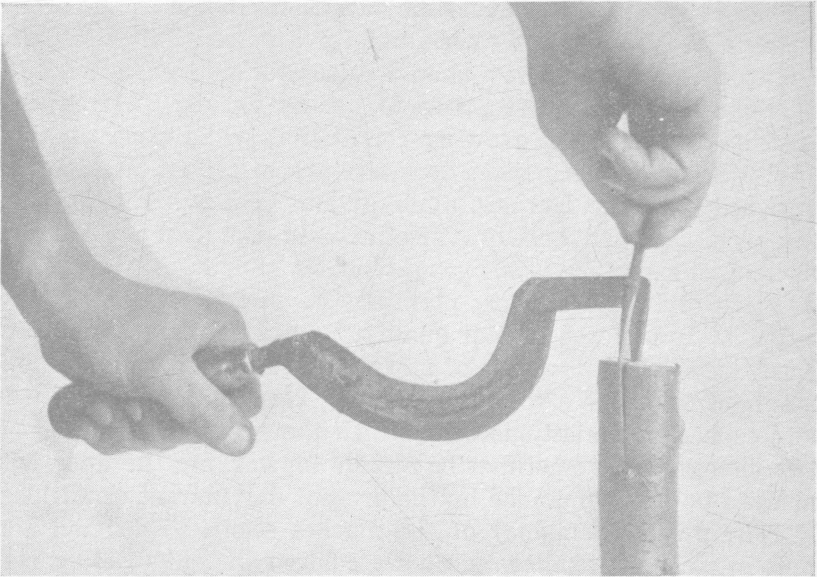


Grafting and Budding in the Orchard



Inserting the scion into the cleft. Note that scion is cut into a wedge and is inserted so that the cambium layer comes into contact with that of the stock.

Grafting and Budding in the Orchard

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Fruit growers of today seldom graft or bud young trees when they set out an orchard. They buy such trees all ready made for planting, but as the trees grow, they often find it necessary to change some kinds over to new varieties.

A good example of the use of grafting in Ohio orchards is where the Stayman is set in large blocks. If Stayman bloom does not have access to any but Stayman pollen, small crops are produced because of improper pollination. Bloom from other varieties such as the Grimes or Yellow Transparent must be placed all through the orchard to correct the condition. Bloom can be brought in temporarily in jars of water, but for a permanent relief, every fifth tree in every fifth row should be topworked by grafting.

Some trees may not prove to be the variety ordered; some may not suit the local growing conditions; while others may not supply the changing market demands properly. In Michigan this happened with the Duchess apple and in Ohio with many of the long-keeping, poor quality varieties. In the case of Michigan Duchess, the change was brought on by improvements in transportation and by the heavy plantings of early apples in southern districts. In the case of poor quality, long-keeping varieties, it was caused by the increased use of storage facilities where more apples were kept to compete with the old, long-keeping sorts. Both cases were caused by conditions over which the grower had no control. Both changes can sometimes be met by topworking the undesirable varieties to ones demanded by the present day market conditions.

The present tendency of the market seems to demand a red apple in place of a yellow or poorly colored one. As red sports of desirable varieties are developed, they can be often used for topworking. Examples of such color are the Starking, a Delicious of more solid red color; the Gallia Beauty or Red Rome, a Rome Beauty of high color; Red Stayman; and Red Spy.

Trunk diseases or weaknesses like the collar rot of Grimes can be overcome by topworking. A variety known to be resistant to trunk troubles can be planted and the desired sort topworked at a point high enough to escape collar rot, winter injury, or sunscald. This type of a tree can be bought from some nurseries as double worked trees. It can also be secured by the grower by planting the hardy trees and topworking them in the orchard.

GRAFTING

SELECTING THE SCIONS

The scion is a piece of live wood, which is used for grafting, and bears buds of the desired variety. Scions are cut from last year's growth at the ends of the branches, which may be distinguished from the older wood by the presence of buds along its entire length and by a ring of bud scars at the point where it



Fig. 1. — Grafts may be used as braces to tie in two limbs that may have a weak crotch. Shoots *a b* and *c d* are braces.

joins the growth of the previous season. Shoots of medium growth should be selected for the scions. In the case of an apple, this would be a shoot that grew about twelve inches the previous season. Those that grow extremely long or short, have small buds that are not very vigorous. It is the large buds that develop into strong growth.

Cut the scions in the winter when *absolutely dormant*. Make them up into bundles of even length, cover with moist sand or sawdust, and store in a root cellar, ice house, cold storage, or bury on the north side of a building.

Keep the sand or sawdust moist so that the wood does not dry out, and hold the temperature constant at about 32°F. Satisfac-

tory results can be secured if the scions are cut during the late winter or early spring, but it is quite important that they should be absolutely dormant. They can, sometimes, be cut in the spring and grafted immediately but the period during which grafting may be done is then much shorter than when the scions are cut and stored.

TIME FOR GRAFTING

Make the grafts just before the plants start their growth in the spring so that the scions will be in place at the beginning of the period of most active growth. If they are inserted too early, there is danger of drying out; if they are inserted too late, a poor union and small set results. The buds on the scion must be dormant or they will have no stored-up food to start growth while the union is being made.

If the bud sticks are cut in the spring and grafted immediately on the tree, there is only a very short time when conditions are just right. If they are cut early and properly stored the work can be carried on over a longer period of time. Consequently, if grafting is to be done on a very large scale, it is necessary to prepare the scions in the fall or winter. If only a few trees are to be done, the scions can be cut and inserted immediately.

GRAFTING WAX

For a good grafting wax the following formula is easily made and is satisfactory:

Rosin	4 pounds
Beeswax	2 pounds
Linseed oil or tallow.....	1 pound

Pulverize the rosin, melt the three ingredients together, and stir constantly to prevent the mixture from becoming lumpy. When all the material is thoroughly melted and mixed, pour it into cold water. Grease the hands thoroughly and pull the wax like taffy candy until it becomes light colored and all the water is worked out. It can then be stored in oiled paper. When needed it can be softened in warm water. It can be applied, after melting, with a paint brush; or if the weather is not too cold it can be kept soft by constant working in the hands of the person who is putting on the wax.

Recently, satisfactory results have been secured by using common paraffin wax such as is used by the housewife in sealing jars of fruit.

KINDS OF GRAFTS

CLEFT GRAFT

Where it is desired to graft on a rather large stock, the common method employed is the cleft graft. This may be used on wood up to about two and a half inches in diameter. It is commonly used for topworking trees in the orchard.

The branch to be grafted should be cut off, leaving the stub about one or two feet long. Make the cut at right angles to the limb. It is important that the stub be long enough so that if the graft does not grow successfully, another cut may be made back into green wood and new scions inserted the following season.

Split the stub with a grafting tool or hatchet, wedge open wide

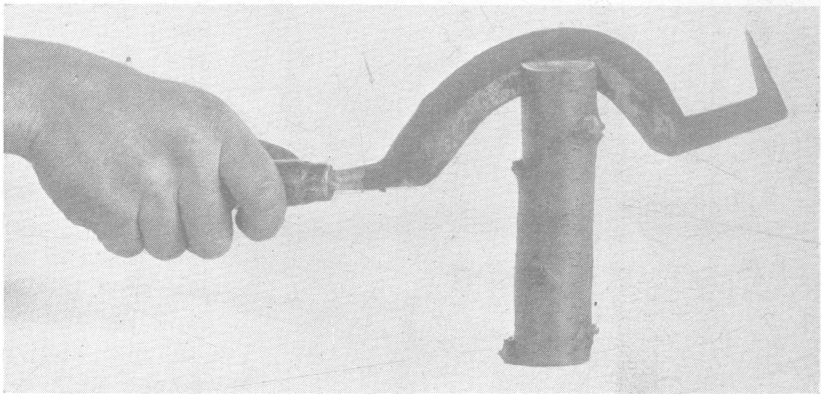


Fig. 2. — Splitting the stock for the insertion of a scion. Note tool used. This one was made from an old file.

enough to receive the scion tightly; and trim the bark to smooth surfaces with a sharp knife.

Select two scions about the size of a lead pencil, with a good bud near the lower end of the scion. On each side of this bud make a long, downward, draw cut to form a wedge at least one and a half inches long. Cut to make the wedge a little wider on the outside than on the inside to insure good bark contact when inserted in the cleft. Cut off the scions just above the third bud.

Insert the two scions in the split stock so that the cambium layer of the scion touches the cambium layer of the stock in as many places as possible. This cambium layer is that green, slippery tissue of the inner bark so well known to every boy who has made a willow whistle. It is the active growing portion of all wood, which makes the first union in the graft.

When the location and the importance of the cambium layer is considered, it can be easily seen why the scion is cut in the manner recommended. One edge is left wider than the other and placed on the outside of the graft so that there will be no chance of the cambium layers being held apart.

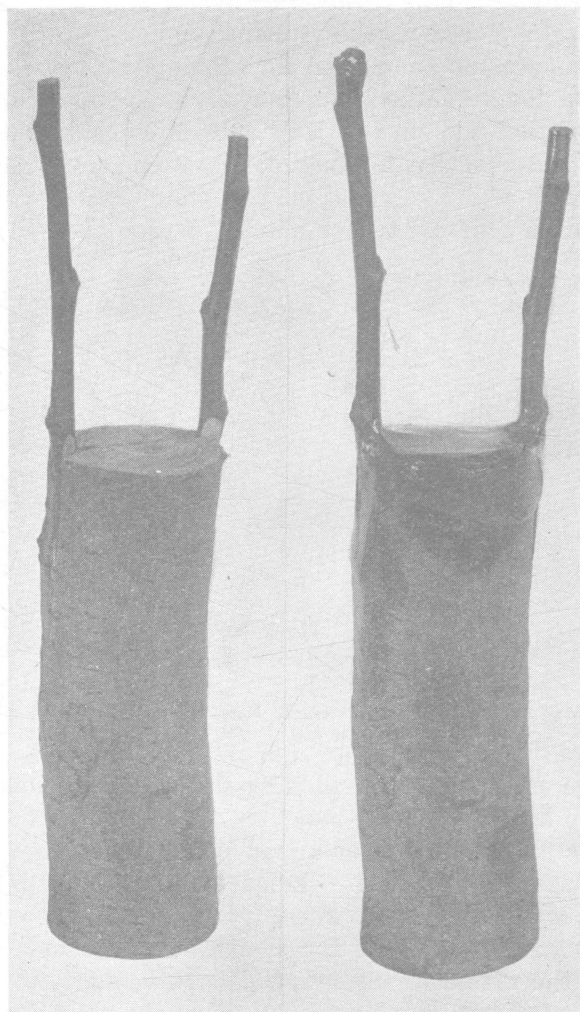


Fig. 3. — The cleft graft before and after waxing.

On the exposed portions of the stock, the scions should be covered with grafting wax to prevent drying. Wax should be put on the split of the limb, at the side, over the end of the stub, and on up a short way over the scion, covering all cut surfaces. Place wax on the tips of the scions where they have been cut off. Strips of old muslin or similar cloth may be wrapped around the waxed parts to hold the wax in place in hot weather.

THE WHIP OR TONGUE GRAFT

Where the stock and scion are about the same size, the whip or tongue method of grafting is employed. This is the common method with small trees, and is used by the nurserymen for propagation purposes.

Select the scions as in the cleft graft and make a long, slant-

ing cut on both the stock and scion. Use a sharp knife and make each cut with one draw. The cuts on both pieces should be at the same angle so that they will fit together evenly.

A narrow tongue is then made into the middle third of the cut on both the stock and the scion (see Fig. 5). Insert the tongue of the scion into the cleft of the stock, taking special care to have the cambium layers together in as many places as possible. If the two pieces are not exactly the same size fit the cambium layers of one side leaving the other side to meet as it may.

Tie the stock and scion with several tight wraps of waxed knitting cotton to strengthen the union, after which thoroughly wax the entire graft. The waxed knitting cotton is prepared by dropping a ball of cotton into boiling grafting wax and leaving it there until it is thoroughly impregnated.

In propagating new trees for the nursery row, this union with the root and scion is made so that it will come just below the ground line. Recent investigation seems to indicate that this



Fig. 4. — This satisfactory growth is what should be secured the first season, after making a cleft graft as in Fig. 3.

type of a graft on nursery trees is responsible for more galls and malformations on the roots than where a bud or wedge graft is used. The exposed cuts either do not heal properly or they permit the entrance of disease. In either case, a gall is produced which hinders the proper function of the roots. Some of this trouble is avoided by budding, by making a wedge graft, or by using the whip and tongue graft only for work above the ground.

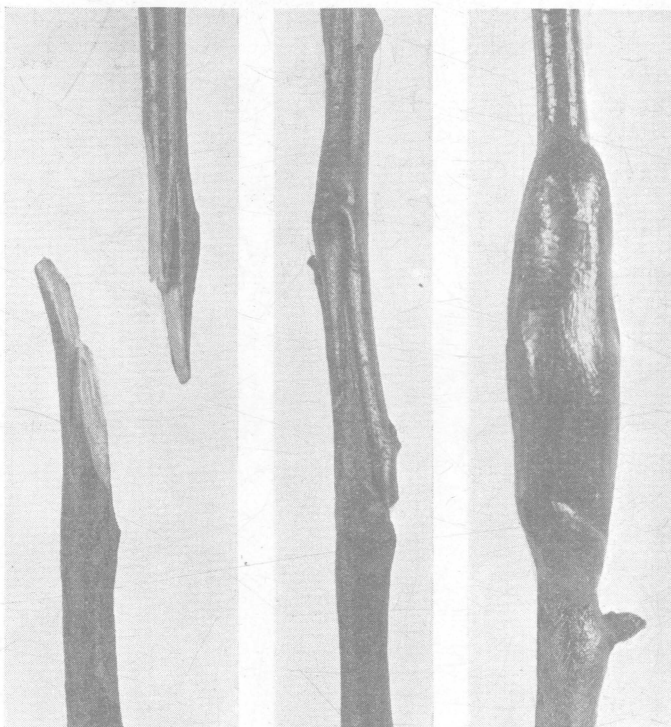


Fig. 5. — The whip and tongue grafts, commonly used for small branches.

BRIDGE GRAFTING

Trees damaged at the base of their trunk by weather, disease, or rodents can frequently be saved by bridging over the wound with grafts. The process is known as bridge grafting, and is merely another application of the principles used in any grafting. The work must be done in the spring before the damaged area has had a chance to dry out. Then the scions catch and carry the sap over the damaged area where it could not go through.

If the damage goes through the bark to the hard wood, clean out the wound and make all the surfaces smooth to enable quick healing. Then paint the exposed portions with white lead and raw

linseed oil. If live bark remains in the damaged area, cover with grafting wax to prevent drying out.

Cut the scions long enough to span the wound, with each end made into a wedge. Slit the live bark of the trunk and insert the wedge on each end into a cut so that there is a slight spring in the scion. Take care that the cambium layers of both the stock and scion come into contact as much as is possible. *Nail in place with a small brad and wax all exposed portions.*

Do not attempt to bridge a wound in any but an upright manner, as any scions in a horizontal position make very slow growth, and in any direction between a horizontal and upright they usually grow in direct proportion to the approach of the vertical.

The grafts will grow with the tree and if they are placed close enough will completely cover the wound in time.

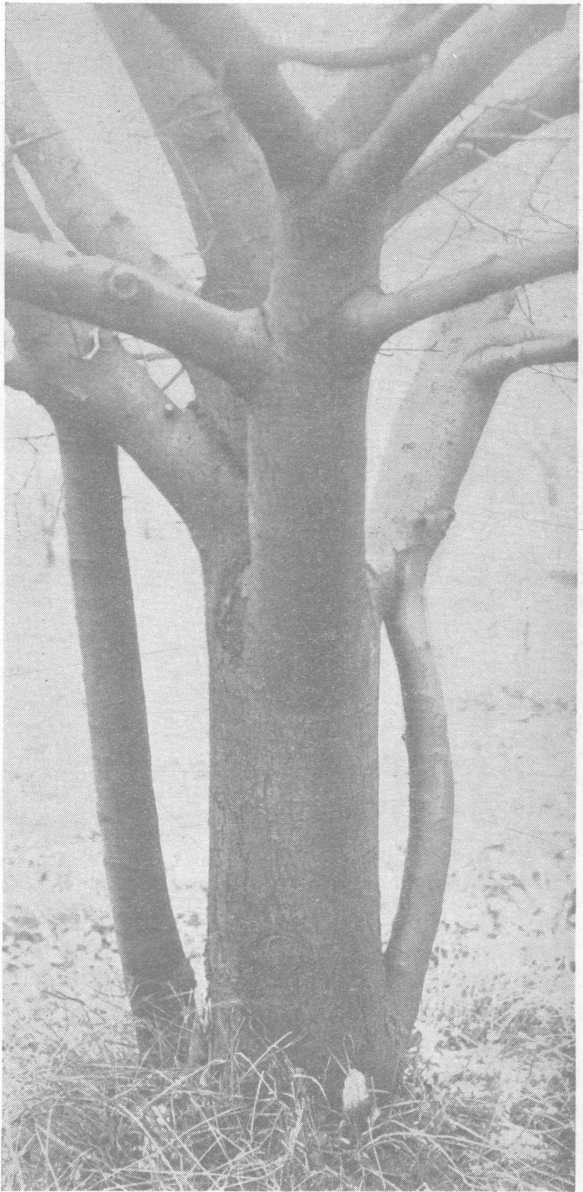


Fig. 6. — Bridge grafts after several years' growth used to bridge a wound.

The number necessary depends upon the size of the wound and the age of tree, but usually two or three inches apart is about the right space between them.

INARCHING OF NURSE TREES

Where trees are seriously damaged in the roots by disease or injury, they can sometimes be saved by inarching nurse trees. Select a good, strong, vigorous tree, one or two years old, in the nursery row, and plant it at the base of the injured trunk. Inarch the top into the trunk just at the base of the scaffold limb as in



Fig. 7. — Nurse trees planted at the base of the tree when roots are dying. Note that nearly all the bark on the trunk is dead at "a." These nurse trees have been in for two years.

bridge grafting. The number of trees needed will depend upon the injury.

A common application of this practice is in the case of trees affected with collar rot. The Grimes apple tree is often so seriously infected with this disease that first one tree and then another will yellow up and die when the orchard should be at its most productive age. Such trees can be saved if they are supplied with nurse trees as soon as possible after the first signs of the trouble appear.

CARE AFTER GRAFTING

The subsequent care of a young tree after grafting is very simple. The limbs are cut; the scions are inserted; and the whole top is changed over in one operation. Its care is then about the same as for any other tree that has received a heavy pruning.

The care of mature trees after grafting is more difficult. Only a part of the limbs are cut for grafting. Others are left to furnish the leaf surface that provides food and protection from sunscald. As the new grafts grow they replace the old top which is gradually cut away.



Fig. 8. — Note vigor of these trees being fed entirely by nurse trees.

Too much top will cause excessive shade and a resultant poor growth of the scions. Too small an amount will allow sunscald and a poor healing of the wounds. The happy medium is desirable and can soon be realized by a little experience.

At grafting time remove all branches around each scion to prevent shading. Then during spring and summer prune off the old wood at several intervals so that the grafts are not shaded by any new growth.

In following out this method there will be little danger of sunscald, but there will be a tendency to leave too much wood and

cause shading. Experience will soon show the right amount, and the beginner would do well to leave a very large opening around and above each scion inserted.

Prune off all the old wood on most trees the second year after the grafts are set. Set what additional scions may be needed, leaving the tree so that all subsequent growth is that of the new variety. In a few cases sprouts will spring from the old wood. Remove these as soon as they appear. If they come into bearing, the tree will be bearing two varieties of fruit, which is undesirable in the commercial orchard.



Fig. 9. — A young tree topworked after one season's growth, showing proportion grafted and amount of top left to carry the tree.

PRUNING THE GRAFT

Nearly all grafts grow vigorously, form long, leggy limbs with few side branches, and result in a tall tree with upright limbs and a poor spread. They can be properly trained by pruning.

Head back the excessively long shoots to insure low branching. Thin out around the short ones so that they have plenty of room to develop. Where two scions are in the cleft, prune one short and the other long, so that the resultant growth will be unequal, mak-

ing a strong crotch where a weak one might easily develop. Remove the smaller graft only after healing has completely taken place and decay cannot start in the wound or cause trouble.

Little attention need be paid to which one of the two shoots is to be removed unless one grows faster than the other or has some natural advantage because of its position. Then the weak or poorly placed growth may be cut back and later removed.

Pruning beyond this point will proceed as it would for any normal tree. Thick places should be thinned out and heading back cuts used only to repress or to furnish more branching.

If the grafting has been done to furnish pollenizers, do not prune heavily or blooming will be delayed. Give only a light pruning to prevent serious weak places in the tree and to provide a desirable shape. In fact, in some cases the early blooming may be in such a great demand that it would be best not to prune at all till the new grafts have started to bear, and then to shape the tree by thinning out cuts as is done on any normal tree.

BUDDING

Some fruits do not respond well to grafting and must be propagated by budding. Other plants that can be grafted can be budded also, and can frequently be propagated or topworked to a good advantage by both methods. In the case of many stone fruits, such as peaches, plums, and cherries, budding is more successful than grafting. On the pome fruits, like the apple and pear, both methods are successful.

All budding is done in the late summer after the buds of that season have been fully made but before the wood stops growing, so that the bud can unite quickly with the stock.



Fig. 10. — Growths suitable for use as bud sticks:
(a) As cut from the tree; (b) leaves removed,
leaving stems for handles of the buds.

Select the bud from wood of the current season's growth that shows maturity, vigor and health. Cut off the leaf, leaving a short portion of the stem as a handle for the bud. Then take a sharp knife and peel off a small, shield-like portion of bark containing the desired bud without much hard wood. This will give the green cambium layer every chance to unite with the stock.

Make a T or H cut in the bark of the stock, loosening it up so that the bud can be slipped into place (see Fig. 11). Tie with string or raffia and ten days later cut the tie to prevent girdling. Suitable stock is from one to four years of age.

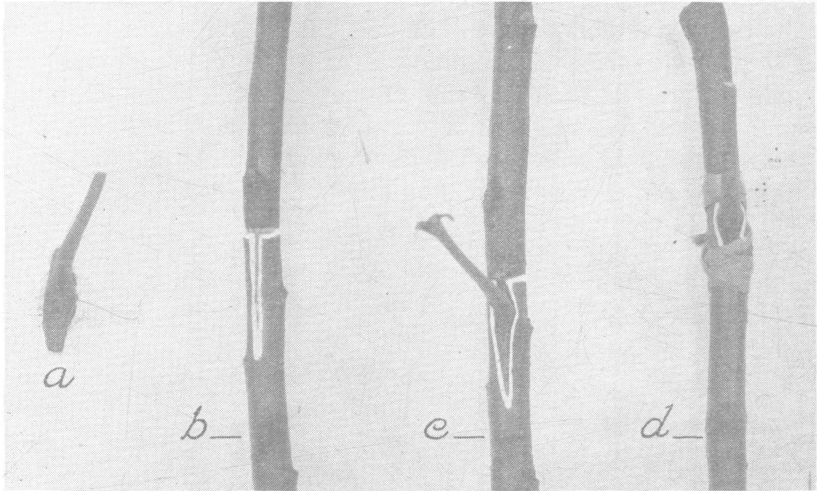


Fig. 11. — Four steps in budding: (a) The bud removed from the bud-stick; (b) a "t" cut made to receive the bud; (c) bud inserted in the stock; (d) operations completed by wrapping with raffia. (The white line shows the line of bark where it had been cut.)

In the next dormant season, it will be very easy to see whether or not the bud has caught. If it has, cut off the stock immediately above the bud to force it into vegetative growth, otherwise it may only grow a leaf and not form a shoot for the future tree.

CONGENIALITY OF STOCK AND SCION

As a general rule, plants of the general botanical classifications can be intergrafted, but this is not always true. Pome fruits like the pear, apple, and quince can be worked one on the other, but with different results from the different combinations. The stone fruits, like the peach, plum, and cherry, may be budded on each other with more congeniality.

The stock has a definite influence on the growth of the top. In some cases, it may dwarf and in others invigorate the top. Commercial use of this fact is made by nurserymen when they sell dwarfed trees. For the apple they commonly use a Paradise or Doucin stock, and for the pear they use the quince.



Fig. 12. — A tree top worked to another variety. Note the good union and congeniality of stock and scion.

On the other hand, using a stock to increase vigor and fruitfulness has been reported with success on grapes and cherries in some New York experiments.

There are many of these factors that must be learned by practice, but for the practical fruit grower the few mentioned above are the only ones he is apt to need. For the amateur fruit grower there is a wide number of combinations to be tried and worked out.

SUMMARY OF TOPWORKING

To many people, topworking a tree seems to be a very complicated operation that cannot be done on a large scale. The process is in reality a simple one. The topworked tree can be changed over so that when it does bear, it gives earlier and heavier production than a new planting will do, often making a gain of several years.

Grafting and budding are useful as orchard operations; to change over undesirable varieties; to quicken production of new varieties; to provide pollenization in plantings of one variety; to correct a trunk weakness, like collar rot of Grimes; to correct errors of varieties made in the nursery; and to keep the kinds of fruit in line with demands of the market or the orchard management conditions.

Trees over twelve years of age are usually undesirable for topworking. Young trees, two or three years old, are changed over quickly; older trees require more time.

Bridge grafting is useful for healing over wounds on the trunk.

Inarching of nurse trees will correct root damages or diseases.

Grafting shoots from one limb on to another forms a natural brace that holds the limbs together and strengthens weak crotches.

Bud the peach, plum and cherry. Graft or bud the apple and pear.

Plants are dwarfed by working them on slow growing stocks. For example, a pear tree is dwarfed on a quince stock; an apple tree on Doucin stock.

Plants have increased vigor on strong stocks. For example, the Delaware grape makes more growth on Gloire roots than on its own.

Prune both stock and scion carefully to secure a well shaped tree after topworking.

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