants of two years old, which have been sown ten or twelve together in the same pot. The leaves of the scion are retained entire or nearly so. After winter the grafted plants are divided, and potted off separately.

The Elm.

Stock.—Common small-leaved or large-leaved elm (from seed). *Mode of Grafting.*—Shield-budding (in July); cleft-grafting (in March and April); close to the ground, or as standards.

Remarks.—In taking the bud from the scion-branch, be careful not to penetrate the alburnum with the blade of the knife, as the stringy wood of the elm does not cut clean. Moreover, should there come off, attached to the bud, a small portion of wood, do not endeavour to remove it. The Planeras do well when grafted on the elm.

The Peach.

Stock.—The almond, the plum-tree, the peach (from seed). *Mode of Grafting.*—Shield-budding with a dormant bud (in July on the plum and in August on the almond); with a

pushing bud (in April); close to the ground or as standards.

Remarks.—The best scions are obtained from shoots on walls which have not been laid in, or from trees growing in the open. Double or triple buds are the best. On gourmand branches there are too many buds which develop badly, and on slender or twiggy ones too many disposed to flowering. When it is desired to bud early, there may not be any scions sufficiently matured, owing to the prolonged vegetation of the peach. To provide against this it will be sufficient to pinch the ends of the shoots which are to furnish the scions as soon as the buds appear. If pinched sooner than this there would be too many blind buds at the base, while those at the top would be developed. When the interval between the period of pinching and that of grafting is not long, the shoots need not be pinched so closely. The hard-shelled sweet almond is the favourite stock for the peach. In nurseries the almond-trees are raised from kernels sown at once in autumn, or kept in layers of sand through the winter and sown in the following spring. The plants are budded when a year old. In June and July the stocks are prepared by cutting away the lower branches to a distance of six inches from the ground. In August they are budded, and the bud is inserted on the north side of the stock, where it will be less exposed to vicissitudes of temperature. This, however, is not absolutely necessary, as the peach is often propagated by double budding (see p. 145). As the sowing of the kernels in a trench forces the root to bend, they should be sown in such a direction that the bent part of the root may throw its rootlets towards the north, that is on the side on which the bud will be placed. This combination will afford peach-trees fit for planting against a wall exposed to the sun, as the root will not come into contact with the wall, and the cutting of the heel of the graft will not leave a wound

exposed to the sun. The heading down of the budded stocks is performed after winter, in March. Those stocks whose buds have missed are cut off under the graft, in order to be budded afresh in the following August, or they need not be so cut, but budded with a pushing bud in April or May, the buds being taken from shoots which have been kept buried in sand at the north side of a wall. Sometimes the stock is allowed to grow to some height, in order to be crown-grafted.

The species of plum which best suits as a stock for grafting the peach is the black damson (which is raised from seed), or any other kind allied to the peach. It is budded in July. On the Myrobalan plum the peach does not live long. In nurseries, where they have either a wild or a cultivated species of plum allied to the peach, they use it in the intermediary method. They graft it at first on a plum-tree of any kind, then in the first August of its growth they bud it with the peach. In a case of uncertainty, the chances of success would be doubled by inserting an apricot or plum-bud over or opposite the peach-bud. When the young shoots shall have reached the length of 6 inches, the plum or apricot shoot is pinched, and cut away altogether when the heel is removed. In this way, should the peach-bud miss, we have the others to fall back upon.

Tall standard peaches are most usually grafted on the top of the stem of the almond or plum. In England they use the Brampton plum as an intermediary, and on it graft the peach. We have obtained very satisfactory results with the peach-plum. In the propagation of rare varieties the peach is branch-grafted under glass. In the open air a trial might be made of the method called mixed grafting, using plum branches which have been budded a year before with peach-buds (see p. 147). These would be cleft-grafted the following spring. The peach on its own roots does not make a vigorous stock,

and is seldom employed for that purpose. Ornamental peach-trees are propagated in the same way as those which are grown for fruit.

The Poplar.

Stock.—White poplar; black poplar; Lombardy poplar; aspen, according to the varieties or sub-varieties to be propagated (from cuttings). *Mode of Grafting.*—Cleft-grafting (in March and April); crown-grafting (in April and May); close to the ground or as standards.

Remarks.—Subjects newly transplanted may be used as stocks, and cuttings may also be employed for the same purpose. This observation applies equally to the willow.

Photinia.

Stock.—Common quince; quince of Angers (from cuttings with a heel or hillock-layers). *Mode of Grafting.*—Shield-budding in the open air (in August); cleft-grafting in the open air in April; close to the ground.

Remarks.—In operating in the open air, the leaves of the scion-bud or branch should be removed. In grafting under glass they are retained; in the latter case the union of the graft is complete in five or six weeks. Disbud thoroughly in the open air, and pinch the young graft-shoots down to a foot to make them branch. Grafting under glass is done in February and September.

The Pine.

Stock.—Select the type of the variety to be propagated, or an allied species bearing the same number of leaves in each fascicle (from seed). *Mode of Grafting.*—Veneering; cleft-grafting; close to the ground (in March and September, under glass). Terminal cleft-grafting with herbaceous scions (in May, in the open air).

Remarks.—Grafting under glass is done in spring or autumn, the air being excluded in the usual way. Terminal herbaceous

grafting is performed in the open air both in forests and in nurseries (see p. 104). The stocks should be, as much as possible, analogous to the varieties to be propagated; thus the pines with five leaves will unite best with *P. excelsa* and the Norwegian pine; those with two and three leaves do best with *P. sylvestris*, *P. austriaca*, and *P. Laricio*; thick-wooded kinds suit the two last-named sorts. The kind best suited to the soil should also be selected. In the south of France the *P. d'Alep* and *P. pyrenaica* make good stocks for certain forms of the group of pines with two leaves. In general, *P. sylvestris*, *P. austriaca*, and *P. Laricio* will suit the greater number of varieties.

Tree Pæony.

Stock.—Tree pæony or herbaceous pæony (a portion of the root). *Mode of Grafting.*—On the root, by cleft-grafting and inlaying.

Remarks.—The roots of the herbaceous pæony should only be used when there is not a sufficient supply of the roots of the tree pæony. Retain two leaflets on each leaf of the scion, and place the grafts under a cloche or frame, keeping the air excluded for six weeks, after which they are to be placed carefully in the shade for a fortnight, or until they appear to have taken well and firmly.

The Pear.

Stock.—Pear on its own roots (from seed); quince (from cuttings with a heel, or hillock-layers; and sometimes white thorn (from seed). *Mode of Grafting.*—In almost every way—by shield-budding; side-grafting under the bark (in July and August); cleft-grafting; English method; inlaying (in March and April); crown-grafting (in April and May; close to the ground or as standards, but always close to the ground on the quince.

Remarks.—The pear on its own roots, when used as a stock,

may be budded the same year in which it is planted, or branch-grafted at least one year after planting. Trees intended to form tall standards may be grafted either close to the ground or otherwise. Stout, straight, and vigorous stocks are the only ones that can be grafted at some height from the ground. A crooked and feeble stock should be grafted close to the ground. When the variety to be propagated is a tender one, such as Esther Comte, Brandes, Beurré Flon, Seckel, Wredow, Van Mons, Bonne d'Ezée, Frédéric de Wurtemberg, Madame Millet, Prévost, &c., we graft, as an intermediary, some hardy and vigorous kind, such as Duc de Nemours, Beurré d'Amanlis, Beurré Hardy, Napoleon Savinien. This, grafted close to the ground on the stock, soon rises into a stem, and after at least two years' growth, is crown-grafted with the kind which it is desired to have as a tall standard. The new stock should not be grafted when either too young or too weak. As the quince does not always coalesce satisfactorily with the pear, care should be taken to facilitate and induce their union by the selection of young and healthy plants, and the employment of buds furnished with a sufficiently long strip of bark thoroughly freed from alburnum.

The quince should be budded close to the ground, and the stock should be a young plant. In the nurseries at Orleans they cut down the quince when planting it, and the following year graft the finest shoot which springs from the trunk; the other shoots are removed after a year's growth, and planted as cuttings to form fresh stocks. At Troyes we head down the plant to one foot when planting it, and bud it in the following August. Except in the vicinity of the place which is to receive the bud, we do not remove any other shoots, but keep them for cuttings to form fresh stocks at the proper time. When the quince is too thick or too old, bud-grafting succeeds badly upon it. The stock is headed down after winter. If the

graft has failed, the stock is cut off under it, in order to graft again next season, or else it is trimmed up to form an ordinary quince-tree. In our nurseries we regraft in spring those quinces whose buds have failed, by veneering them with strips (see p. 86). We use scion-branches which have been preserved in sand on the north side of a wall, and we graft in April, when the sap begins to flow.

It would be wise to provide against the failure of the grafts by examining them a fortnight after budding; and, wherever they have missed, they should be budded afresh, either on the stem or at the heel of one of the lower branches. In a nursery quarter which contains several kinds of trees, kinds with variegated wood might be grafted on the second occasion, as the evergreen Photinias, whose appearance will always sufficiently distinguish them from the rest, but it is always better to employ the same kinds as those which were grafted the first time. Now that the plough is beginning to be used in nurseries, the precaution should be taken of budding the quince-stocks in the direction of the rows, which will prevent the young scions from being broken off by coming into contact with the plough when breaking up the ground the following year. Tie up firmly the young scion from the graft on the quince stock, and cut off the heel carefully before the fall of the leaves, pretty early in the season.

Those kinds of pear which do not answer well when grafted directly on the quince, such as *Arbre courbé*, *Beurré Bretonneau*, *B. Spaë*, *B. d'Apremont*, *Grand Soleil*, *Marie Louise*, &c., may be grafted, in the intermediary way, on a hardy kind which has itself been previously grafted on the quince, such as *Bon Chrétien d'Eté* and *de Bruxelles*, *Jamiette*, *Monseigneur des Hons*, *Curé*, &c. These may be grafted in the second year with the tender kinds. In the nurseries at *Vitry-sur-Seine* they employ the variety *Curé*;

at the establishment of MM. Jamin and Durand, at Bourglala-Reine, they prefer the Jaminette. The same mixed method is used to obtain tall standard pears on quince. The vigorous kinds, such as Beurré d'Amanlis, B. Hardy, Conseiller de la cour, Madame Favre, &c., form stems directly, and serve as intermediary tall standard stocks for the other kinds.

M. Carrière, head nurseryman at the Muséum, Paris, has shown us, grafted close to the ground on quince stocks, some fine specimens of those kinds of pears which generally do not take well on the quince. He had, without using an intermediary, employed cleft-grafting instead of budding in their case. The hawthorn is seldom used as a stock except in soils which do not suit the pear on its own roots or the quince, and only robust kinds are propagated on it. We have thought of grafting the quince on the hawthorn, in order to graft it afterwards with a pear scion, and so be enabled to obtain pears on quince in arid soils.

The Apple.

Stock.—Apple on its own roots (from seed); Doucin and Paradise (from hillock-layers). *Mode of Grafting.*—Shield-budding (in August); crown-grafting (in April and May); cleft-grafting; the English method; inlaying (in March and April); close to the ground or as standards (on the Apple on its own roots); close to the ground only (on the Doucin and Paradise stocks).

Remarks.—The late and tedious vegetation of the apple-tree indicates that the time of grafting should be late in the season rather than early. The apple, when intended for the larger forms, should be grafted on the apple on its own roots. For tall standards it may be grafted either close to the ground or otherwise. A hardy and promising stock might be worked at some height; a stunted one should be worked close to the

ground, and the shoots from the graft will rise and form a stem. When strong stocks are to be grafted in a nursery in a cool or shady situation, it will be prudent to take them up and replant them a year or two before grafting. Without this precaution, there would be danger that the remission in the flow of the sap, brought about by the violent operation of heading-down the stock, would occasion disorders and provoke the appearance of canker on the stem. Transplanting, seconded by a partial pruning of the branches, will prepare the stock for the mutilations which accompany grafting. The Doucin and Paradise stocks, which are intended to furnish low standards, should be grafted close to the ground. Young plants are to be preferred, and they should be budded one year after planting. Inspect the grafts a fortnight afterwards and replace any that have missed. In dry soils, where the sap soon declines, the scion branches may not be able to ripen sufficiently; in that case shoots of the previous year should be preserved in a cool cellar buried in sand; the undeveloped buds of these are to be grafted in the months of May or June when the stocks are in sap. An old or hardened stock should be branch-grafted. When planting it, the buds should be removed from the roots, and at all times the suckers should be extirpated. Ornamental Apple-trees are propagated in the same way as those grown for fruit.

The Plum.

Stock.—Damson and St. Julien (from seed); Myrobalan (from cuttings). *Mode of Grafting.*—Shield-budding (in July and August); cleft-grafting (in March and September); inlaying; the English method (in March); close to the ground, or as standards.

Remarks.—Suckers should never be used as stocks in propagating the plum. The Myrobalan should be budded rather

late in the season, and its branches should be tied up together some time before grafting, and their tops cut off immediately afterwards. It very frequently happens with the damson and St. Julien in dry soils, or with old stocks, that the sap ceases flowing in the middle of summer. In that case it will be prudent to have pinched the scion-branches beforehand, so that their buds may be sufficiently matured to be grafted early. Should there be an after-flow of the sap, those buds which have missed can be replaced. In nursery quarters, this replacement is often made with buds of the apricot, peach, or almond, instead of the same kind of plum. The stock is not headed down till after winter. Young scions grafted close to the ground on the Myrobalan stock should be secured to stakes as soon as they have grown about 20 inches high. The heel of the graft should be removed before the fall of the leaves. Plum-trees which are branch-grafted do not suffer so much as other kinds from being transplanted at the time of grafting. Ordinary cleft-grafting is the most certain. It is performed when the sap begins to flow in March, or before its complete subsidence in September. In crown-grafting the plum, the scion should be cut sufficiently thin beyond the pith as far as the inner bark. Tall standard plums are obtained by grafting either close to the ground or otherwise. But, with a stunted stock, the dwarf bushy kinds, such as the Mirabelle, form a stem with difficulty. In such a case a robust and vigorous intermediary should be employed, such as *Impériale ottomane*, *Mitchelson*, *St. Catherine*, *Reine-Claude de Bavay*, &c. This grafted close to the ground on the stock will, in its turn, be grafted as a tall standard with the tender kind in at least two years after the first grafting. The stocks which are intended for standards should be cut back when one year planted. The varieties *Reine-Claude*, *Mirabelle*, and *Quetsche* are mostly propagated by seed, but it is better to graft them, selecting

good sound scions; there will then be little cause to fear the degeneration of the type. Ornamental plum-trees are propagated by shield-budding on young stocks, either close to the ground or otherwise. (See *Amygdalopsis*, page 168).

Rhododendron.

Stocks. — *Rhododendron ponticum* (from seed). *Mode of Grafting.* — Veneering; English saddle-grafting; ordinary cleft-grafting; side cleft-grafting (in September and October); by approach (from April to August); close to the ground, and sometimes as standards.

Remarks. — Cleft-grafting and inlaying necessitate the previous amputation of the stock, and are not so good as the other methods. However, if a leafy shoot is retained at the top of the stock opposite the graft, good results may be obtained. Saddle-grafting is described and illustrated in the account of English Grafting (see p. 113). Veneer-grafting is the method most frequently used. It is done in July and August; the stock is not headed down previously; if it is too long the top is pinched. After grafting, the plants are placed under cloches with the air excluded for five or six weeks, until the union of the graft is ascertained; they are then gradually hardened off in the usual manner. Side cleft-grafting is equally good. Performed in August under a double-lighted frame, the union of the graft is complete in about five weeks. In all these methods the leaves of the scion are retained; the longest, however, may be diminished one-third in length. The rooting tendency of the rhododendron allows of its being grafted on stocks which have been taken up, then placed under a cloche, and afterwards planted out in a bed, without any necessity of potting it when removed from the cloche. It is as certain to succeed as if the stock had been potted at the time of grafting.

Robinia.

Stock.—Common robinia (white acacia) (from seed). *Mode of Grafting*.—Cleft-grafting (in April); close to the ground or otherwise.

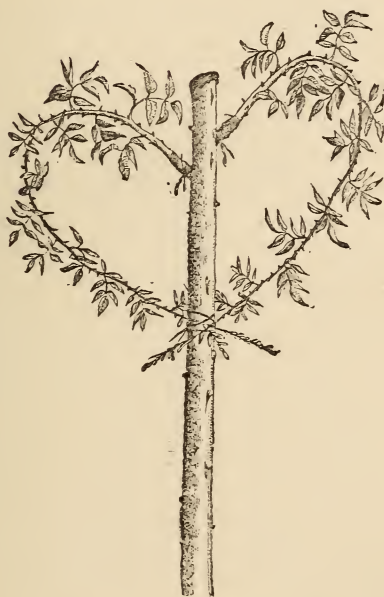
Remarks.—Slender-wooded kinds, such as *R. tortuosa*, *rosea*, *linifolia*, *Van-Houtte*, &c., should be grafted at the projected height of the branches. The vigorous kinds, *R. Decaisneana*, *unifolia*, *pyramidalis*, may be grafted close to the ground, even when they are intended for tall standards. The Robinia may be taken up and transplanted without injury at the time of grafting. In certain localities it succeeds when budded.

The Rose.

Stock.—Dog-briar (from seed or suckers); *Manetti* (from cuttings), *R. quatre-saisons*. *Mode of Grafting*.—Shield-budding, with a dormant bud (in July and August); with a pushing bud (in May and June); cleft-grafting; inlaying (in March); close to the ground or as standards.

Remarks.—The rose is chiefly propagated on the dog-briar. The stock may either be raised from seed, or the plants may be procured in hedges or woods. Those raised from seed are used for low standards, while tall standards are obtained both from sowing and also from suckers. They are planted either permanently or provisionally in the nursery. If the effects of heat are feared, the stems should be covered with clay or mud, and the cuts with mastic. The scion-branch is in proper condition when in flower or just after flowering; before this time it is not sufficiently woody, and afterwards it will have become too hard or the buds will have broken. This observation applies more particularly to those kinds that flower continuously; the other kinds supply good scions ripened by pinching. When the prickles come off if rubbed by the hand, it is a sign that the scion is sufficiently ripened. In the case

of varieties which run much to wood, and have little tendency to flower, choose the upper buds of shoots terminated by a flower. The future rose-bush will inherit the flowering qualities of the scion. Buds that have commenced to break may be used, but then the precaution should be taken of inoculating a latent bud also on the same stock. In preparing

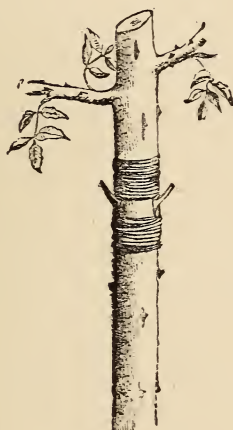


Dog-briar budded with Rose-buds.

the scion-bud, the leaf is to be cut on its stalk, and the accompanying stipules removed. The prickles should be cut off level with the bark and not plucked or torn off. The prickles at the swelling of the buds of roses with bracts should be retained. Moss-rose scions need not be completely cleared of their prickles; it will be sufficient to remove those that

would be an obstacle to the insertion of the bud under the bark of the stock. The stock when newly planted bears two or three branches at the top, the rest having been removed (see p. 203). They are budded in the first year as soon as they have grown sufficiently thick and woody. When the sap is abating and the green tinge of the outer bark at the heel of the branch becomes white when cut, no time should be lost, as the sap is passing away. It is better not to head down the dog-briar before grafting. The bud should be inserted on the branch of the dog-briar close to its junction with the stem. It is bandaged with two or three woollen threads, and later on inspected to see that the bandages have not become too tight. Unskilful operators are known by the number of branches which break a week after budding, in consequence of the transverse incision of the T having been made too deep. This fracture either causes the bud to shoot at once or else kills it. To avoid this evil, some English florists merely make a longitudinal incision, and do not complete the T by the transverse one. This, however, renders the insertion of the bud somewhat more difficult. Budding with a dormant bud is performed in July and August: with a pushing bud in May and June. It is not, however, rare to find early buds which do not develop until the following year, and late ones which break immediately. When a dormant bud is employed, the branches of the dog-briar are bent and fastened to the stem. They may also be raised and fastened over-head like a garland. The buds will sometimes break on the bent branches, then these branches should be headed down when the graft shall have grown at least four inches. If it is desired that the bud should remain dormant, the stem and roots should be only moderately dis-budded and dis-branched, so that the sap may not concentrate its strength at the top of the stock, and either cause the bud to break or else

bring on strangulation. If the graft is made with a pushing bud, the budded branches should be cut ten inches from the bud a week afterwards, and cut back to four inches as soon as the young shoots have grown four inches long. Buds and shoots must be vigorously removed from the stem and roots of the stock. Grafting with a pushing bud should be performed early in the season, in order that the shoots of the graft may be sufficiently ripened before winter. It may be



Dog-briar budded on the stem.

practised in April and May on the branches of the preceding year with scions which have been preserved in sand on the north side of a wall. The stem also of the stock may be budded early in the season under the branches at the top. As the stem does not increase in diameter so quickly as a branch, the graft should be bandaged very firmly. Here we employ cotton or thick woollen thread. Some kinds, such as the Tea Roses, Moss Roses, Bengal Roses, Souvenir de la Malmaison Ernestine de Barante, &c., succeed better when budded in

August than in June. The bandage should be removed in September, except in the case of tender kinds, when it should be retained until spring. The final cutting back of the branches to within two inches of the bud takes place after winter, and before the new growth has commenced. At the same time the buds of the stock which surround the graft should be rubbed off, especially those at its base; those which are above it may be retained to draw the sap. The more doubtful a bud appears, the shorter should the branch on which it is budded be cut; if it is still alive, its latent condition will cease, and it will break vigorously. If it fails, a fresh shoot of the stock must be prepared for the next season's budding.

Low standards are treated in the same way. They are easily budded on the stem, because young stocks are employed. The sap does not continue active so long in the stem, which is rather against late buddings. However, this may be obviated to a certain extent. For instance, at M. Cochet's, at Suines, and in the neighbourhood of Briecomte-Robert, where the *Rose du Roi* is propagated by thousands, they plant rather late in the season the dog-briars intended for budding, so that the sap is still active when the scions of the *Rose du Roi* are well grown and furnished with prominent buds, which rarely occurs the first season with this variety.

Branch-grafting, crown-grafting, cleft-grafting, or inlaying the dog-briar succeeds in spring on stocks whose bark is grey rather than green; the graft should be covered with a paper cone to preserve it from heat and atmospheric vicissitudes. Portland roses succeed well when cleft-grafted. Cleft-grafting in June with herbaceous branches also does well; they too should be protected by a paper cone, and the leaves should be cut on their stalks. As soon as the young scions push, they should be tied up to the heel or a prop made with

twigs (see p. 109). When they have grown 6 inches long they should be pinched, and especially if they are very slender and drawn, or if there be only one. They will soon become bushy and will also resist the wind better. This allows us to suppress the other shoots which spring from the stem, and some of which we might be tempted to utilise in the case of a solitary graft. Branches should only be retained for a second budding if the first graft appears to be tender, and their vitality should be concentrated by a prudent pinching or disleafing as soon as they have grown 10 inches long.

Budding on the Manetti.—The Manetti is propagated by cuttings. It is cut back to obtain stocks for standards, and these should not be budded for at least two years afterwards. When the stock is budded too young or too thin, the result is never satisfactory. For low standards, plants of one year old are budded in the August after they are planted. The modes of grafting are much the same as those employed in the case of the dog-briar; however, the prolonged vegetation of the Manetti must be taken into account, so that it may be worked earlier with a pushing-bud and later with a dormant one. The Manetti, therefore, is a suitable stock for those kinds whose scions ripen either early or late in the season. The Manetti does not produce suckers like the dog-briar, but it emits from beneath the neck a very large number of shoots. This may be in some degree remedied by rubbing off the eyes at the base of the cutting at the time of its preparation, and by extirpating the buds on the roots of other stocks at the time of planting.

Budding on the Quatre-Saisons.—The variety named Quatre-Saisons, or Monthly, is much prized by rose-growers for forming low standards under glass, and especially the new varieties offered in trade. Formerly it was the only stock employed. Nowadays it is used in conjunction with the

Manetti, just as the latter helps out the dog-briar in the open air. The stock, potted in autumn, is cleft-grafted under glass in spring following, about February. The stock having been cut obliquely, the scion is inserted at the bottom or at the top of the incision. A bud or shoot should be retained on the stock opposite to, or on the same side as, the graft. When the union of the graft is ascertained, when the buds of the scion swell, and are ready to break, it is gradually exposed to the air, and ultimately removed to a cold frame. The young branches being sufficiently hardened, and often in a flowering condition while it is still spring, the subjects may be removed into the open ground.

Fir.

Stocks.—The type of the variety to be propagated, whether Abies, Picca, or Tsuga (from seed). *Mode of Grafting.*—Veneering, close to the ground (in February and September, under glass); herbaceous cleft-grafting in the crown (in May); cleft-grafting with a terminal bud (in April).

Remarks.—Grafting under glass is performed on young vigorous plants raised in pots. The other two methods are practised in the open air, and if properly done, the tree grafted will grow quite as straight as if raised from seed. Grafting with a terminal bud is described at page 102. *Abies nobilis* is generally more vigorous when grafted on *Abies pectinata* than when raised from seed. The best stocks for each tribe of the firs are—*Abies pectinata* for the Abies; *Abies picea* and *sapinette* for the Piceas; *Abies canadensis* for the Tsugas; and *Abies Douglasii* for the Pseudo-Tsugas.

Sophora.

Stocks.—*Sophora japonica* (from seed). *Mode of Grafting.*—Shield-budding (in July and August); cleft-grafting (in April); close to the ground, or as standards.

Remarks—The sophora comes into growth rather slowly, and its bark is so tender that it is not necessary to cut beforehand and preserve the scion-branches intended for grafting. A fine day should be selected for the operation, as soon as the buds begin to swell. The leaf-stalk entirely covers the graft-bud and is inserted with it into the stock. Stocks intended for budding should have young and vigorous stems. Success, however, is so uncertain that in the nurseries of Bollwiller, for example, they bud the same stocks at two or three different times with an interval of about twenty days between each.

Rowan-tree, or Mountain Ash.

Stock.—White-thorn (from seed). *Mode of Grafting*.—Shield-budding (in July); cleft-grafting (in March); crown-grafting (in April); close to the ground.

Remarks.—Reject the buds which grow at the base of the scion-branches, as they develop badly; and also those at the top, as they are not easily worked and are too much disposed to flowering. Do not take the scions from cankered subjects, especially in the case of the service-tree (*Pyrus domestica*). With large graft-buds the cross-like incision (see p. 142) should be employed. Disbud the white-thorn stock vigorously, as soon as the graft develops itself. The weeping Mountain-Ash is grafted on its type, as a tall standard, either by shield-budding or cleft-grafting or crown-grafting.

Taxodium.

Stock.—*Taxodium distichum* (from seed). *Mode of Grafting*.—Cleft-grafting (in April); close to the ground or as standards.

Remarks.—Ordinary cleft-grafting on the headed-down stock will be more likely to succeed if practised under glass. The treatment in other respects will be the same as for the other

conifers. If the operation is performed in the open air (in April) the graft should be covered with mastic, and protected with a paper cap. The *Taxodium* may also be grafted in the end of summer.

Thuja—Biota.

Stock.—*Thuja canadensis* or *occidentalis*; *Biota orientalis* or *Thuja sinensis* (from seed), according as the variety to be propagated belongs to the genus *Thuja* or *Biota*. *Mode of Grafting.*—Veneering, close to the ground (in February and September); cleft-grafting in the forkings of the branches (in April and May).

Remarks.—Veneer-grafting is performed under glass, either in a house or covered pit, as we have already described. Stocks grafted with varieties whose moderate vegetative powers do not provoke an extension of the roots, (the *Biota aurea*, for instance) may be grafted and replanted without being potted; it would be unwise, however, to do this in the case of vigorous kinds, such as *Thuja gigantea*, although grafted on the same species of stock. If the stock has been grafted after being taken up, it will be necessary to pot it when removed from under the cloche. Grafting in the forkings of the branches is done in the open air; the scion is inserted in the angle which a branch makes with the leading shoot (see p. 106).

Lime-tree.

Stock.—Dutch Lime-tree (from seed). *Mode of Grafting.*—Shield-budding; side-grafting with a simple branch (in July and August); close to the ground, or as standards.

Remarks.—The stocks should be large enough to receive the graft; but bud-grafting is more certain on a young stock or on a young part of a leading shoot. When the bark of a stock is too thick, it can be side-grafted under the bark with a simple branch (see p. 68).

Privet.

Stock.—Common Privet; oval-leaved Privet (from seed or cuttings). *Mode of Grafting.*—Cleft-grafting; veneering; inlaying (in September and November); shield-budding; side branch-grafting (in July); close to the ground or as standards.

Remarks.—Evergreen kinds should be grafted close to the ground on young stocks, either single or grouped in a pot, and placed under a cloche with the air excluded. The leaves should not be removed from the scion. Deciduous kinds succeed either when bud-grafted or branch-grafted under the bark. The stocks are to be raised from seed.

The Vine.

Stock.—Vine (from cuttings or layers). *Mode of Grafting.*—Cleft-grafting; in the forkings of the branches; cutting-grafting (see p. 116); layer-grafting (see p. 117); on the neck of the root (see p. 127); the English method in April and September); by approach (in spring, see p. 53); shield-budding (in July).

Remarks.—We have already sufficiently explained all the peculiarities connected with each mode of grafting the Vine (see pages in index). With the exception of grafting in the forkings of the branches and by approach, all the methods require the soil to be heaped up around the graft in order to facilitate the union. Even when shield-budded it has no chance of success, unless the soil is heaped up around the part budded. In all cases the scions should be well ripened and free from disease (see p. 127), and the stock not so old as not to be worth grafting. When it is possible to choose the scions before-hand on the parent vine, care should be taken to prune them and to pinch the tops before the fall of the leaves, so that the wood may be properly ripened. Vines are more

frequently grafted in order to repair deficiencies of shoots along the stem than for the purpose of propagation.

Guelder Rose.

Stock.—*Viburnum Lantana* (from seed). *Mode of Grafting.*
—Veneering (in August and September).

Remarks.—Select young stocks a year old, and planted in pots. Graft close to the ground, below the neck of the root rather than above it. The operation is performed under glass. Up to the present *Viburnum macrocephalum* is the only kind propagated by grafting. (We have succeeded in cleft-grafting it on the *Laurustinus* very satisfactorily). The other kinds are propagated by layering the branches.

RESTORATION OF TREES BY GRAFTING.

It often happens that a tree disappoints the expectations that were formed of it at the time of its planting. It turns out badly; its branches are irregular and ugly; its appearance is not ornamental, or its fruit does not come up to the standard we had hoped for. If it is so old and far gone that it cannot be preserved, we cut it down and prepare the place it occupied for another. But if it is still likely to live, and is sound at the base, it is better to renew its vigour by cutting the branches and supplying new and good soil to the roots. Now a tree may either have an ugly lot of branches or may be of a bad kind. Both these faults may be remedied by grafting. In the first case we supply new branches, in the second a new kind of tree.

Restoring the Branches of a Tree.—The irregular branching of a tree may be corrected, to some extent at least, by means of certain processes of grafting which have been already described. We may here advert to the union of the branches

of trees trained in certain forms by approach-grafting, without any detriment to the well-being of the subjects thus treated (see pp. 58, 59, 60, 61).

Restoration of a Bruised or Cankered Stem (see p. 53).—

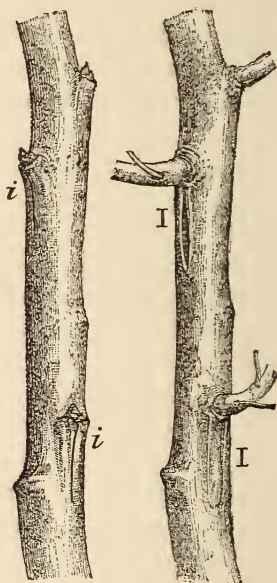
When branches have grown from the base of the tree, they are grafted on the stem, by inarching, above the diseased part. If the tree has no branches at the base, a young vigorous stock should be planted near it, of a kind analogous to the tree which is to be restored, or of a kind which will not refuse to be grafted on it. This is to be grafted by approach on the injured tree, and, when united to it, will supply additional sap.

Replacing a part of a Trained Form (see p. 54).—Here, on a chandelier-palmette, a portion of the figure is wanting and cannot be supplied by a neighbouring branch. In this case a new stock is planted, which is afterwards grafted to the others by approach, and thus supplies the deficiency. Should it not be possible or convenient to plant a second stock thus, scions may be inserted on the bare places of the stem. When the stem is young, buds may be used, but when the stem is thick, we must employ branch-grafting, either by (1) veneering with strips (see p. 86); (2) a simple branch (see p. 68); or (3) a branch with a heel (see p. 69). By the last method we can insert scions twenty inches in length, furnished with twenty buds; but we must be careful to prepare them for this operation by disleafing them a week beforehand, and after they are grafted, they should be covered with an envelope of mud and leaves to protect them from the heat.

The same object would be attained by grafting by approach the branches of the tree itself, or of a neighbouring tree on the bare parts. Approach-grafting applied to horizontal cordons (see p. 62), and the piecing-graft (see p. 63), which unites two subjects distinct from each other, come under the

same heading. We need hardly mention that a broken branch may be repaired by means of crown-grafting, veneering at the end, cleft-grafting, or inlaying, the scions being inserted on the stump of the broken branch.

Furnishing Bare Branches.—When the principal branches are too bare, they may be furnished with shoots in a number

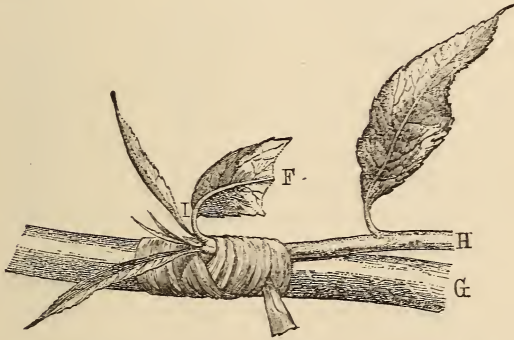


Incisions under buds to excite their development.

of ways. First, if there are any rudimentary buds, we excite them to develop themselves by making notches in the bark about half an inch above them (see Z, p. 86). If the bud is visible, it will be sufficient to make small longitudinal incisions (*i, i*, above) through the bark under the buds, and extending to their swollen base. As the sap flows, the

incisions become widened and heal (I, I, see p. 214), and the buds form branches. The incisions have this advantage over the notches that the bark is not cut across nor the alburnum exposed, but they do not stimulate a sluggish bud so well.

When there are no buds to be treated in this way, grafting alone will supply the deficiency. Shield-budding would not answer on old stems, as the condition of their sap would not permit the bark to be raised when the scion-branches were sufficiently ripened for budding. On the other hand, herbaceous scions may be grafted by approach in spring. If the operation



The leaf of a Peach-tree pinched to stimulate the buds at its base.

is postponed till after July, the union of the graft will be less certain and the future branch will want solidity. Ordinary approach-grafting (see p. 42), and inarching (see p. 44) are employed with equally good results.

Let us take the case of a peach-tree. It is well known that the anticipative shoots are not always furnished with buds at the base which facilitate the mode of pruning necessary for this tree. Pinching the leaves will, to a certain extent, remedy this deficiency. Thus the branch (H) (see above) having been inarched (see p. 46) on the branch (G)

in May or June, the bud which was inoculated under the bark begins to break some weeks afterwards. This is the time to pinch the leaf (F), in the axil of which the bud is situated, nearly to the middle. The result will be that the scion produced from the bud (I) will be furnished with buds at its base, and will become a fruiting branch with wood of replacement at its base. The young leaves of the shoot may be similarly pinched, if necessary.

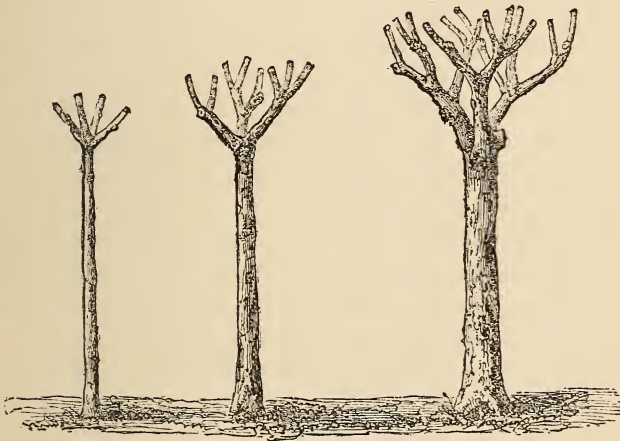
In the absence of scion-branches for this operation we have recourse to side-grafting with a simple branch (see p. 68), and to veneering with strips (see p. 86). These two methods are of the greatest service in arboriculture and deserve to be very generally adopted.

Restoring a Tree by Grafting a New Species on it.—A tree which is vigorous, but of an unsuitable or inferior kind, is grafted on the stem and branches with the kind desired. Whatever may be the nature of the old subject, the new kind will very soon produce its own fruit undeteriorated by any of the bad qualities of fruit formerly borne by the stock. In this way it is easy to change a cider apple-tree into one which will bear dessert fruit, a summer pear-tree into a winter pear-tree, a wild plum-tree into an apricot-tree, a barren vine-stock into a fruitful one; and to gather in autumn medlars, quinces, and even pears, from the hawthorn which is planted for the sake of its May flowers. The white chestnut will thus be covered with rosy flowers, the pyramidal poplar will become an umbrella, and the stunted fir will yield masts for ships! It is easily seen that this system of substitution by grafting is of very extensive application, although at present chiefly used in connection with fruit-trees.

It is asserted that the quality of a fruit-tree is improved by grafting it repeatedly and successively on the same tree. It would seem as if the swelling of every graft were a filter

through which the sap is purified and refined. However, pomology is so rich in good fruits, that we generally prefer grafting a variety of established reputation to improving the inferior ones by these circuitous operations.

The re-grafting of large trees is not yet well understood. It is wrong to trim them down too closely instead of furnishing them with a sufficient number of shoots to absorb the supply of nourishment elaborated by the roots. The stronger a tree



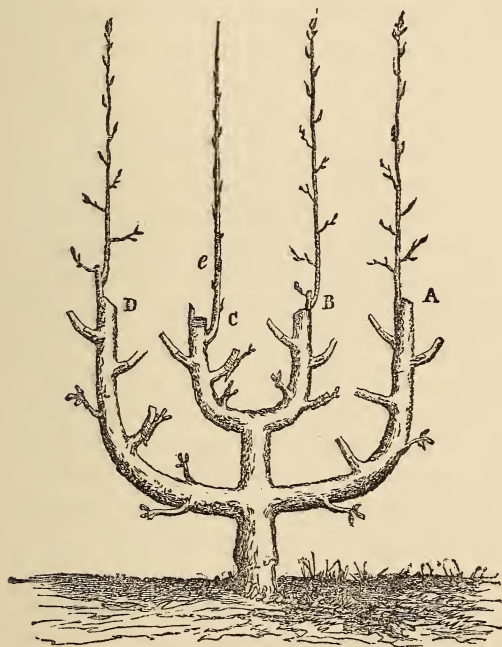
Large trees prepared for restoration by grafting.

is the greater the number of its branches which should be grafted, and the greater the number of scions which should be inserted on them. The engraving represents three trees, tall standards of different dimensions, ready for grafting or re-grafting. The number of branches retained is in proportion to the strength of each subject. The result will be that each will be more speedily furnished with a well-developed fresh growth, than if this discrimination were not observed. Should

there be a deficiency of scions, the branches at the centre and top should first be grafted; the rest may be grafted in summer or the following spring on their young shoots, having been previously amputated with the others. With thick trunks crown-grafting is preferable, as, besides allowing the insertion of a greater number of scions, it does not require the stock to be cleft. If the cortical layers of the stock are too old and wrinkled, we employ oblique cleft-grafting (see p. 97).

When thick trees are grafted, props should be fastened to the stumps, to which the young shoots of the graft are subsequently to be tied, in order to save them from being broken off by the wind (page 160). The bark of the stock should be cleaned and whitewashed, and the soil around the roots renewed. These last operations should be performed in winter at the same time when the branches to be grafted are provisionally amputated. Very frequently the pruning of the branches and roots is done a year beforehand, to moderate the vigour of the tree, and prepare it to support the fresh graftings. Low standards are treated in the same way. Subjects trained as vases, bushes, fans, cordons, palmettes, or chandeliers, pyramids, and columns, grown in the open or against walls, are regrafted on the stem and principal branches, sufficiently high to preserve the outline of the form, but at the same time low enough to give the renewed part greater extent. Bushes which have been thinned by the suppression of useless or too crowded branches should be grafted at the forkings of the branches. Vases should be grafted on the branches which form the outline of the subject, and at the same height. It is also easy, by means of regrafting, to modify the outline or the dimensions of the vase. The fan is grafted on its principal branches, and the amputation of the branches is calculated, so that when shortened they may continue to form the skeleton of the fan.

The single or double vertical or oblique cordon may be re-grafted as low as possible. The horizontal cordon should be grafted at the height of the elbow formed by the unilateral or bilateral stem. The horizontal or oblique palmette, single or double, is grafted on each of its branches. When there are



Restoration of a tree trained as a chandelier.

many series of branches, about one-third of them is cut away, and the stem is also amputated at this height. The branches are to be afterwards shortened in graduated lengths, diminishing from the base of the tree to the top. With a palmette of some width we can with greater certainty maintain the vigour

of the lower branches by giving the young shoots of the graft a vertical direction, so as to transform the ordinary palmette into a chandelier-palmette. The chandelier (p. 219), is grafted on its four branches (A, B, C, D). At A the scion crowned with its terminal bud, has finished a direct prolongation of the old branch. At B and D the scions, bearing two buds, have produced two branches. The upper ones have been pinched down, and the lower ones form the continuation or renewal of the old branches. When we want to prove or study a variety, it is grafted in this way on a tree in bearing. But instead of pinching the useless shoots on the stock-branch, they are bent down, and an annular incision is made to hasten the production of fruit. The graft at C has missed, and to meet this a shoot (*e*) of the old branch has been retained and trained at the time of dis-branching and staking. About August a bud of the new variety is to be inserted on this shoot, at the height at which it is calculated the next pruning will bring down the other branches. A few buds, inserted below it on the shoot, will be useful in bearing fruit, while the uppermost bud will furnish the shoot for continuing the branch. It is always wise to double the chances of success by using several scions; if the uppermost one fails we have the others to fall back on.

When amputating the principal branches, we also prune their shoots and ramifications, which are intended to bear fruit, so as to obtain new wood. On the shoots which spring from them it will be most convenient to graft the new variety by the method of budding (see p. 139), or branch-grafting under the bark (see p. 68), or with strips (see p. 86).

When it is required to change the variety on a tree trained as a pyramid (see p. 221) we begin by cutting off one-third of the height of the tree; we then cut the main branches (the upper ones shorter than the lower ones), so that the stumps may present a conical outline. Thus they might be left a foot

long at the base of the tree, and four inches long at the top. We then graft on the stem and amputated branches. The branches of the tree here shown are being shortened in this graduated manner

Crown-grafting answers the best; we have adopted it in preference to any other method whenever we have to change the variety on our old fruit trees. It is easy to cut the inserted part of the scion as far as the inner bark, so that its



Restoration of a Pyramid-tree.

union with the stock is the better ensured, and the danger of breaking off at the point of junction is diminished. Nevertheless ordinary cleft-grafting (see p. 92), oblique cleft-grafting (see p. 97), and veneering on the crown (see p. 84) are not wanting in advantages, and may be employed with success by those who prefer to use them.

THE END.



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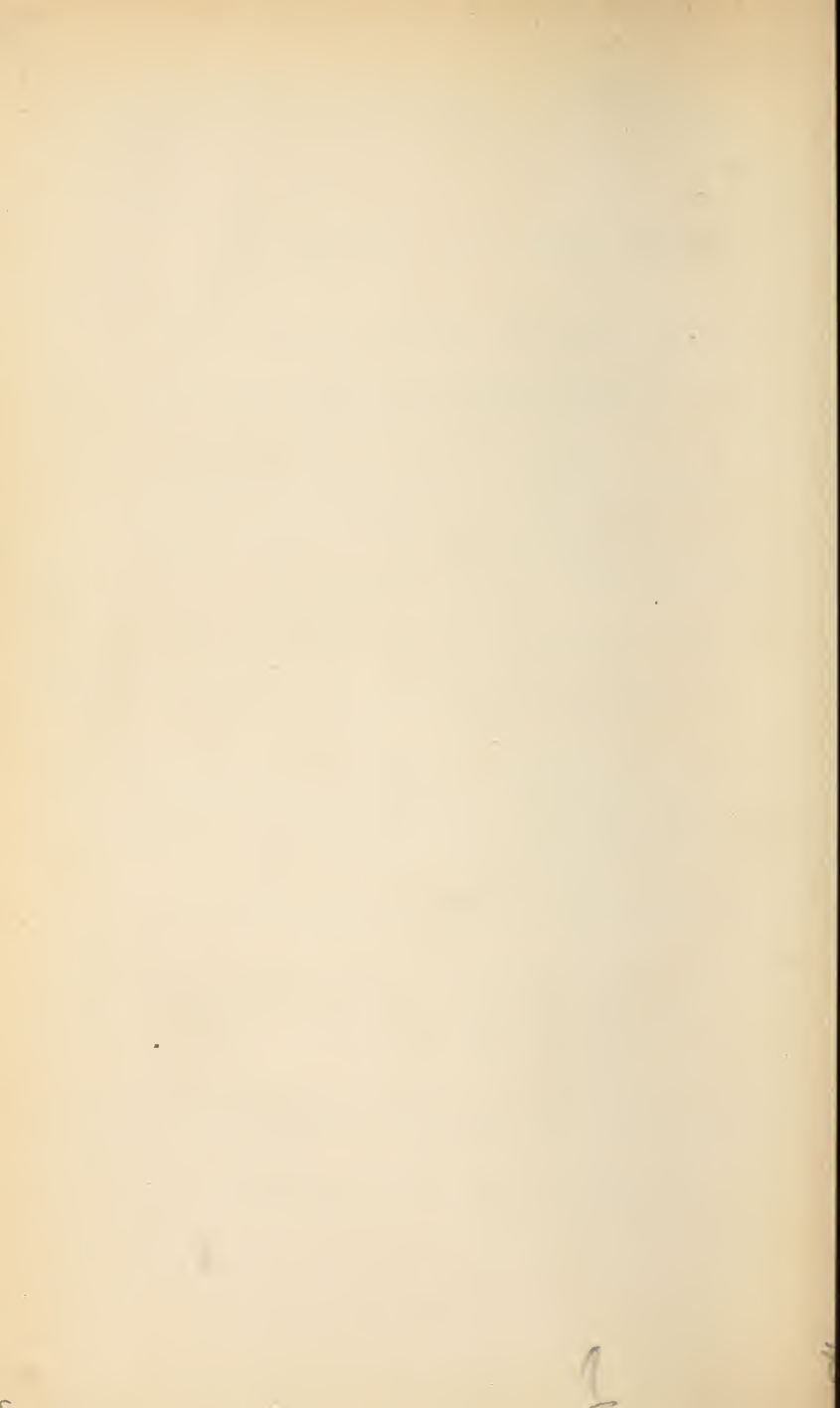
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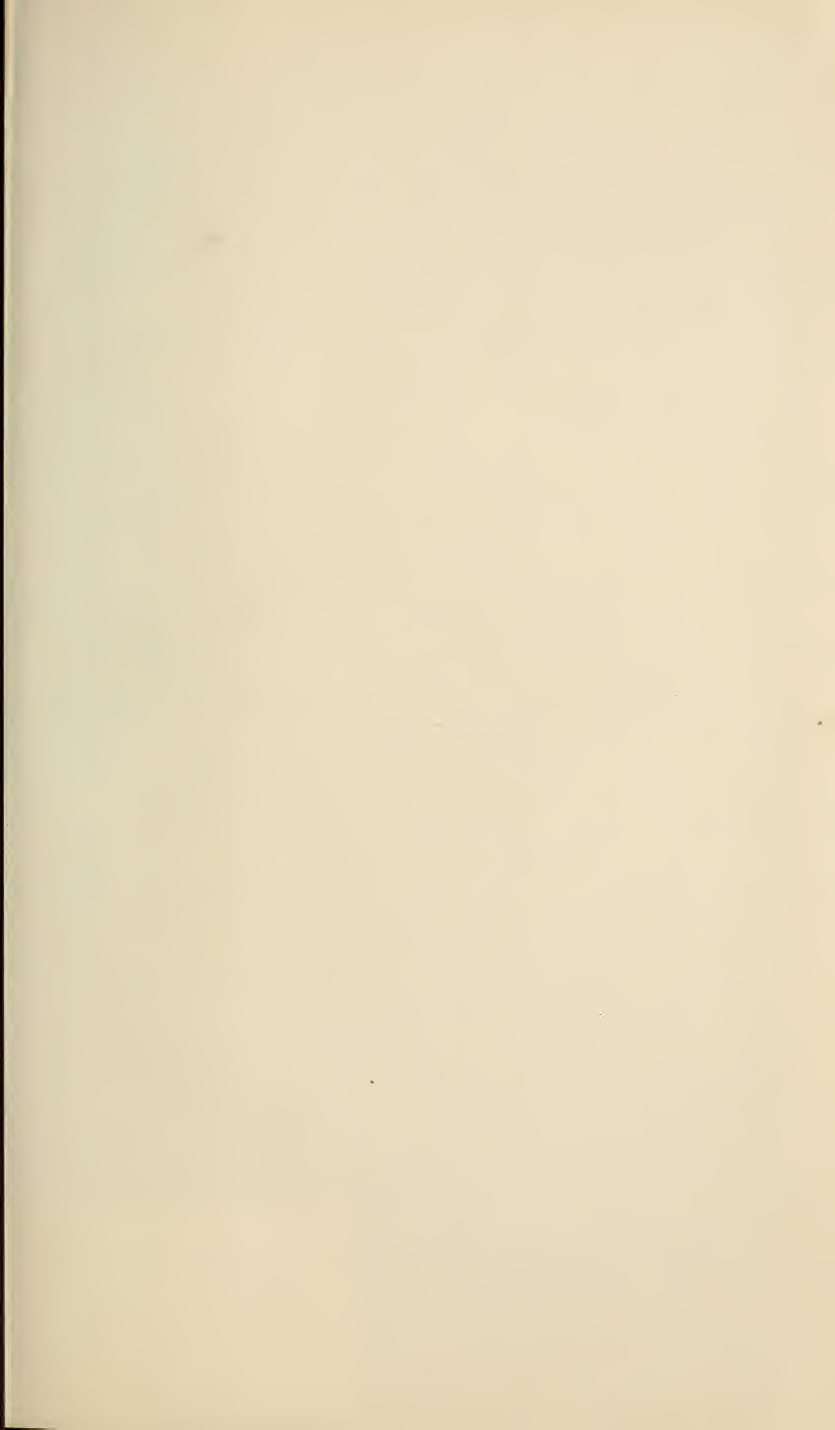
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