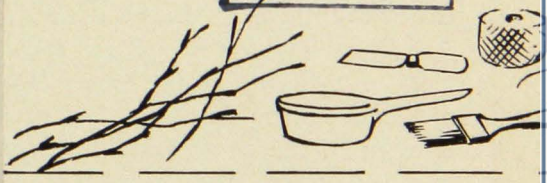
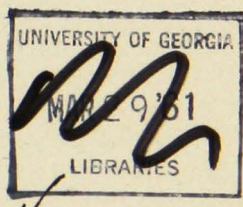


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# GRAFTING FRUIT TREES



T. S. WEIR

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UNIVERSITY OF MINNESOTA  
*Agricultural Extension Service*  
U. S. DEPARTMENT OF AGRICULTURE

## **GRAFTING SERVES MANY PURPOSES**

*The art of grafting is very old; no one knows who first grafted a tree. Occasionally natural grafts occur in the woods where a branch of one tree becomes wedged in the crotch of another. Perhaps modern grafting originated there.*

*Grafting is now a common practice in the propagation and culture of many kinds of plants. Many trees are now alive and useful since bridge grafting healed the usually fatal wounds made by rodents or other agencies.*

*Pathologists graft in the study of certain virus diseases. And orchardists graft pollenizer varieties on otherwise unproductive trees.*

*But the hobbyist who grafts just for fun receives the kind of compensation that the painter or sculptor enjoys. He creates something new. Then he goes on to graft variety after variety on one tree until he no longer dares to prune. And he feels the same thrill from seeing buds swell and grow from his last effort that he did from his first clumsy attempt.*

# Grafting Fruit Trees

T. S. WEIR

## What Is Grafting?

Grafting serves the purpose of topworking a tree to different varieties or repairing damage caused by mice and rabbits. The latter is called bridge grafting.

By topworking you can do the following:

- An undesirable variety can be changed over by grafting a preferred variety to the branches.
- Varieties that lack hardiness or have poor crotches can be made more durable by grafting them on hardy, strong-crotched varieties such as Hibernial or Virginia crab.
- Pollinator varieties can be grown much sooner by topworking than by planting young trees.
- New varieties for trial can be brought into bearing in 2 or 3 years if topworked on stock of bearing age.
- Interesting novelties can be developed by grafting several varieties on one tree.

## What Are The Terms Used?

**TOPWORKING**—The operation of cutting back the branches and top of an established tree (for example, Hibernial) and grafting another variety (for example, McIntosh) on it.

**UNDERSTOCK OR STOCK**—The part on which the cion is inserted; the part below the graft.

**CION**—The part inserted on the understock; a piece of last year's growth with three or four buds.

**CION WOOD**—Vigorous, well-matured dormant shoots of last season's growth, up to 18 inches. Such a stick might make three or four cions.

**CAMBIUM**—The growing part of trees; located between the wood and bark. At the season when bark separates freely, cambium will be both on the wood surface and on the inner bark.

**DORMANT**—The condition of live plants at rest—as trees in winter.

**BUD STICK**—A shoot of the current season's growth used for budding. Leaves are removed, leaving  $\frac{1}{2}$  inch of leaf stem for a handle.

**SUCKERS OR SUCKER GROWTH**—New shoots that start below the graft.

## What Trees Can Be Grafted

Young, vigorous trees 2 to 5 years old are best for topworking. Older trees can be topworked, but the operation is more severe and these trees must be worked at a higher point. Hibernial and Virginia crab, because of their vigor and their strong, well-placed branches, make exceptionally good understocks. Delicious does poorly on Virginia crab.

In topworking branches of young trees, be sure to have 1 to 2 feet of branch between the trunk and the graft. Otherwise the good crotch formation of the understock will be lost by the trunk expanding past the union.

Trees up to 5 years old can be grafted all at one time. On older trees about half—the upper and center part only—should be worked at one time. The remainder should be done a year later.

## How Do You Collect and Store Cions?

Cion wood for grafting can be taken any time in the fall and before growth begins in spring. But there is some danger that the buds will start to grow or be injured during the winter if the cions are left on the tree until spring. Actually, November-cut cions grow best.

This cion wood should be tied securely and carefully labeled. If placed in moist (not wet) sawdust or moss and kept in a cold place, cions should be in good condition in the spring. They also may be stored for a short time in a quart fruit jar and kept in the refrigerator.

It is important that cion wood be kept dormant until grafting time. Temperatures slightly below freezing are best. A good way to keep cion wood in good condition is to collect them before the ground freezes and bury them. Wrap them first in a covered box or with burlap.

## When Do You Graft?

It is best to graft in the spring, from the time the buds of understock trees are beginning to open until blossom time. April or early May are preferred times.

## What Equipment Will You Need?

1. **Suitable understock.**
2. **Dormant cions**—true to name and in good condition.
3. **Sharp knife**—of good steel that holds its edge well.

4. **Hand saw**—for cutting branches to be cleft grafted.
5. **Pruning shears**—sharp.
6. **Cleft-grafting chisel and mallet**—a heavy knife or hatchet can be used for a small job.
7. **Light hammer and No. 20 gauge 3/4-inch flathead (cigar box) nails**—for bridge grafting.
8. **Grafting wax, paraffin, asphalt water emulsion**, or other material for covering the grafts.
9. **A melter and a paint brush**—about an inch wide; necessary if you use grafting wax.
10. **Good whetstone**—to keep the knife sharp.
11. **Tying material**—Nursery tape, adhesive tape, electrician's rubber tape.

The following is a fuller explanation of three types of equipment mentioned above:

**Rubber tape**—An excellent material that will both bind and protect graft unions is electrician's rubber tape. Choose a brand that is elastic and amply adhesive—a good tape for the purpose will stick well to itself. Do not stretch this tape too tightly or it may crack or weather. To lengthen its life coat with orange shellac. However, the better brands with no covering will last throughout the first summer. After that the tape is no longer needed.

**Asphalt water emulsion**—is becoming more and more popular for topgrafting. It is of pasty consistency and can be applied with a brush; however, a small paddle will smear it on thicker, which is preferable. **Caution**—be sure to read all the instructions on the container.

**Melters**—If one has many trees to graft, a good wax melter is necessary, and there are good ones on the market. For small jobs, however, it is an easy matter to melt wax with simple equipment. Take a large metal container and

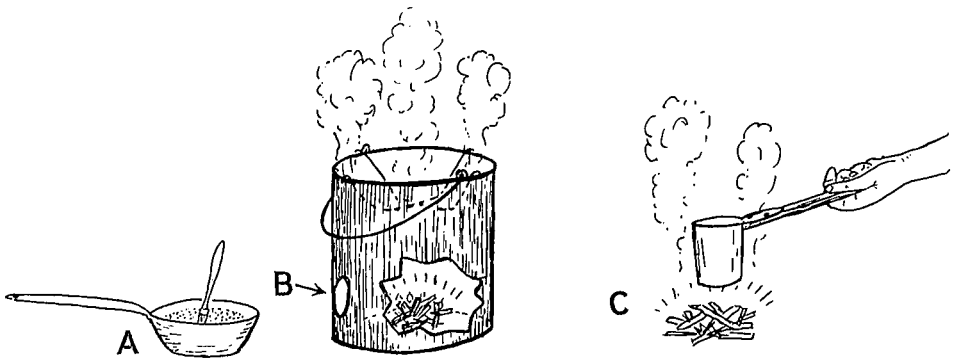


Fig. 1. Three of the devices for melting grafting wax are shown.

make a hole near the bottom for a vent (see B in figure 1). Place some heavy wires near the top for a grid and heat the wax in a pan or similar container—preferably one with a handle (A). For heat build a small fire of chips or shavings in the large container. This can be carried from place to place. Use a paint brush (1 inch wide is best) to apply the melted wax.

A still more simple device is shown in C of figure 1. Attach a handle to a tin can and heat the wax over a small open fire.

Here are some additional tips for top-working. If the weather is hot and dry at the time of grafting, additional assurance may be had by covering the cions with a small paper or plastic bag. After the buds begin to grow, cut or tear the bag partly open. As soon as growth starts remove the bag—preferably on a cloudy day.

**CAUTION**—At grafting time, grass and weeds burn readily. Build the fire or place the pail only on bare ground and watch both carefully.

## The Side Graft

The side graft is very useful and easily made. It is adapted to a fairly wide range of sizes of understock (up to  $\frac{3}{4}$  inch), and it can be made before the bark will slip.

**Cuts**—Select a smooth place on the understock branch at least a foot from the trunk. Make a slanting cut at a narrow angle almost to the pith (see B in figure 2). Cut the cion to a short, sharp wedge (about 1 inch) with one side thicker than the other (see A).

**Union**—Bend the branch slightly to open the cut. Press the cion in so the cambium layers of the stock and cion

meet at one side (C). Cut off the stock above the union (D), using sharp shears in order to avoid disturbing the cion.

**Tying and waxing**—Tying is unnecessary if the stock binds well, but you may have to tie small materials if the cion is not held firmly. Wax or tape all cut surfaces carefully (E).

**After-care**—Grafts should be thoroughly covered with wax or other material. It may be necessary to rewax in a day or two.

If the graft has been tied, cut the binding shortly after growth starts; this will prevent girdling. You may allow

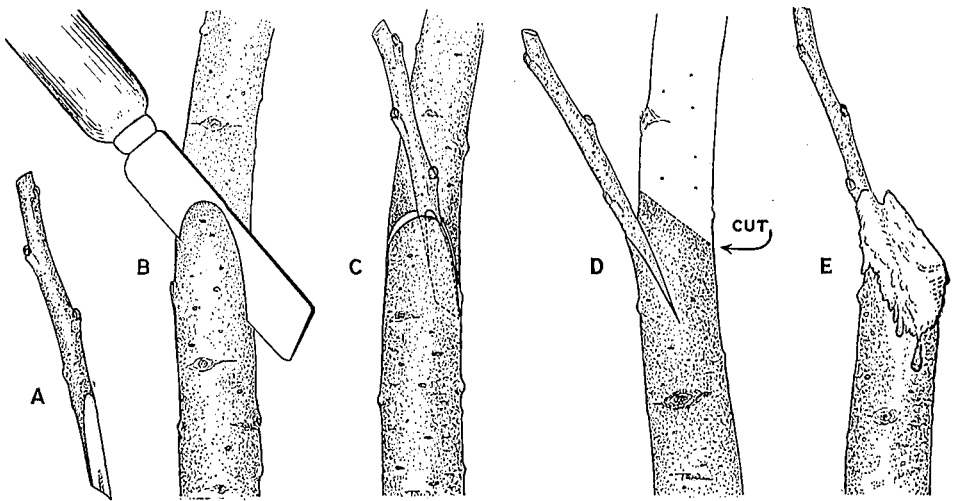


Fig. 2. In the side graft the cut goes across the grain to reduce splitting.

some sucker growth from below the graft to grow the first season, but do not permit this growth to shade the cion growth. After the first season all growth but that from the graft should be cut off.

Inspect grafts during the growing season to guard against faulty waxing or binding. If aphids appear, spray with nicotine sulfate. If the shoots are attacked by fire blight, cut them 6 inches below the visible symptoms.

## The Whip Graft

Use the whip and tongue graft where the understock is nearly the same diameter as the cion.

**Cuts**—Cut off a branch of the understock, leaving a stub at least a foot long. Make a straight, slanting cut about 1½ inches long on both the cion and the stock (see A and C in figure 3). Make the cut straight and even—one stroke with a sharp knife will do it.

For the tongue make a straight draw cut (not split), beginning near the top and cutting about the full length of the bevel (see B and D).

**Union**—Match the two parts together (E). Unless the cion and stock are the same size, **be sure the cion is in contact with the inner bark on one side.**

**Tying and waxing**—Bind tightly. Then carefully wax or tape the union and upper parts of cions; two coats of wax are preferable.

In dry seasons cover the graft with a paper bag to help prevent rapid drying. This should be removed gradually—merely tear the bag at first.

This type of graft is difficult for the beginner but is used extensively by experienced operators. It lends itself exceptionally well to the rubber-tape method of binding. Tape serves to seal the wound and bind the parts together.

While other types of grafts depend on the bark slipping well, the whip graft does not. In fact, it is best if you make this graft before the bark slips. Other-

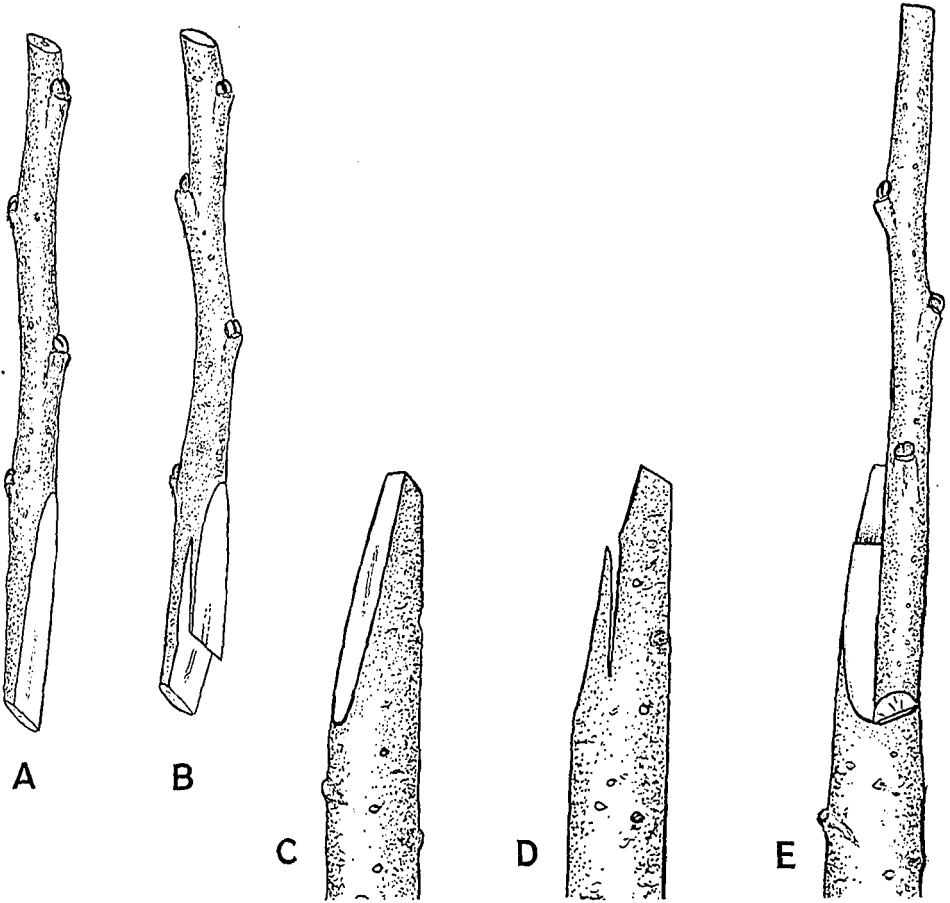


Fig. 3. The whip graft is usually used for root grafting but is also used for grafting small branches.

wise there is danger of the bark peeling from the narrow tongue of wood.

**After-care**—See the section on the side graft on page 5.

## ***The Cleft Graft***

The cleft graft is used when the understock is large—up to about 2 inches in diameter.

**Cuts**—Select a place free from knots and cut off the stock with a saw. Cut the cleft (avoid splitting if possible)

with a grafting chisel, large knife, or hatchet. After a trial or two you will learn the proper depth of cleft. In horizontal branches the cleft should be side-wise—that is, not perpendicular—to reduce breakage from birds and storms.

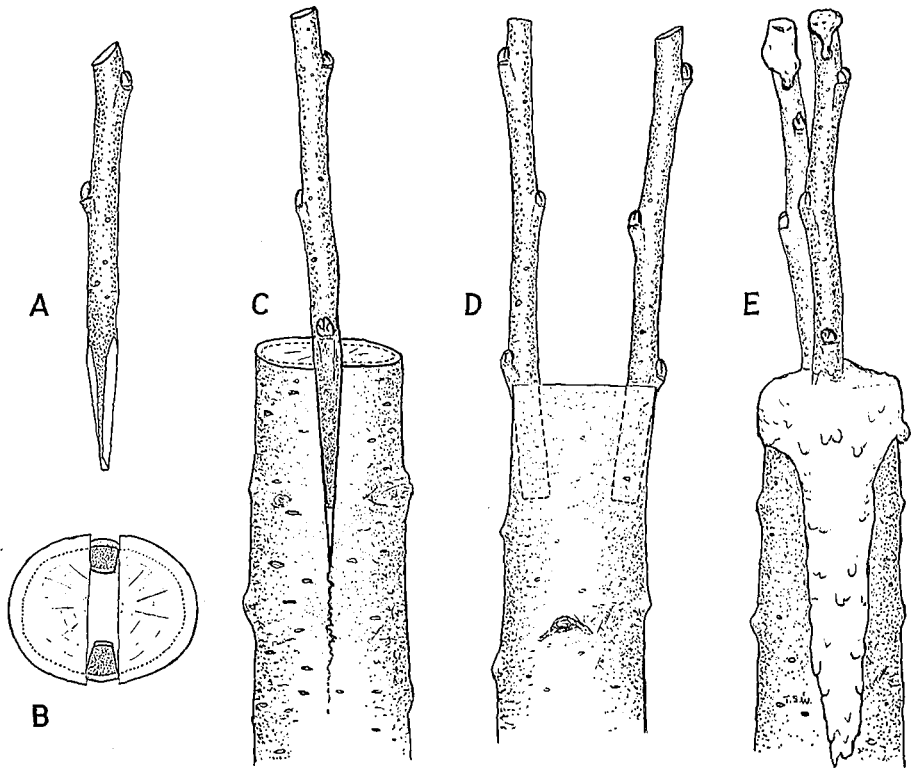


Fig. 4. The cleft graft is the one to use on large branches.

Cut the cions to a blunt wedge about  $1\frac{1}{2}$  inches in length, with one side slightly thicker than the other (see A and B in figure 4). If the cion wedge is cut to a sharp point there is danger of the bark peeling. Also a sharp cion wedge will not fit the cleft as well (C).

**Union**—Open the cleft slightly with a grafting tool or screw driver. Insert a cion on each side, with the inner bark of stock and cion in contact. Have the thick side of cion outward (B).

Keep in mind that the bark of the larger stock is thicker than the cion bark, so the cion should not be flush with the stock. A very slight tilt will assure a contact, at least where the cambium layers cross (D).

**Tying and waxing**—There is no need

to tie—unless the stock is small and does not bind well. Wax the unions. Be sure the cleft is covered its full length (E).

**After-care**—Cions that are growing vigorously will need attention to prevent breakage by birds, ice, and storms. Either tie the cion to a supporting brace (see B in figure 5), or pinch back the tips before growth becomes "leggy." Circle all the shoots from one stub with twine to give some support (A).

The first season let all cions and the "sucker" growth from below the graft grow undisturbed. However, do not permit this understock growth to shade out the cions. The second spring select the most suitable as the permanent branch and consider the others as spares. Leave



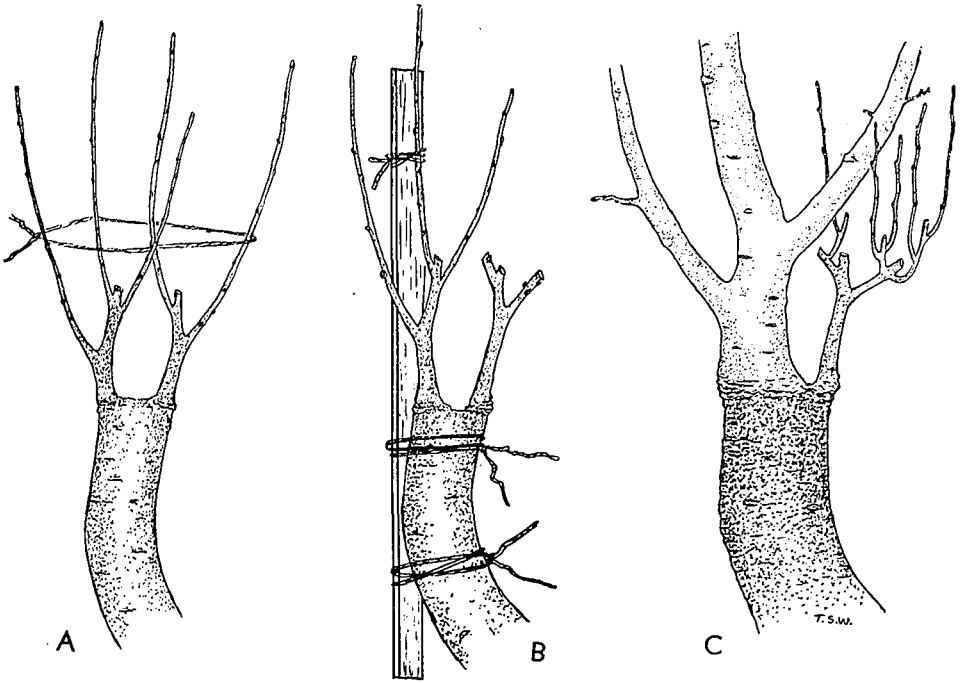


Fig. 5. Three stages of the evolution of a branch from a cion are shown.

the spare cions on to assist in healing over the stub, but cut them back to a few buds on each (see B). The third spring, cut the spare cions back severely again. In the fourth season or when crowding is noted, cut off all of the spare cions as seems necessary.

Very large trees are poor subjects for grafting, but some trees are worthless otherwise. Grafting such large branches calls for a slightly different method than that ordinarily used.

Saw off the branch carefully, undercutting it first to avoid tearing the bark. You may need to recut the stub to get it smooth. Saw the branch instead of splitting it to receive the cions.

Make two clean saw kerfs (or grooves) about 4 inches deep at right angles to each other across the end of the stub, making a + shape. Then fit the cions tightly into the four places made by these saw kerfs.

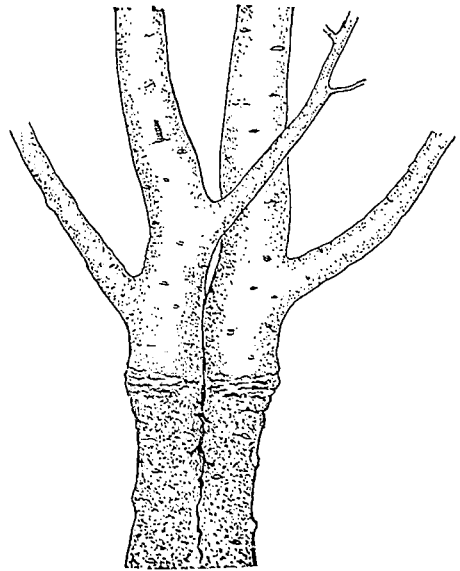


Fig. 6. Trouble ahead in the next storm. Don't let two leaders compete.

## The Modified Cleft Graft

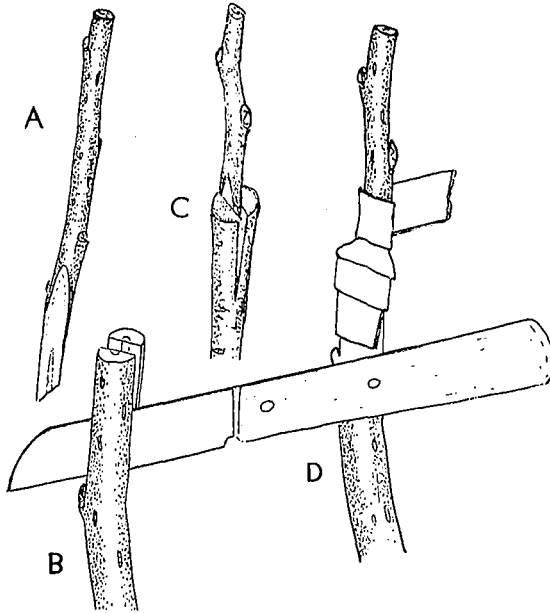


Fig. 7. The modified cleft graft is simple but effective.

Instead of trying to master the whip graft or side graft, use a simple kind of cleft graft on small understock. Stock (see B in figure 7) about the same size as the cion (A) may be split and a wedge-shaped cion inserted.

Should the stock be larger than the cion, be careful to set the cion to one side instead of on center (C). In this way the cambium of stock and cion will make contact.

Wrap this graft union (D) carefully with a good grade of rubber tape. As the graft grows the tape stretches and eventually deteriorates.

## Shield Budding

Shield budding is a method of grafting that is done in summer when the bark of the stock slips easily and when there are well-grown buds—usually from July 15 to August 15. The first step is to cut bud sticks of the desired variety from strong shoots of the present season's growth (see A in figure 8). These buds should be mature, as indicated by a slightly brownish color.

Clip off the leaves as soon as the bud sticks are cut, leaving about a half inch of the leafstalk for a handle. Discard the soft tips of the bud sticks.

Wrap the bud sticks in moist burlap, moss, or paper to prevent drying out.

Branches from the size of a lead pencil up to a half inch diameter may be worked by this method. The bark of larger branches is too thick for satisfactory budding.

**Cuts**—On the branches of the stock, about 15 inches or more from the trunk, make a T cut just through the bark (C). Then with a knife blade or bark separator lift the corners and carefully loosen the bark. Then cut a bud from the bud stick which may include a thin piece of attached wood (B), or

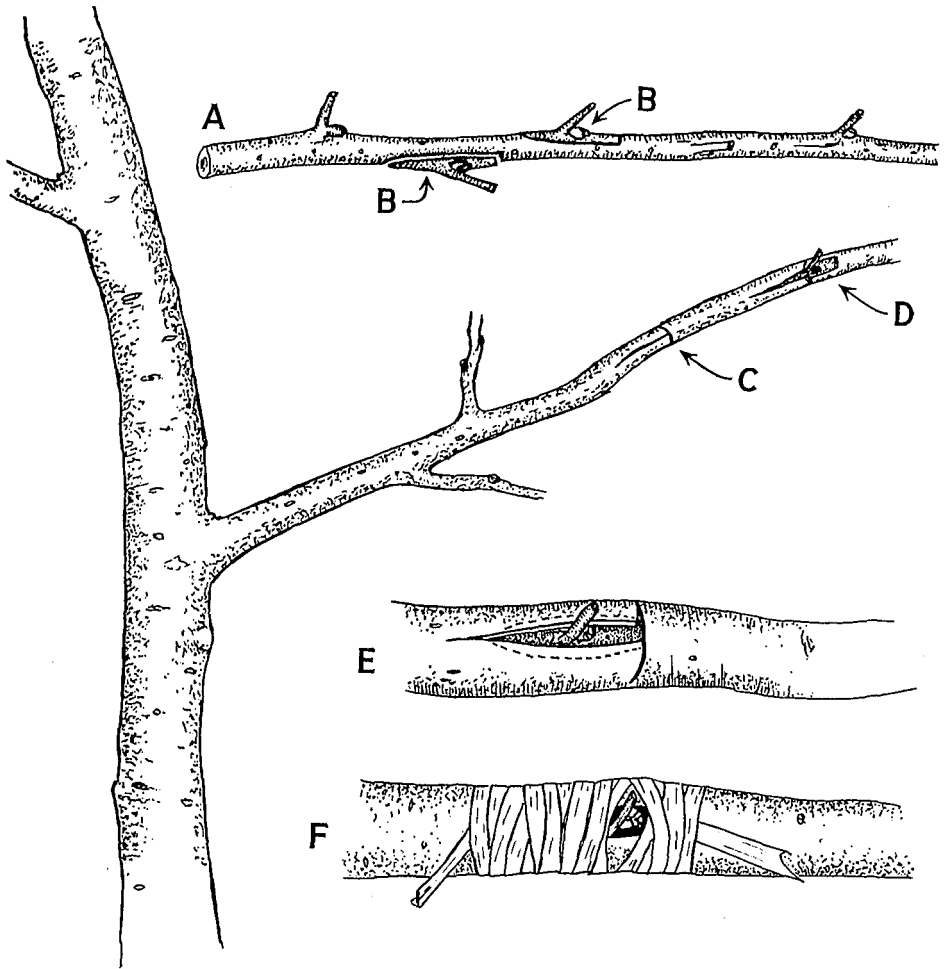


Fig. 8. In budding, a single bud does the work of a cion.

you may wood the bud as shown in figure 9. Start the bud under the flaps of bark and lead it down by the handle (see D and E in figure 8).

Wooded buds have a complete cambium surface exposed to meet the cambium of the stock and sometimes result in better take, but they are not rigid enough to handle easily. Buds with wood attached are easier to handle and usually give good results. In bud grafting branches, put in two or three buds on each branch for good measure.

**Tying**—Use raffia, rubber strips, electrician's tape, adhesive tape, cloth, or soft twine to tie the bud. Wrap and tie tightly, making sure you do not cover the bud (figure 8). Raffia for tying buds should be cut into lengths of from 12 to 15 inches and moistened before using.

**After-care**—Cut the tie before it binds too tightly—that is, in 2 or 3 weeks. Cut on the side away from the bud. Rubber budding strips need not be cut. The bud should remain dormant

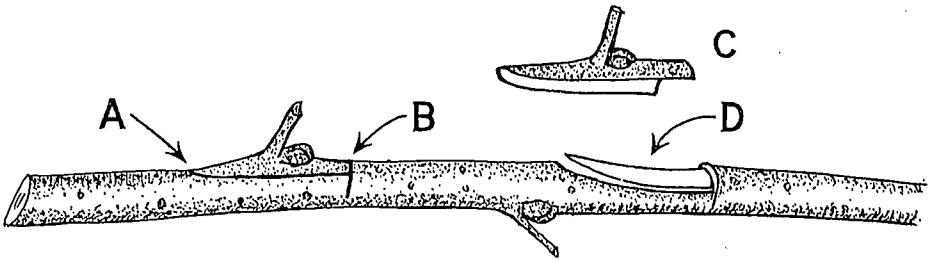


Fig. 9. Wooding the bud is not always necessary.

until the following spring. As soon as the bud starts growing, cut off the stock above or beyond the bud.

Do not permit any shoot growth.

After the second year remove all extra growth from the stock, that is, keep only the bud-grafted shoots. Where two or more buds take, you can use more than one if you wish, but one is enough to produce a new branch.

**Wooding the bud**—In the illustration above, cut from A well under the bud to B. Remove the knife and rock the blade just through the bark at B. Grasp the bark between your thumb and finger and pinch the bark with attached bud free from the wood (D). If the bud stick is fresh and in good condition, you will be successful after a few tries.

## The Bridge Graft

When the bark of a tree is removed or destroyed all the way around, the part of the tree above the girdle will die. Even though girdled, some trees may leaf out and remain alive for one season but both top and root will die the second year unless sprouts have been produced below the girdle.

**The work of rodents**—Rodents girdle many fruit trees each year. Occasionally a tree may only appear to be girdled if the gnawing has not gone through the bark to the wood. If such an injury is protected from drying out, new bark will grow from the cambium. As soon as you discover an injury, cover it with shellac, an asphalt compound, or very heavy paper or burlap. Mounding with soil is good protection.

Rabbit damage is usually some distance above the ground or snow line. These animals cut off twigs and pull off bark in shreds. Mice work near the

ground out of sight under grass or snow. They usually begin at one spot and enlarge it. Pocket gophers gnaw off roots below ground. Trees hurt this way often tip over—they can not be repaired.

**Minor damage**—Bridging may not be necessary if only the outer bark has been gnawed away. With protection from drying, new bark will form.

Small patches or a partial girdle may benefit from some bridging, but they will probably heal over if protected from drying.

**Tools and materials**—To repair girdled trees the following supplies are necessary:

**A sharp knife**—a good jackknife will do

**Small nails**—cigar box size (No. 20, flat head,  $\frac{3}{4}$  inch)

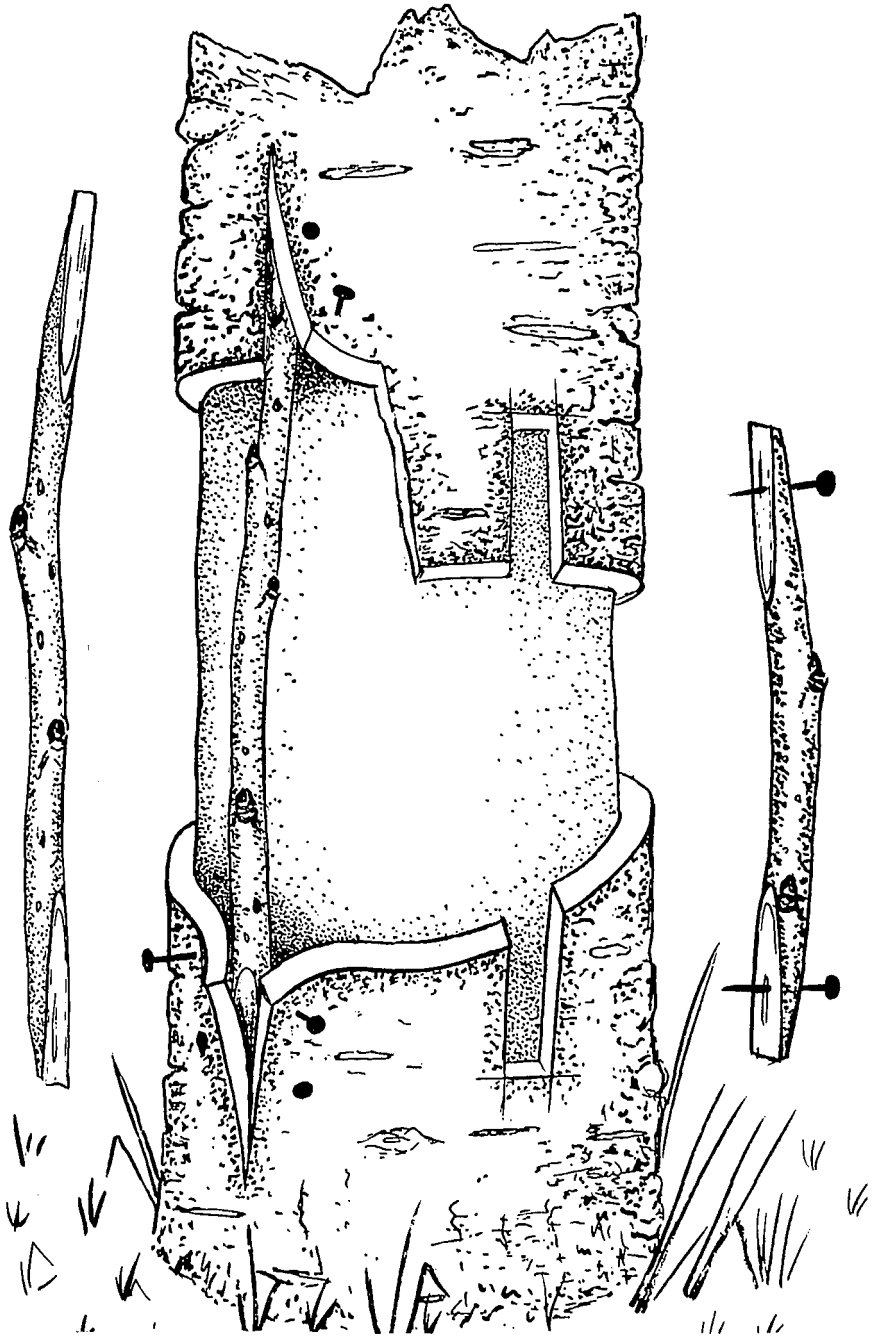


Fig. 10. Two methods of bridge grafting are shown. The cion on the left is inserted under the bark at each end; the cion on the right is inlaid in a groove at each end.

**A light hammer**

**A nail set**

**A saw**—for trimming old thick bark

**A shovel or trowel**—if damage is below ground

**A heavy scrub brush**—for cleaning excavated bark

**Cions for bridges**—stored dormant or fresh cut

**Grafting compound or wound dressing**

**Cions**—Cions for apple trees may be taken from any hardy variety of apple or crabapple. Pear cions must be used for pear, plum for plums, etc. Old trees rarely produce good cion wood unless they were pruned well the previous year. If 1-year wood is not available, 2-year wood may be used. If you can anticipate the need, you should cut the cions before any growth begins. Keep them in moist and cool storage. If you bridge promptly before shoot growth begins, you may cut the cions fresh as needed.

**Small trees**—Trees under 2 inches in diameter are too small to bridge. The swaying of such small trunks by strong winds will dislodge the cions. If a tree under 2 inches is girdled, it is best to saw it off just below the girdle, then wax or mound the stump. Shoots of the same variety probably will grow out from above the place the tree had been grafted originally. To be sure that the right variety will grow, you can cleft graft the stump.

**Bridge graft**—Don't attempt bridge grafting until the bark of the tree to be repaired will lift readily from the wood. This is usually between April 15 and May 15.

The first step is to trim the bark of the girdled trees both above and below the girdle. Cut back damaged or frayed bark an inch or so to sound bark. The edges should be clean and smooth.

Scrape down old rough bark to live bark.

Then starting at the edge of live bark cut a slit about 2 inches long in the bark below the girdle. Lift the edges with a dull smooth tool. Such a tool can readily be shaped from hardwood or a piece of plastic. The rat tail of a comb serves very well for this purpose. Do not use the cion to lift the bark.

Prepare a second slit at the upper side of the girdle and directly above the first.

Shape the cion on the lower end (see left side of cut) and measure against the girdle to determine the length of the cion. Shape the upper end of the cion to a definite taper with a longer flat surface next to the tree. Slip the ends under the bark, nail them in position, and nail down the flaps of bark. In nailing either cion or bark, use care to avoid crushing the bark. A nail set will help to avoid injury to the bark.

**Inlaying**—Another method of bridge grafting is to inlay the cion. This is the best method—in fact, it is a necessity for a short span. To make an inlay bridge select a curved cion. Measure the distance to be spanned and make the cion long enough to extend  $1\frac{1}{2}$  to 2 inches beyond the girdle at each end. Cut a straight smooth face on each end.

Place a nail (cigar box size) in each end (as illustrated). Tack this lightly to the tree bark to mark the place. Mark around each end on the bark to get the exact size of the cion. Remove the cion, cut to the wood on the marks, and lift out the piece of bark. Then fit the cion in the channels in the bark and nail carefully. One nail is usually enough.

In either method of grafting place a cion about every  $1\frac{1}{2}$  to 2 inches around the tree.

There is a third method of inserting the cions in bridge grafting, as shown in figure 11. Little or no trimming is

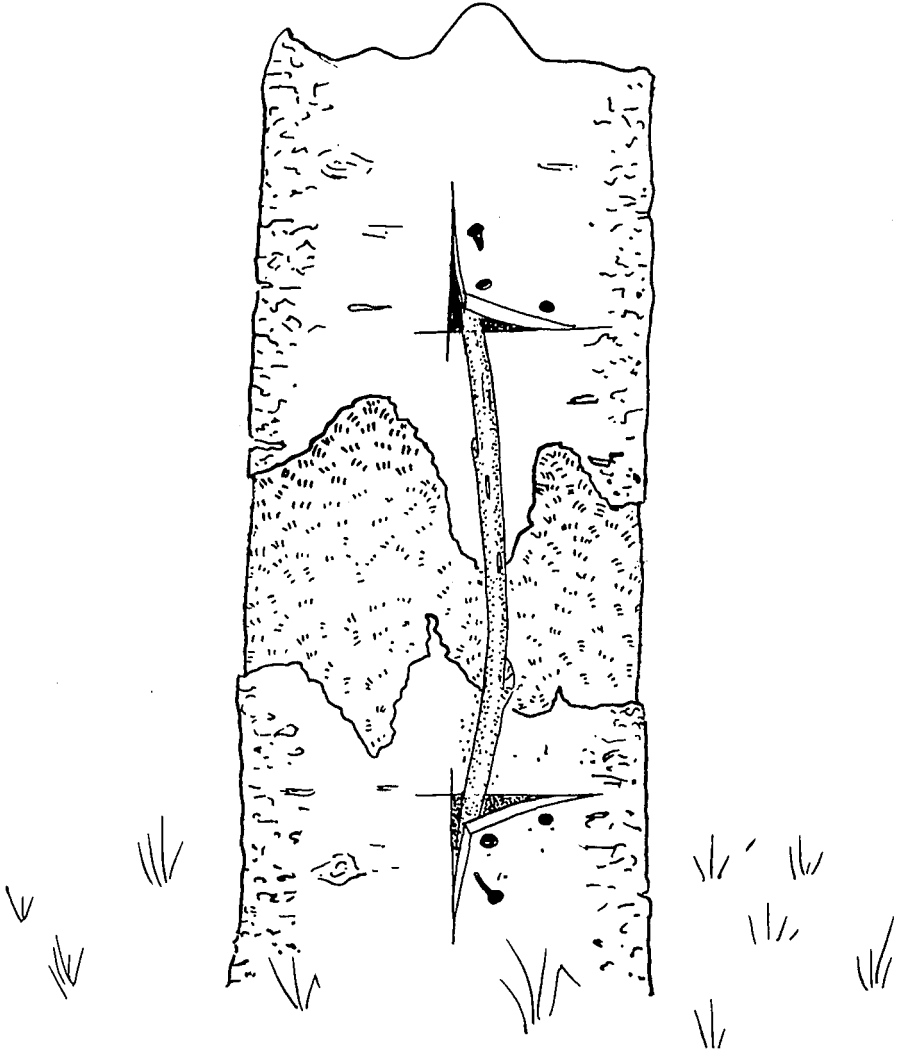


Fig. 11. A quick way to bridge girdled trees. Cions are cut and inserted essentially the same as in figure 10.

done to the bark bordering the damaged area. This is a little less tidy and it requires somewhat longer cions, but it is quicker and equally effective.

**Waxing and care**—When the cions are all in place, the graft unions should be covered with grafting wax or some commercial grafting preparation. The

entire girdled surface should also be so covered. Melted grafting wax applies very readily with an inch-wide brush. Apply more than one coat of wax.

In bridge grafting, after the cions begin to grow, it is important that all shoots or leafy growth be cut or rubbed off the cions.

# After You Graft . . .

## How Do You Protect the Graft?

Cions should be protected from drying out after they are inserted in the stock. Protect the union by covering with grafting wax, asphalt emulsion, or by wrapping with rubber tape.

**Grafting wax**—There are a number of suitable preparations for protecting grafts.

Grafting wax is easily applied, cracks very little, and lasts a long time. It can be obtained at a seed store or nursery, or from an orchard supply dealer. You can also prepare it from the following formula:

- 4 pounds resin
- 2 pounds beeswax
- $\frac{3}{4}$  pint raw linseed oil or 1 pound tallow

Heat these ingredients together over a slow fire until melted. Cool slightly. Pour into a tub or bucket of water. Grease your hands with tallow or oil and pull the wax until it assumes a smooth grain. Shape it into lumps of a convenient size and it will keep for years. This wax works best if melted and applied with a brush. **CAUTION**—don't use it too hot or it may injure the cions.

**Other material**—If grafting wax is not available, melted paraffin may be used, but this tends to crack in cold weather. Extra care should be taken to rewrap if paraffin should begin to flake off. Asphalt emulsions are quite satisfactory and do not require melting.

## Why Do Grafts Fail?

1. Cion and stock incompatible. Apple will not unite with plum, for example.
2. Grafting done at wrong season.
3. Understock not healthy.
4. Cions not vigorous.
5. Cions dry or winter injured.
6. Cions not dormant.
7. Cambium of cion and stock not meeting properly.
8. Cions upside down.
9. Improperly waxed or wax was too hot.
10. Cions displaced by wind, birds, or storms.
11. Graft shaded too much after growth starts.
12. New growth damaged by aphids or other insects.
13. New growth killed by fire blight.
14. Union girdled by failure to release binding or label in time.

## What Do You Do If Grafts Fail?

One hundred percent success in grafting is rare. The failure of one or two cions is not serious, since usually more cions are inserted than are necessary for the completed tree. On branches where the cions fail, let sucker shoots grow. These can be budded the same summer or grafted later. Some sucker growth is needed for regrafting, **but don't let these suckers become so dense they crowd the cions.**