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Nursery hints

L. C. Corbett

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MORGANTOWN, W. VA.

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JANUARY, 1899.

Nursery Hints.

BY L. C. CORBETT.

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PREFACE.

The matter in this bulletin is not claimed as original nor is it technical only in so far as the use of correct language demands. It has been written to meet a demand for information in regard to the propagation of various plants, particularly the methods used in budding and grafting.

The growing interest in orcharding calls for information upon root grafting, budding and cuttings, while the large number of unprofitable apple orchards demand information upon cleft grafting so that these unprofitable horticultural investments can be transformed into paying ventures.

NURSERY HINTS.

Success in the nursery business follows the man who has untiring energy coupled with a knowledge of the methods of his art. Growing nursery stock is one of the most intensive divisions of the art of soil culture, we have to deal with small, tender plants, the success of whose growth frequently depends upon a few hours' work just at the proper time.

Viewed from an aesthetic standpoint, the nursery business presents quite a different scene. The materials and factors with which the nurseryman daily comes in contact are themselves sufficient to stimulate him to greater activity, and at the same time, to develop in him a love for nature and nature's God. The man who sows a seed and rears a plant from it has witnessed a transformation almost miraculous in its nature. But this process is so common that it creates neither wonder or admiration. Is it strange then, that the cultivators of the soil acts "by rule of thumb" and tradition when they know not what they do or with what mysterious powers they are dealing? It is time that we become lovers of our art rather than mere servants of it. Plants should become entities possessing life and individual characters which are pleasing to us rather than mere machines for transforming so much inorganic soil material and sunlight into fruits, or flowers, which, at the close of the season, will leave us that much richer. But the conception of the plant world as a great manufacturing establishment is much better than no conception of it at all. Study every factor with which the plant you are growing has to deal. The beauty, harmony and complexity of the cycle of life of any plant will leave you richer for having traced it. After viewing one scene of nature's theatre, the student will ever be asking a glimpse at another. The love of witnessing this panorama is what lifts the horticulturist and the agriculturist out of the sphere of the laborer into that of the investigator, and what was before

irksome toil now becomes pleasure because we are prepared to enjoy what it unfolds.

The canvas and unmixed colors without the skilled artist are no more than so much clay. The soil, the plant, and the atmosphere are to most of us merely so much raw material, we use them as we have been taught without stopping to ask why; but as soon as the plant suggests to us its complex and beautiful round of life, instead of merely what it is good for, then we are led into nature's secrets of "how plants grow and how plants feed."

The following pages, as the title indicates, are intended to stimulate an interest in the art of propagating plants. Aside from the economic features of the work, the growing of plants is itself a fascinating occupation, but there are so many benefits to be gained by the local production of nursery stock, that fruit growers of a developing region cannot afford to neglect this art. The introduction of dangerous pests can be avoided, cions and buds from trees thoroughly acclimated can be obtained by the propagator, a pedigreed tree can therefore be produced; and what is equally important the young stock will not be forced to suffer the shock of long transportation, and a change of climate. To those who have studied the question, no stronger argument can be brought in favor of the home production of seeds and trees than effects of climate upon plants.

The home-grown tree may possess these points of advantage: Freedom from foreign pests, such as San Jose Scale; to have been grown from buds or cions of perennial bearing trees; to be thoroughly acclimated; and last and by no means least, the orchardist can have his trees grown by contract, from cions or buds from his favorite trees. He thus has the satisfaction of knowing exactly what he has purchased.

In considering this subject, it has been taken up by topic, in order to give prominence to its various sub-divisions. These have been made to conform as closely as possible to the natural order in which they would be considered by the expert nurseryman.

A general consideration of soil, methods of culture, and pruning, is followed by full directions for the various natural and artificial methods of propagation, and the text is amply supplemented by illustrations.

Soil. The soil for the nursery should be a strong, deeply tilled loam, underlaid with hardpan at a depth of 18 to 20 inches. Soils with a sandy sub-stratum have a tendency to induce the development of a large cylindrical tap root with a deficiency of laterals. Such trees do not endure transplanting as well as those with a greater supply of lateral roots.

The area to be planted in young stock should have been thoroughly tilled to free it from weeds. Plow deep and follow with the subsoiler, so that the earth may be thoroughly loosened to a depth of at least 15 inches. Such cultivation can be done with profit during the fall and winter, when it is intended to plant root grafts or stored stocks on the area in the spring.

Culture. Frequent shallow cultivation is the great factor in quick and profitable growth in nursery stock.

A rule strictly observed by many nurserymen is to cultivate as soon after each shower as the ground will permit. Such practices are not designed merely to kill weeds, but to conserve moisture. Moisture is the all important factor in determining the rate of growth of plants, as well as the available supply of plant food for their use. Plant food cannot become available without a proper supply of moisture, and plant growth cannot take place without available food.

Careful judgment is needed, however, for cultivation beyond a certain date (usually Aug. 15 to Sept. 1st, for nursery stock,) causes sappy growth which does not ripen perfectly in the fall, winter killing is a result and in certain sections of the United States it causes the *black-heart*, so much to be avoided. A healthy growth, well matured, is not only less likely to suffer from injury during winter, but is much less susceptible to attacks from insects and fungi.

One great factor in the economical cultivation of the nursery is straight rows which are parallel and at uniform intervals,

This requires care at planting time only, while it facilitates ease and rapidity of culture during the whole period of growth of the stock. The distance between rows should admit the horse and cultivator, and yet be close enough to induce an upward rather than a lateral tendency of growth in the young trees. Four feet will, in general, meet these requirements.

Pruning. Under this heading, a few general remarks that have universal application to nursery practices are all that can be given as various plants, as well as the purpose which they are to serve, will determine the treatment they must have.

All root grafted apples are, as a rule, cut back to within a few inches of the top of the cion, at the beginning of the second season. Budded stock seldom or never requires this treatment, as the growth from the bud is usually greater than from the cion. Root grafted plums seldom require such severe treatment. Subsequent care is directed to removing lateral branches, allowing a single shoot only to grow. The ease with which this will be attained will be determined largely by the variety of trees grown. The habit of growth of different varieties is made of such moment by nurserymen that orchardists have great difficulty in obtaining some otherwise desirable varieties, simply because they do not make a straight, slightly tree in the nursery. No amount of pruning can entirely correct a poor habit of growth, but it may go a long way in that direction.

It must be borne in mind that the pruning done in the nursery is merely the elementary training of the tree, and the final form which each individual tree is to assume will, to a large degree, depend upon the part it is to take either in the orchard or kitchen fruit garden. The success of the latter pruning will, however, depend in great measure upon the care given in the nursery. Although somewhat outside of the province of the subject in hand, the reader will find under another heading in this bulletin, a brief consideration of the treatment to which a tree should be subjected at the time of planting in the orchard.

Propagation. Propagation of plants is the art of increasing

their number. Under this head we usually consider two processes—nature or natural and man's or artificial. Under the first caption—natural process of reproduction in plants, we find the following:

Natural processes of propagation.	{	1. Seeds.
		2. Root-stalks. -
		3. Stolons.
		4. Suckers or root sprouts.
		5. Bulbs.
		6. Corms.
		7. Tubers.

While under the artificial or man made process we find the following:

Artificial processes of propagation.	{	1. Cuttage.	{	1. Division	{	1. Hard Wood.				
				2. Cuttings proper.		2. Soft wood or herbaceous.				
		2. Layering.				3. Leaf.				
						4. Root.				
		3. Grafting.				5. Root Stalk.				
						6. Tubers.				
		{	Cleft.							
			Whip.							
			Veneer.							
			Saddle.							
			4. Budding.		Herbaceous.					
					Cutting.					
		{	Shield.							
			Flute.							
			Veneer.							
			Ring, etc.							

From the nature of the nurseryman's work he must be more or less familiar with all these varied means of increasing plants. The following is a brief consideration of the more important economic facts connected with each process.

NATURAL PROPAGATION.

Seedage. i. e., propagation of plants from seeds, is in most departments of our rural art a very easy operation. The nurseryman and florist, on the other hand, frequently encounter, just here, some of their greatest stumbling blocks.

For the successful germination of a seed, three conditions are

essential, in fact, all three must be present in order that the life processes in the seed be started. These are *heat, moisture, and free oxygen*. If any one of this trio be lacking, as has before been stated, germination will not take place.

With the cereal grains and most garden seeds, these conditions as they are given us during nature's growing season (spring time) are all that is necessary.

But with hard shelled and nutty seeds, as well as those having a delicate seed covering and low vitality, the conditions are different.

Seeds with hard shells or integuments, like the apple, peach, plum, acorns, etc, must be *stratified*, if they are to germinate readily at planting time.

Stratification is planting in the fall in its simplest form. Seeds of the character above mentioned are gathered at maturity and then immediately stowed away in boxes containing first a layer of sand, then a layer of seeds, then sand, and so on until the receptacle is filled. It is then placed, in the more southern latitudes, on the north side of a building or hedge, where it will freeze and remain frozen during all the colder portion of the winter. If the propagator is further north, he buries the box a few, or many, inches deep, according to the depth of the frost line in that locality.

The intention of this operation is to induce freezing and thawing once or twice during the winter and to overcome repeated freezing and thawing as well as too severe freezing. Bags are sometimes employed instead of boxes as receptacles for seeds to be stratified, but experience has proven that boxes are under all circumstances, to be preferred. In the case of walnuts or acorns, it is not necessary to take the trouble even to mix them with sand. When such seeds are to be handled in quantity, they may be piled in a broad, flat heap and slightly covered with forest leaves. It is best to select a sheltered place for such heaps, as in a young growth of timber or at the north of a hedge.

Planting stratified seeds in the spring should be given as

careful attention as the process of stratification itself. Large seeds should be screened out and dropped at proper intervals along trenches of suitable depth, and immediately covered with fresh earth. Exposure to sun and wind for a few hours after removing from stratification may cause the loss of what might have been a good stand of trees. Small fine seeds may be scattered with the sand along the furrow and lightly covered or tramped in.

Seedlings may be grown in rows or the seeds may be sown broadcast, but in all cases, except when the plants are to be budded instead of grafted, it is not necessary to sow the seeds in rows having the desired distance of the nursery row between them, as all root grafted and crown grafted trees, as well as many budded trees are transplanted once or twice before being worked. In our own State it is believed that seedlings should always be grown in rows instead of broadcast in seed beds.

Root Stalks. The nearest approach to the use of root stalks that falls within the work of the nurseryman is the propagation of blackberries from root-cuttings and root-sprouts. This is not

Fig. I.

a case of true root stalk propagation, but an approach to it. A case of natural propagation by root stalks is seen in Johnson grass and the other couch or quack grasses shown in Fig. I.

Stolons. Increasing plants by their ability to avail themselves of new territory by striking root at the end of the

Fig. II.

branches is of great economic importance to the nurseryman. Black raspberries and strawberries are exclusively propagated by this means. The black cap strikes root readily at the end of the shoot as shown in Fig. II, and strawberries Fig. III, throw out numerous runners which strike root at intervals along their course, and give a large increase per plant.

Layers. The distinction between layers and stolons, is that in the case of stolons, the act of striking root is wholly depend-

Fig. III.

Fig. IV.

E.H. parent plant.

Layering is a favorite method of multiplying woody plants, which strike root from cutting with difficulty. The Quince, Currant, Gooseberry are easily multiplied by stools which is a form of layering shown in Fig. IV. The grape is easily increased from layers made by burying a cane at intervals or throughout its whole length, roots and branches are thrown out at the nodes or joints and each one forming roots may be used as an independent plant by detaching it from the parent. Such a layer is shown at Fig. V. The growth of the young plants resulting from layering would not appear as represented in the drawing, but the largest plant would undoubtedly be the one farthest from the parent, and it

Fig. V.

might be the only one formed in the entire length of the layer, unless means of checking its growth were used so as to stimulate growth from the other buds.

E.H.

Suckers or Root Sprouts. The young shoots that spring up around blackberry, red raspberry, plums, pears, and many of our cultivated plants are good illustrations of this mode of reproduction.

In forestry this natural mode of reproduction is a favorite resource for certain lines of work, as the production of tan-bark, posts, and stove-wood, and is given the special name of the Coppice System of forestry.

Nursery practices are greatly facilitated by this natural tendency in plants which reproduce their kind true to variety. This is the case with all the red raspberries, and blackberries. Some plums also reproduce true to name in this manner.

Fig. VI.

Fig. VII

In general, seedlings and all plants that have been grown from cuttings will come true from root sprouts, if they reproduce in that way. Outside the bush fruits, however, this method of reproduction should be discouraged rather than encouraged. Nothing is more annoying to the orchardist and fruit grower than the persistent sprouting of some plants—the hazel and the blackberry are striking examples of

such nuisances; also some of the poplars when used as lawn trees.

Bulbs, Corms, and Tubers. Plants of this character, in general, form only an insignificant part of the work of the local or even the general nurseryman.

The seedsman and gardener has of late years largely assumed the cultivation of plants of this type. Illustrations of bulbous plants in which the local nurseryman may be interested are the various lilies, hyacinths, etc., a bulb is shown in Fig. VI.

Fig. VIII.

The *Corm* is exemplified by the bulb-like part of the Crocus, Indian Turnip, Cyclamen, Gladiolus Fig. VII, and *tubers* by

thickened subterranean parts of the common potato, Fig. VIII, and Jerusalem artichoke.

ARTIFICIAL REPRODUCTION.

The primary object of the nurseryman's business is to multiply plants, and secondly, to *perpetuate cultural varieties*. The most of the art then consists in the perpetuation of *cultural varieties*, for as we have already seen, nature has amply provided for the simple multiplication of plants. The artificial methods which we now have to consider are the chief resources of the nurseryman in the perpetuation of all desirable varieties of fruits. If it were impossible to continue the existence of a variety of apples through seeds, root sprouts, or some one of the natural processes of reproduction, that variety, no matter how desirable it might be, would be lost but for the resource found in the man-made processes of reproduction; and if these processes were taken from the civilized world to-day, the duplication of our large orchards, vine yards, and orange groves, made up as they are of only a few varieties, would be an absolute impossibility. The importance of these processes in modern horticulture is sufficient to justify a somewhat careful description of the simplest and most important of them.

Cutting. The process or operation of propagating plants by cutting is called *cuttage*.

A cutting is a detached portion of a plant inserted in soil or water with the intention that it shall grow.

In nursery practices, a knowledge of hardwood cutting, herbaceous cutting and root cutting will, in general, prove sufficient.

Hardwood Cutting. This term is interpreted as applying to cutting made from ripened wood of deciduous plants of the present or previous season's growth.

Plants that are usually propagated in this way are: grape, currant, gooseberry, willow, poplar, cranberry (not deciduous) and some conifers.

From a commercial standpoint this is one of the most important of the artificial methods of propagation, and when the great

number of plants of grapes, currants, gooseberries, poplars, and willows, all of which are propagated in this way, are taken into consideration, the pecuniary value of this method becomes evident. By no means the smallest merit of this method of reproduction rests in the ease with which horticultural varieties or sorts of plants can, by use of it, be increased. This as has already been stated, is the great merit of the artificial methods of reproducing plants.

The grape is usually increased from a two to three eye (bud) cutting. The cut at the base of the cutting is made close to the bud or eye, as is shown in Fig. IX., while the cut at the distal or upper end of the cutting is made at considerable distance from the top bud. The reasons for such practice are that the node represented by the bud at the base of the cutting is richer in root forming material than that portion of the wood between the buds or nodes called the inter node. The practice of leaving a portion of the inter node beyond the distal bud is not so easily explained and is founded more upon tradition than science, but it may be said with some degree of truth, that the long portion of the inter node left above the top bud prevents loss of moisture from that bud, and to that extent acts as a guard to the bud.

The cuttings as prepared are tied in bunches (butts all one way) of from 25 to 50. This is usually done while the wood is dormant during the fall and early winter, and as fast as made, the cuttings are buried, bottom end up, in a trench which places the top buds below dangerous freezing and exposes the butts of the cuttings to the action of frost and the stimulating influence of the sun as it warms the earth in spring. In this way natural influences are taken advantage of to produce the same result aimed at by the gardener in his artificially heated green house,—root action is stimulated by bottom heat, while the top buds are kept dormant by a lower temperature and the exclusion of light.

The currant is handled in like manner, except that currant cuttings are usually made about 8 inches long, regardless of the number of buds they contain.

As soon as planting time arrives,—the succeeding spring,—the cuttings which have been wintered as above described, are taken from the trench, the bunches broken, and the individual cuttings (Fig. X,) scattered along the side of a trench, in such a way that about 3 inches of space remains between each cutting and the topmost bud or buds remain at or above the surface of the soil. The soil is then placed upon the cuttings and thoroughly packed. It is as essential that the earth be firmed about a cutting as about a seed or tree.

Fig. X.
(After Fuller.)

Fig. XI.

Fig. XII.

FORMS OF HARDWOOD CUTTINGS.

The simplest form of hardwood cutting has already been described, in speaking of the grape and currant.

The Heel Cutting shown at figure XI consists of a portion of the present season's growth, containing from two to five or more buds with the shoulder of the branch attached. The enlarged portion of a branch at its point of origin from its parent branch, is found to be capable of developing roots, when used as a cutting, under conditions when other portions of the same branch would give an indifferent plant or none at all.

Mallet Cutting. The name of this form is suggestive of its shape. It differs from heel-cutting in that a portion of the

parent branch, from which the one used for a cutting took its origin, is retained at the base of the cutting. This form is shown at Fig. XII. It is of especial importance where the present season's growth is too soft to make a satisfactory cutting, and also in those cases where the plant is inclined to be indifferent to propagation by cuttings. Its merit consists in having a portion of thoroughly mature wood at its base, together with the shoulder which constitutes the chief value of the heel cutting. In both the heel and mallet cutting, the store of cambium about the shoulder and the node from which the lateral branch had its origin is believed to be the explanation for the higher percentage of success in the use of cuttings of this class.

There is a serious drawback to the commercial use of these forms of cuttings because a single heel or mallet cutting is all that can be taken from a lateral branch, no matter what its length. For this reason they become expensive, and the exclusive use of these styles for the propagation of plants on a large scale is impracticable.

Single Eye Cuttings. These differ from the simple cutting described above only in length, each bud is so treated that it becomes an independent plant. When mature wood is used, such as that of the grape, Fig. XIII, single eye cuttings are packed away in barrels of sand to callus. When this is successfully accomplished, they are then placed in cutting beds, either under glass or in the open, the cuttings being placed either in a reclining position with the buds up and covered with one inch of sand, or in an upright position with the buds buried about an inch below the surface, as

Fig. XIII. ^{EH} in the former case. This is, as will have been noticed, the most economical method of multiplying plants by cuttings, and when it is desirable to produce a large number of plants from a limited supply of wood, this is the propagator's only resort. It is in its field as economical as budding in the art of grafting.

HERBACEOUS, SOFT-WOOD OR GREEN-WOOD CUTTINGS.

This class of cuttings is represented by the familiar example of the *slip* used by all flower lovers to increase house-plants. Commercially, this style of cutting is of quite as much importance as the hard-wood cutting. All greenhouse plants, including roses, carnations, geraniums, chrysanthemums, fuchsias, etc., are increased by this process. The chief advantage of this operation over the preceding is that it can be used during the winter months, while the plants are under glass. With some plant-men, the business of growing plants in this way demands the erection and maintenance of extensive glass structures, and the employment of numerous skilled laborers. Near the larger towns and cities, the propagation of decorative plants for use upon lawns and in parks becomes a very remunerative business.

Fig. XIV.

Herbaceous cuttings may be made from leaf, stem, or root.

Leaf Cuttings are commonly employed in multiplying Hoyas, Begonias, and plants possessing thick, fleshy leaves containing

Fig. XV.

a large quantity of food material, either in the body of the leaf, or its larger ribs. Such cuttings may be made from a portion

of the leaf, as shown in Fig. XIV, or it may employ the whole leaf, as in Fig. XV. In either case the essential for success is a mature leaf from which to make the cuttings. The leaf should have reached its full development and be in an active, healthy condition; leaves beginning to show signs of decay should be avoided. After the proper leaf has been selected from which to prepare the cuttings, the next essential is to have a suitable bed in which to root the cuttings. For this purpose fine, clean creek gravel or sand is preferable. Soils containing large quantities of decomposing organic matter are to be avoided, and sand containing quantities of clay and dirt are less desirable than that which is water-washed, or artificially prepared by crushing sandstone. For use during the winter months, a few degrees of bottom heat will be found an advantage to cuttings of most plants, while others cannot be induced to strike root without it; and still others require a close atmosphere about the top, as well as bottom heat.

Fig. XVI.
(After Fuller.)

E.H.

A Stem Cutting or Slip is a portion of a branch containing two or more nodes with leaves attached as shown in Fig. XVI. The coleus, geranium and allied plants strike root so readily from cuttings of this character that the following caution, which is of considerable importance with many leafy cuttings, hardly needs to be mentioned. In preparing herbaceous cuttings the leaf area should

be reduced to a minimum, in order to lessen the demand upon the stem for water. A reduced leaf area partially overcomes

the necessity for a confined atmosphere, by lessening the total evaporation and the consequent danger of flagging or wilting.

Bottom heat is supplied to the cutting bed or frame preferably by hot water or steam pipes beneath the bench upon which the sand has been placed.

Depth of sand varies with the plants to be propagated, but usually an inch of clinkers or finely broken stone or coarse gravel for drainage overlaid by $1\frac{1}{2}$ to 3 inches of sand, will be found amply sufficient for all soft wood cuttings.

Damping Off. Young seedling plants as well as cuttings frequently turn black just at the surface of the soil and soon die. This is called "damping off." It is caused by a fungus which is capable of remaining in the soil or sand of the seed bed or cutting frame for a considerable period. A frame once infested with this disease should have the sand removed, the inside carefully scrubbed or whitewashed, and clean sand used to replace that thrown out. This renovation should be carried out, at least once a year, even in houses not troubled by this disease.

Confined Atmosphere. With cuttings which have thin leaves liable to wilt easily or drop off and endanger the vitality of the cutting, a confined atmosphere over the tops is required. The case is the same with herbaceous cuttings requiring a long period in which to form roots, or those from soft wood which suffer from exposure. Such a device can be arranged by partitioning off a portion of the cutting bed and placing over it an independent sash. Provide a tight frame to support the sash, of sufficient height to give room for the plants to be grown in it. The object of this device is, as has been stated, to prevent too rapid evaporation, until the detached portion shall have developed a root system sufficient to support its leaf area. The simplest form of this device is the bell glass, and this is yet used in private places for propagating limited quantities of some of the more tardy rooting plants. Many other devices are used for hastening the development of roots upon cuttings; here, however, only the simpler contrivances have been mentioned.

GRAFTING.

Grafting. "Grafting is the process or operation of inserting a cion into a stock."

Cion or Scion, "a portion of a plant inserted upon the same or another plant, with the intention that it shall grow."

The wood for cions like that for hard wood cuttings must be taken while in a dormant or resting condition. The time usually considered best is after the leaves have fallen, but before severe freezing begins in early winter. The cions are then tied in bunches and buried in moist sand where they will not freeze, and yet be kept cold enough to prevent germination. Good results often follow cutting cions in the spring just before or at the time the grafting is to be done. If cleft-grafting is the style to be employed, this practice frequently gives good results, but spring cutting of cions for whip grafting i. e. root grafting, is not desirable, as not enough time is given for proper healing of the wound before planting time in the spring.

Were all forms of the art of grafting to be taken from the horticulturist to-day, commercial fruit growing in its high state of perfection would decay with the orchards now standing.

All horticultural varieties or sorts of fruits belonging either to the pomes, drupes, or citrous classes, are now multiplied by budding or grafting. These arts are really the corner stones upon which the entire horticultural superstructure of to-day rests. The progress in plant-breeding and the great rapidity with which new sorts are now disseminated, could not be attained without

Fig. XVII.

the aid of budding or grafting. Under existing conditions, it is not necessary for the originator of a new sort of apples to give any thought to the question of fixing that type so it may be reproduced from seed; the method of reproducing the sort

does not enter as a factor in his efforts to secure the desired variation. Grafting or budding has settled that long ago, but were it otherwise, horticulturists would be studying different problems, and the nurseryman would be more of a scientist than a manufacturer.

Cleft Graft. This style of graft is particularly adapted to large trees when for any reason it becomes necessary to change the variety. Branches too large to be worked by any of the methods hereafter described can be grafted by this method.

A branch 1 or $1\frac{1}{2}$ inches in diameter is severed with a saw. A second cut should generally be made a few inches below the first one in order that the bark shall not be loosened from any portion of the stub. Split the exposed end with a broad, thin chisel or implement such as shown in Fig. XVII;

then with a wedge or the wedge shaped prong at the end of the grafting tool,

spread the split stock so the cions shown at Fig. XVIII may be inserted. The completed operation is shown at Fig. XIX.

The cion should consist of a portion of the previous season's growth of the variety to be propagated, and long enough to have two or three buds. In general, it is a good plan to cut the cion so that the basal or proximal bud shall be located just at the base of the opening of the triangle formed in cutting the cion into the wedge shape necessary in this style of graft. The situation of the bud is shown at *a*,

Fig. XVIII. In addition to the advantage of having the proximal bud located as above

Fig. XVIII. *E. H.*

Fig. XIX.

above described, the wedge of the cion should be made thicker on the side to face outward when the cion is in position as

shown at *b* Fig. XVIII. The advantage of this will be noted from Fig. XX, which shows how the pressure of the stock is brought upon the outer growing parts of both cion and stock, whereas, were the cion thicker on the inner side the conditions would be reversed and the death of the cion would follow; there would be no flow of sap from stock to cion, as the contact would be between heart-wood and growing wood, instead of between two growing layers. The importance of having an intimate connection between the growing tissues of both cion and stock cannot be too strongly emphasized, for upon this alone the success of grafting depends. To make this contact of the growing portions doubly certain, the cion is often set at a slight angle with the stock into which it is inserted, in order to cause the growing portions of the two to cross.

Fig. XX.

Grafting Wax. In this climate a soft wax is not desirable for exposed work. Soft wax may be used in whip-grafting, but in cleft grafting where all wounded surfaces are exposed to the weather, a hard wax, made by melting together five pounds resin, two and a half pounds bees wax, and one-half pound of tallow or one-half pint linseed oil, is preferable.

Waxing is quite as important as a proper adjustment of the cions. This consists in covering all cut or exposed surfaces with grafting wax, grafting clay, or some non-corrosive substance which will exclude air and moisture. The wax may be applied hot, with a brush, but the safest plan is to spread it with the hand while it is only sufficiently heated to allow it to be worked like taffy. If spread carefully over all cut surfaces and pressed closely, upon cooling it will form a sleek coating quite impenetrable to air and moisture.

Waxed String. The wax for this purpose should be a softer wax than that to be used on parts above ground, hence the following is preferred; Resin 4 parts by weight; beeswax 2 parts; tallow 1 part. Heat until all parts go into solution, then pour into a pail of cold water. Work in the hands until all lumps have been softened and the mass is of uniform consistency. This will be found to be an excellent wax for cool climates, as

well as a superior one for soaking knitting cotton to bind stock and cion together in whip, saddle or veneer grafting. Melt a portion of the wax above described in a convenient receptacle and dip a ball of No. 18 knitting cotton into the molten wax, leaving it long enough to become thoroughly soaked; remove to allow it to cool and the waxed twine is ready for use. If preferred, strips of muslin or other light cloth can be soaked in the molten wax and used as a substitute for the waxed cord. In general, however, it is believed that the waxed knitting cotton will be found most convenient.

Whip Grafting. This style of grafting is the one most universally used in root-grafting. It has the advantage of being well adapted to small plants only one or two years of age, as well as the other great consideration that it can be done indoors during the comparative leisure of winter.

The graft is made by cutting the stock off diagonally,—one long, smooth cut with a sharp knife, leaving about three-fourths of an inch of cut surface, as shown in Fig. XXI, which is ideal.

Without changing the stock, place the knife about one-third of the distance from the end of the cut surface, at right angles to the cut, and split the part in the direction of its long axis. Cut the reverse end of the cion in like manner, as shown in Fig. XXII, and when the two parts are forced together, as shown in Fig. XXIII, the cut surfaces will fit neatly together and one will nearly cover the other, if cion and stock are of the same size. A difference in diameter of the two parts to be united may be disregarded, unless it be too great. After the cion and stock

Fig. XXI

Fig. XXII

have been locked together as shown in Fig. XXIII, they should be wrapped with five or six turns of waxed cotton, in order that the parts may be held firmly together.

The root or stock may be left any convenient length from 2½ to 6 inches, and the cion cut accordingly. In general, the shorter the root the longer the scion and vice versa. The practices of the more rigorous climates tend to short piece roots and long cions. At planting time the whip graft, when used upon small stocks, should have the cion covered as well as the stock, the topmost bud of the cion, if any, left above the soil. If the graft is to be exposed, it should be covered with waxed muslin, or with the harder wax above described. When deeply planted either in a furrow or with a dibble, the waxed cotton will be ample.

BUDDING.

Budding. There are numerous styles of budding, but here the one in most common use will be described.

Budding is one of the most economical forms of artificial reproduction, and each year witnesses its more general use. Some nurserymen have gone so far as to use it as a substitute for all other modes of grafting, save whip-grafting, in the propagation of the dwarf pear. Budding is economical in the amount of wood used from which to take buds or cions. In this method a single bud does the work of the three or more upon the cion of the cleft or whip graft. But while it is economical of wood, it is expensive in the use of stocks, a seedling being required for each tree, while with the piece root system of grafting, two, three or more stocks can be made from a single seedling. The operation is simple and can be done with great speed by expert budders. The expense of the operation is, therefore, not more than that of whip-grafting, although the work has, usually, to be done in July, August, or early September. The usual system is for a man to set the buds, he being followed closely by a boy who does the tying.

Budding, then, is the operation of inserting a bud or bud cion into a stock. This is literally true, as the bud is usually inserted under the surface of the bark of the stock, as is shown in Fig. XXVIII.

Fig. XXV.

Fig. XXVI.

E H

Fig. XXVII.

E. H.

The Bud is taken from wood of the present season's growth. Since the work of budding is usually done during the season of active growth, the bud sticks are usually prepared so that the petiole or stem of each leaf is left attached, to serve as a handle to aid in pushing the bud home when inserting it beneath the bark of the stock. A bud-stick is shown in Fig. XXIII., and a detached bud

Fig. XXV. A.

Fig. XXV. B.

NOTE—Figures 20, 21, 22, 23, 24, 25 a, and 25 b, from Thomas' American Fruit Culturist, by permission of publishers, Wm. Wood & Co.

ready for use in Fig. XXV. This is what is usually called a shield bud, and is cut so that a small portion of the woody tissue of the branch is removed with the bud. The operation of cutting the bud is illustrated in Fig's. XXV., A and B.

The stock for budding should be at least as thick as the ordinary lead pencil. With the apple and pear a second season's growth will be necessary to develop this size, while with the peach, a single season will suffice, i. e., peach stocks can be budded the same season the pits are planted; consequently the peach is left until as late in the season as is practicable in order, to obtain suitable sizes of stock.

The height at which buds are inserted varies with the operator. In general, the nearer the ground, the better. The cut for the reception of the bud is made in the shape of a letter T, see Fig. XXVI. Usually the cross-cut is made at a slight angle with the body of the tree, instead of at right angles to it, and the stem to the T starts at the cross-cut and extends towards the root for an inch or more. The flaps of bark caused by the intersection of the two cuts, Fig. XXVII, are are slightly loosened with the ivory heel of the budding knife, and the bud, grasped by the leaf stem as a handle, is placed under the flaps and firmly pushed in place, until its cut surface is entirely in contact with the peeled body of the stock. See Fig. XXVIII. A ligature is then tightly drawn about, above and below the bud, to hold it in place until a union shall be formed. Such a bandage is shown Fig. XXIX. Bands of raffia about 8 or 10 inches long make a most convenient tying material. As soon as the buds have united with the stock (taken) the ligature should be cut, in order to prevent girdling the stock and bud. This done, the operation is complete until the following spring, when all the trees in which the buds have taken, should have the top cut off just above the bud, as is shown in Fig. XXX in which the upright shoot represents the growth from the bud. This forces the entire strength of the root into the bud, and since the root itself had not been disturbed by transplanting, a more vigorous

E. H.

FIG. XXVIII.

E. H.

FIG. XXIX.

E. H.

FIG. XXX.

growth usually results from the bud than from cions in whip or crown grafting.

The one objection to budding is that it causes an unsightly crook in the body of the tree, unless the tree is planted deeply enough in the orchard to cover the deformity. In rigorous climates, where trees upon tender roots are likely to suffer from severe winters, a bud of a hardy sort upon a tender root is no hardier than the root, because budding leaves a portion of the stock exposed above the surface of the soil and thus precludes the possibility of the development of roots from the portion above the bud; while a piece root grafted tree with a long cion is practically the same as a tree propagated from a cutting, as the cion will strike root and the new plant will be upon its own root. In regions where severe winters do not enter as a factor, there is undoubtedly a number of reasons why budding will be the most desirable method of reproducing horticultural varieties.

PRUNING AT PLANTING TIME.

As has already been remarked. the ease of after training of a tree is, to a great extent, determined by the treatment it has re-

ceived during its life in the nursery. Important as this early training is, the care and management of the tree at and after planting time, more emphatically determines its value to the orchardist.

The growth made during the first three years by young trees transplanted from the nursery, to a large measure, determine the later value of the orchard as a fruit producer, as well as the length of its life. Aside from cultivation, there is no one operation connected with the maintenance of young trees which so largely determines these after conditions as *pruning*.

Just here it is pertinent to make a distinction between *pruning* and *trimming*.

Pruning is the removal of dead or superfluous parts, or cutting to correct a bad habit of growth.

Trimming is the removal of parts, in order to induce growth in a certain direction, so that the plant may be made to assume a form different from that natural to it.

Pruning is practiced by the orchardist in removing crossing twigs, shortening or heading in peaches, etc.; while trimming is what the vineyardist practices when he cuts his vines into desired form, in order that he may train them in a given manner. Another example of trimming, by far too common in this country, is the fantastically shaped evergreens and hedges of various sorts.

Pruning is a corrective art, while trimming is directive. At planting time both these operations are brought to bear upon the young tree. The roots are pruned, all broken and torn portions are cut away, any dead or superfluous parts are also removed. The top, however, frequently requires severe trimming. The balance between root area and the number of branches as, as well as their extent, should be carefully guarded. It is better to err on the side of too little top expanse, than on the side of too small a root area. The root system of a tree is comparable to the boiler of an engine. A 20 horse power engine with a 10-horse boiler is capable of doing only partial duty, so a tree lacking roots is only capable of making a feeble growth when the demands of the branches cannot be fully

met. An insufficient food system means a partial food supply, lack of moisture, weak and unsatisfactory growth which invites the attacks of insects and fungus diseases.

Good culture and rational pruning will overcome such drawbacks, when good stock is at hand to begin with.

Trimming the Top. If the whole of the top carried by a tree as it stands in the nursery were to be retained when it is planted in the orchard, the lessened root surface, together with the unsettled condition of the roots, would soon prove that the balance between root and top had been interfered with, and that the tree was top-heavy. The demand of the expanding leaves and growing branches would soon prove too great for the reduced and disturbed root system. To overcome this difficulty is one of the primary objects of trimming, but where this is the only motive, the operation would fall quite as naturally under the category of pruning as of trimming. The height of the head, as well as the number of main branches, of the future tree is determined by trimming at planting time. An apple tree, as it came from the nursery, is shown at Fig. XXXI. The root system is ample, but somewhat deformed; the branches are of moderate growth, but too much like whips in character, and there are more of them than we desire the tree to bear in the orchard. As shown in Fig. XXXII, the deformed portion of the root system has been cut away, and superfluous branches removed; the three retained, shortened to about 8 or 10 inches in length.

The branches retained to form the head, it will be noticed, are distributed equi-distant about the trunk, and at different heights upon it. A line drawn through the ends of these branches would describe a circle, and the points where the branches touch the circle would divide the arc into three nearly equal segments.

The novice may think three to be far too few branches, but it will be found amply sufficient, if growth during later years is properly directed.

How shall the cut be made in removing these branches?

Fig. XXXI.

Fig. XXXII.

This is a much more pertinent question than at what season shall the cut be made, although in removing large branches from old trees, the season becomes a much more important consideration. Cut as close to the point of origin as possible. Do not leave a stub, as it will die back, decay will follow, and injury may be done to the heart-wood which will result in premature death to the tree. Figure XXXIII shows the attachment of a branch to its parent branch. The enlargement

Fig. XXXIII.

which braces and strengthens it is very noticeable. Beside the function of giving greater strength to the angle of the branch, it is found that if the cut in removing the branch is made through this enlargement, decay seldom follows, while the wound quickly heals. If, however, the cut is made one or more inches from this enlargement decay is sure to follow and the

rotting heart-wood of the dead branch carries its injuries past the enlargement at the base of the branch on the heart wood of the parent. This opens a suitable entrance for destructive insects, as well as invites birds that nest in such hollows. The result of all this is that the decay which was originally set up by a careless tree pruner is being aggravated constantly by these outside agents, and the period of usefulness of the tree lessened.

Small wounds heal more readily than large ones.

Never remove large limbs unless it is necessary.

Prune while the cut can be made with the pruning knife, and the injurious results of rot and insect depredations can be avoided.

L. C. CORBET.