

# Budding and Grafting

Chuck Ingels

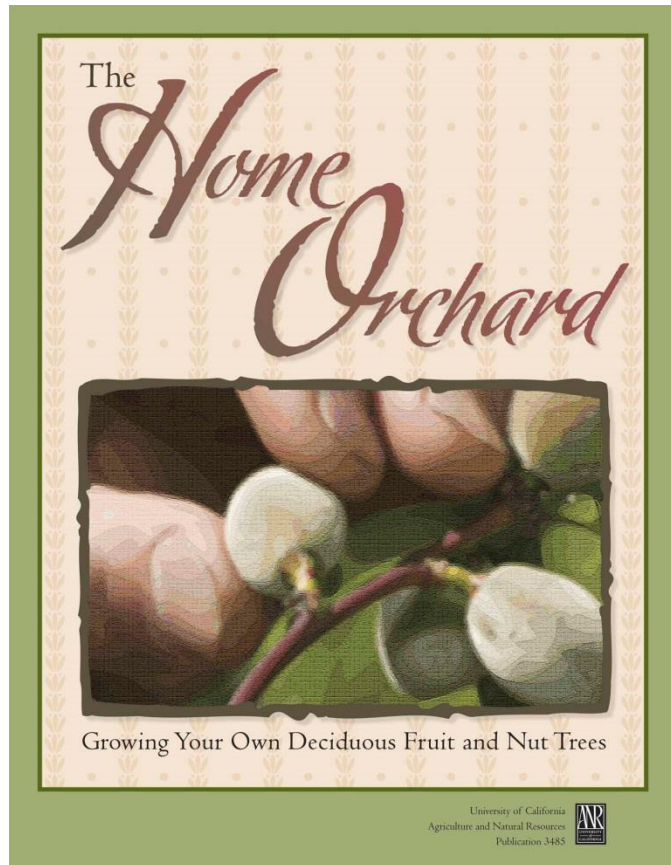
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# The Home Orchard: Growing Your Own Deciduous Fruit & Nut Trees



## Ordering:

Visit <http://anrcatalog.ucdavis.edu>

On the left, enter 3485 under “Browse”

# Fruit Tree Terms

- Rootstock – tree below graft union
- Scion – Tree above the graft union
- Crown: trunk below ground (also canopy)
- Tree size
  - Standard – 20-25 ft.
  - Semi-dwarf (dwarfing rootstk) - 12-20 ft.
  - Genetic dwarf (std. rootstock) - 8-12 ft.
    - Peaches, nectarines, citrus

# GRAFT / BUD UNIONS



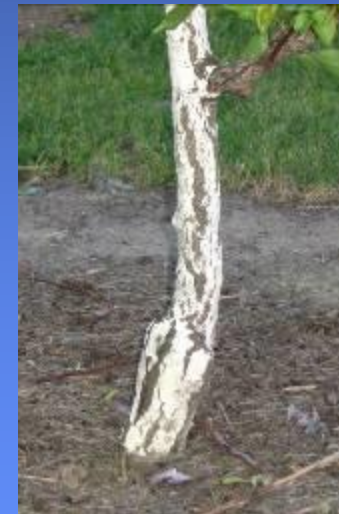
English on  
Black Walnut



Almond



English on  
Paradox Walnut



Apricot



# Genetic Dwarf Peach



# INTERNODE LENGTH

Standard Peach



Genetic Dwarf Peach



# Fruit Tree Terms (Cont.)

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- Branch – Growth that is 1+ years old
- Shoot: current season elongated growth
- Scaffold branch: main structural limb
- Spur: short fruiting twig
- Water sprout: vigorous shoot from branch or trunk
- Sucker: shoot from rootstock or roots



# Spurs

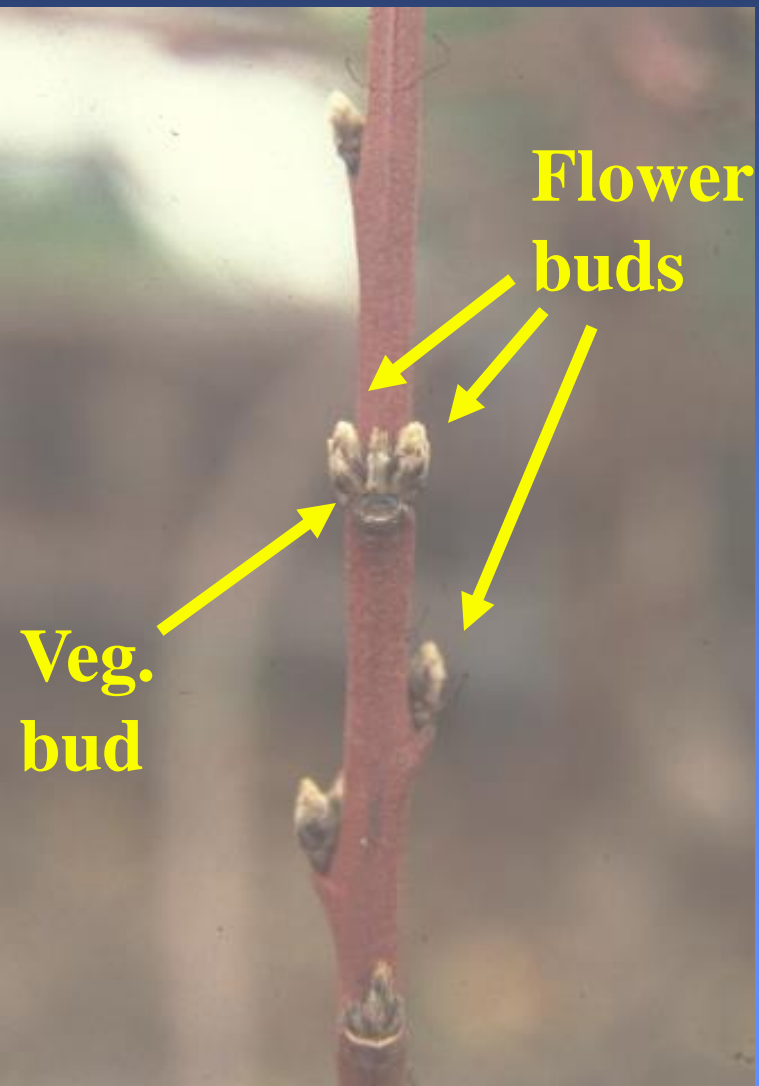


Asian Pear



Cherry

# Peach Fruiting Branches



# Vascular Tissues

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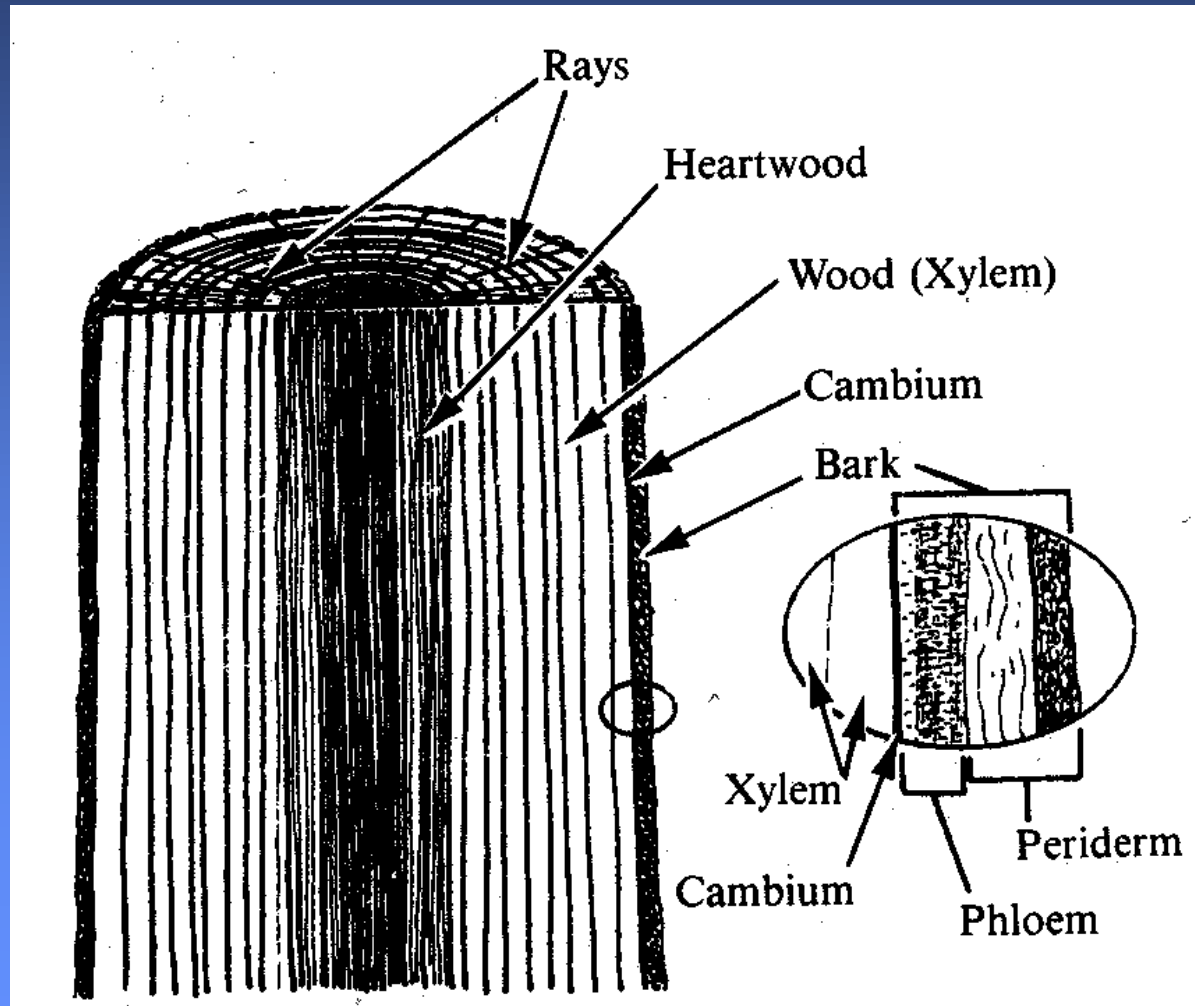
- Phloem – inner bark tissue that conducts carbohydrates, hormones, etc. from the site of production to tissues and organs throughout the tree
- Xylem - woody tissue, located inside the vascular cambium, through which most of the water and nutrients in a tree are conducted



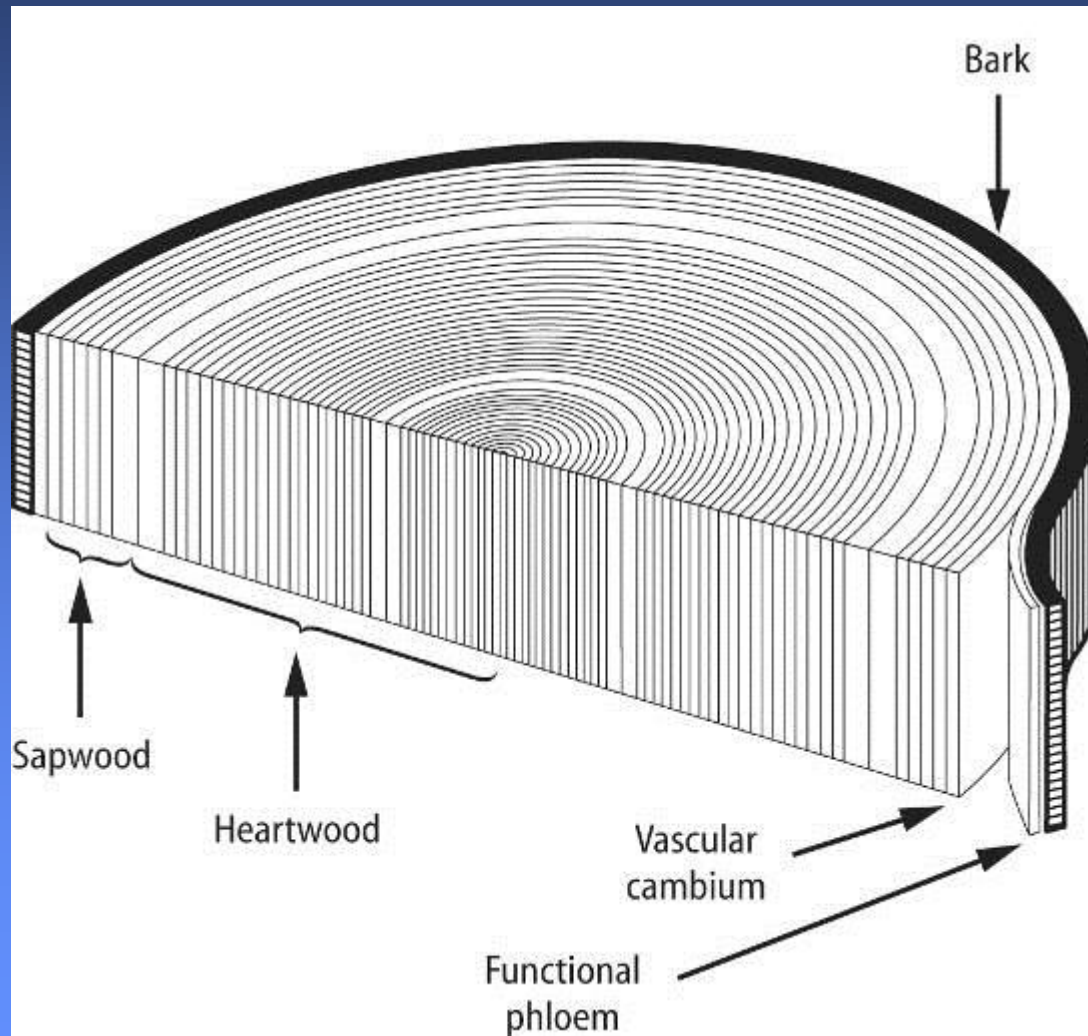
# Meristematic Growth

- Meristem – undifferentiated plant tissue from which new cells and new plant tissues arise.
  1. Apical meristem – forms terminal growth
  2. Vascular cambium (“cambium”) – actively dividing layer of cells between bark and wood; produces new sapwood to the inside and new phloem to the outside; causes thickening
- Callus – undifferentiated tissue that forms a around a wounded plant surface

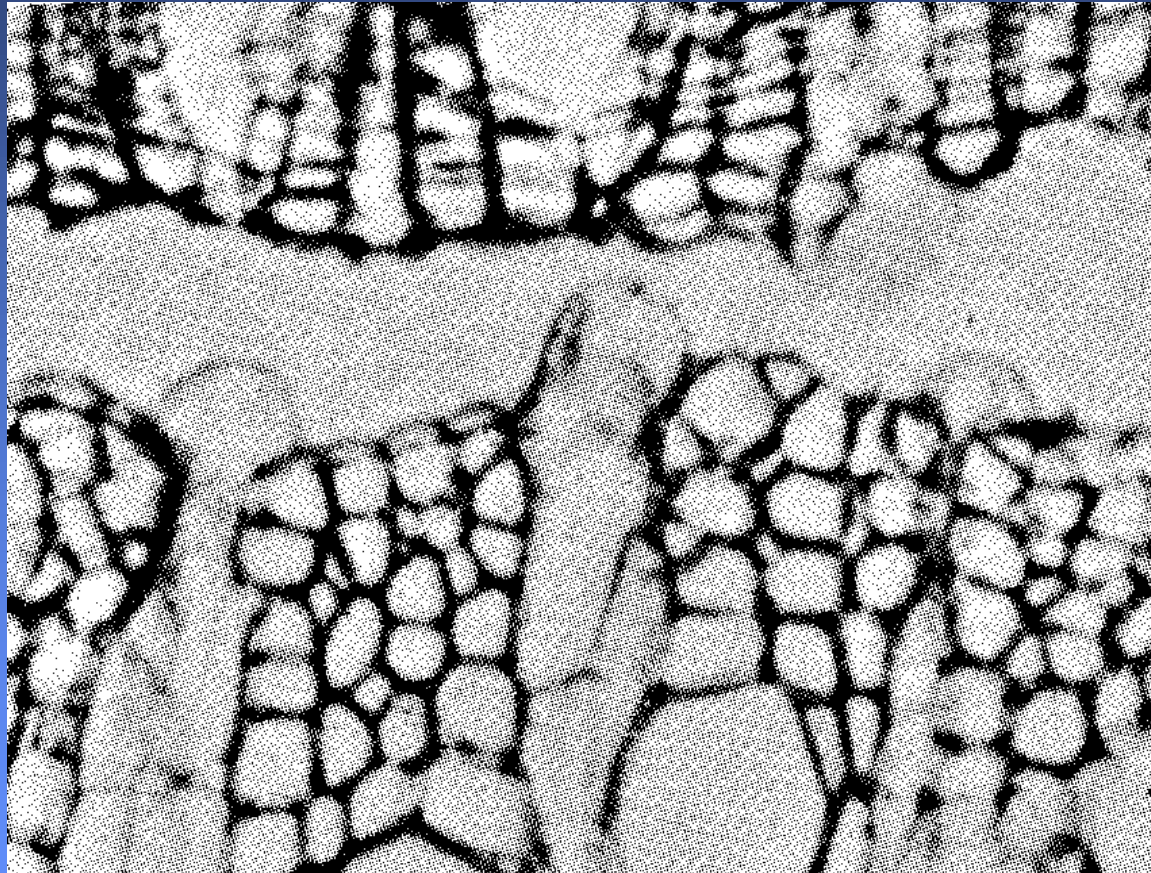
# Cross-Section of Trunk



# Cross-Section of Trunk



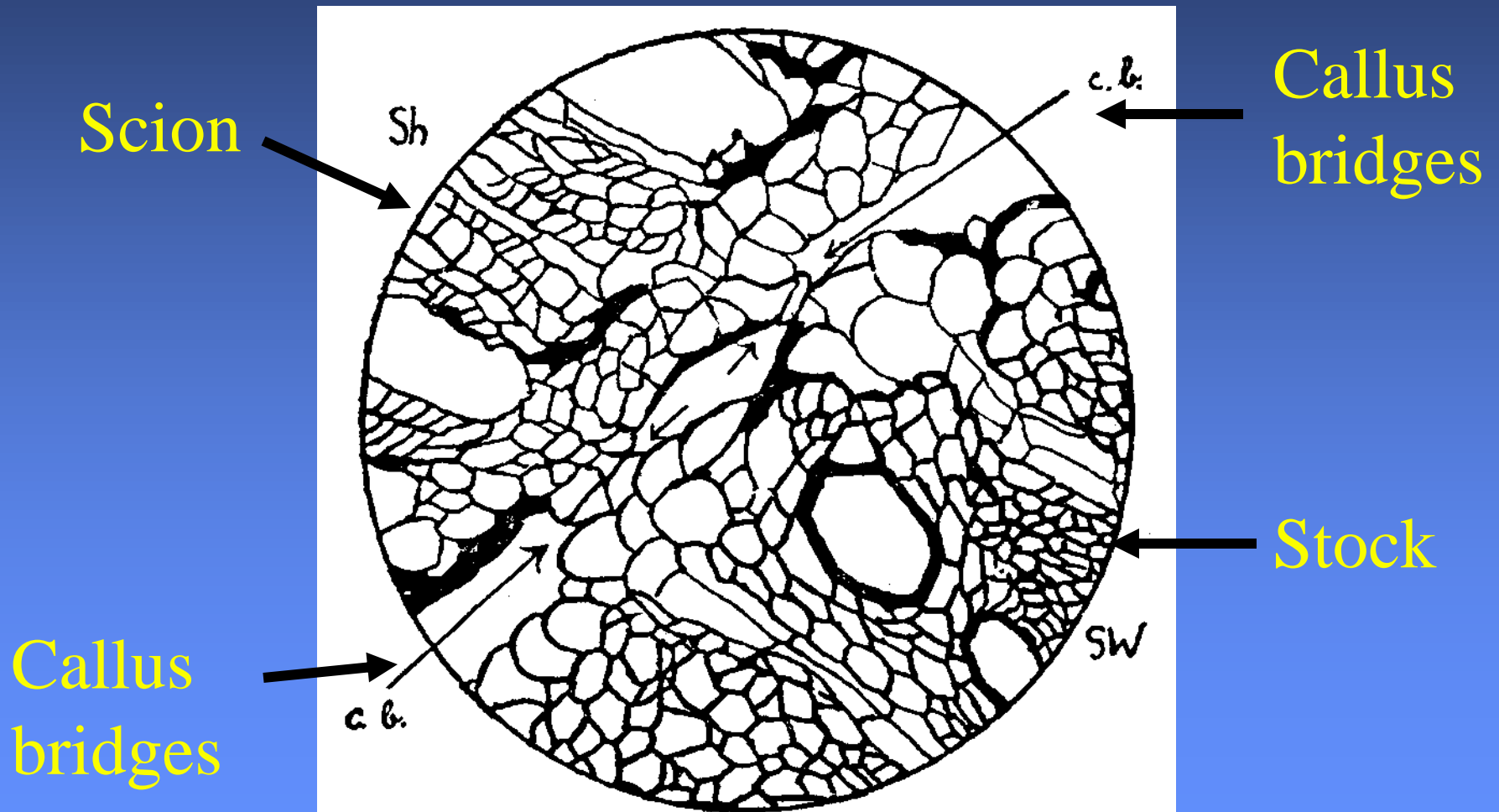
# Growth of Cells 1 Day After Graft



Stock

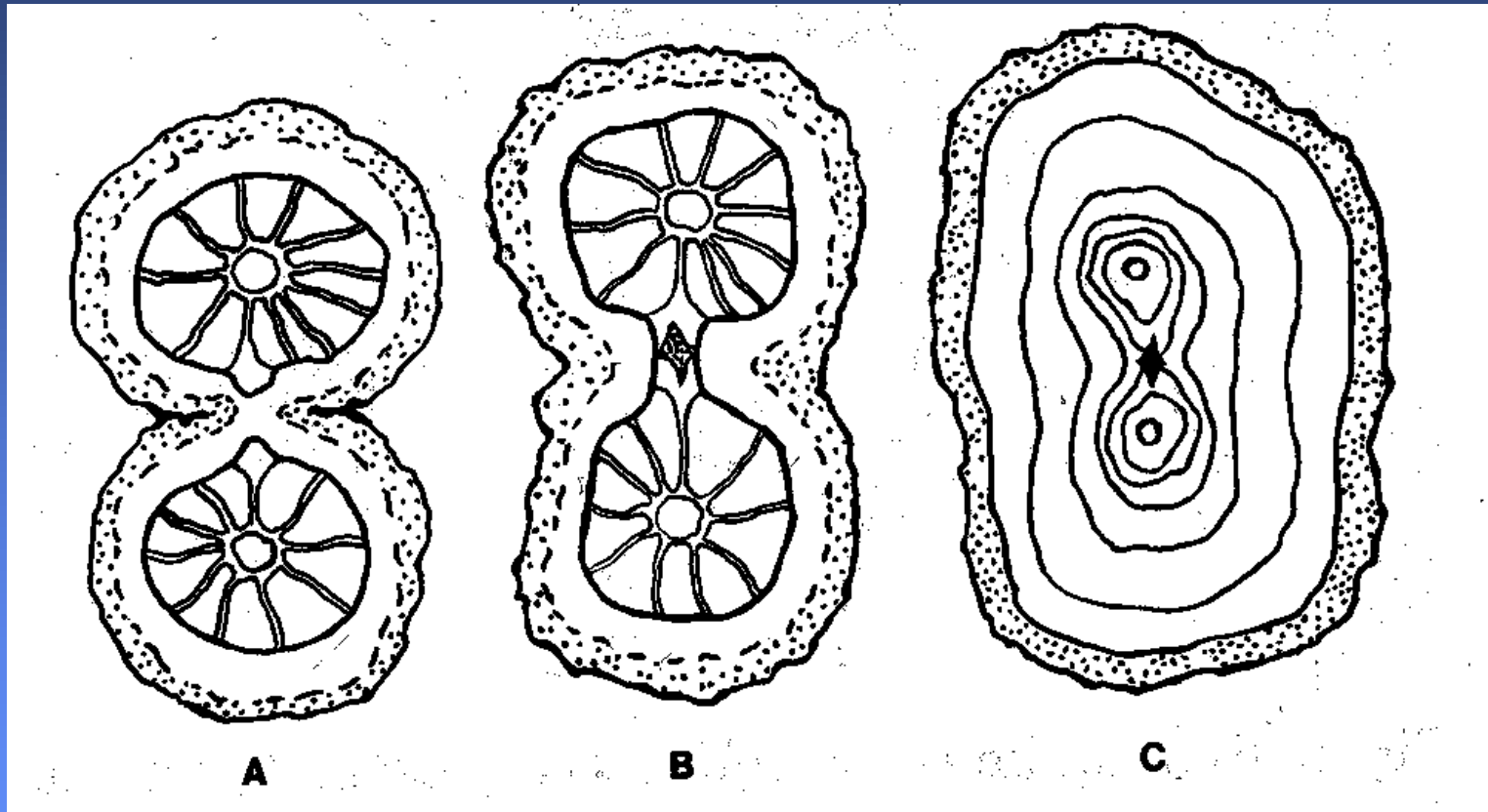
Scion

# Growth of Callus Cells 5 Days After Graft



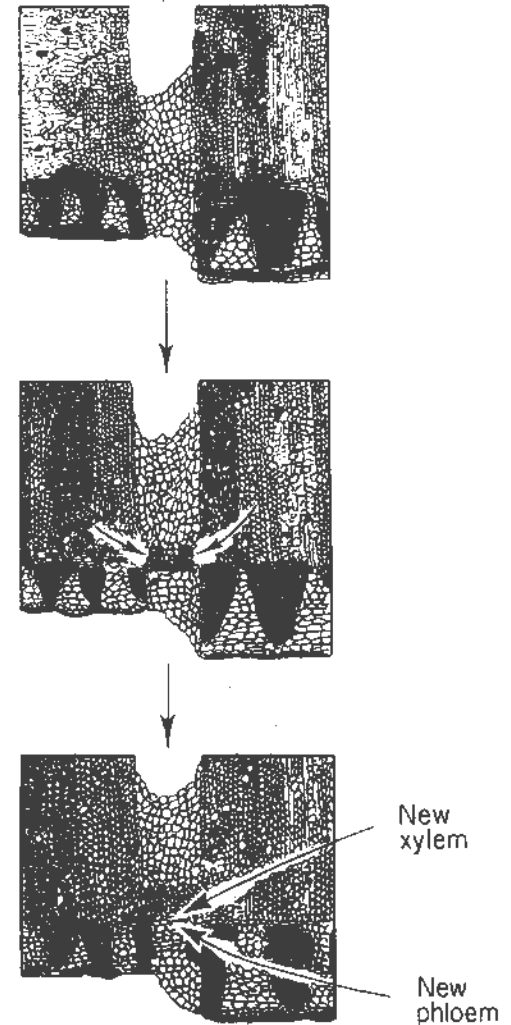
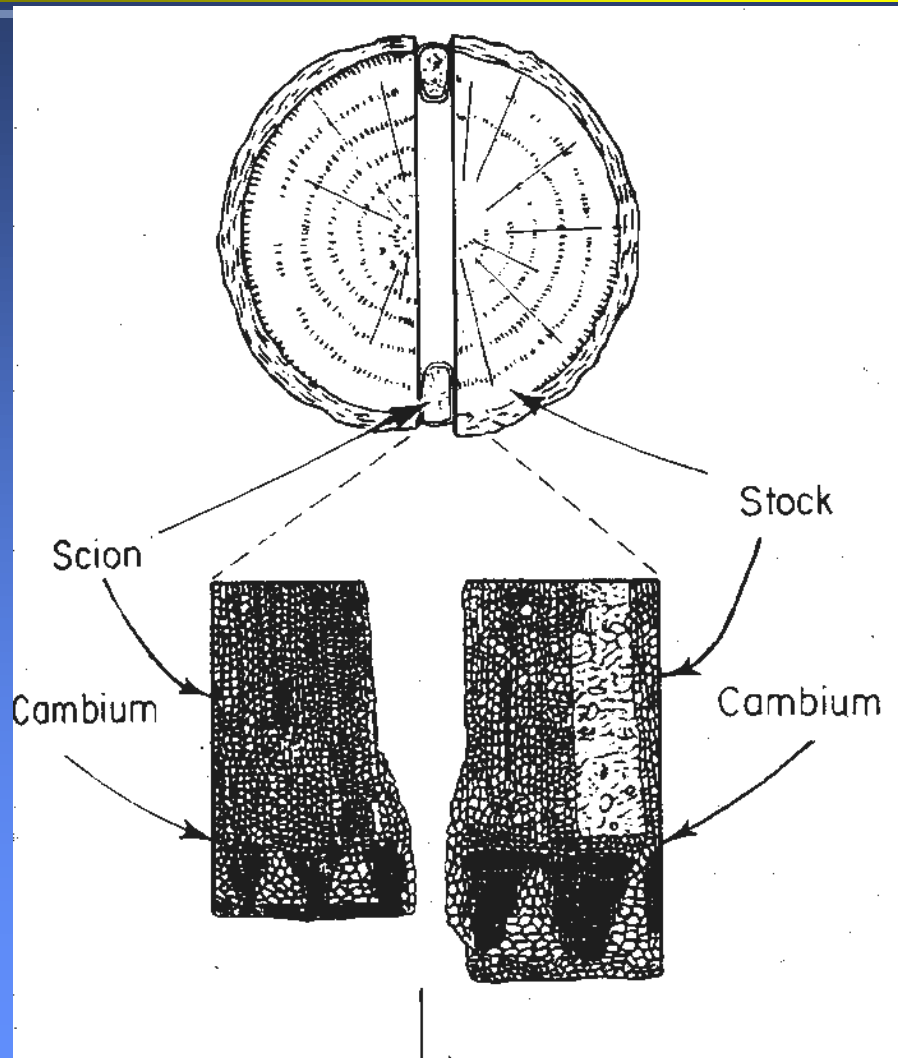


# Natural Graft between Two Young Stems

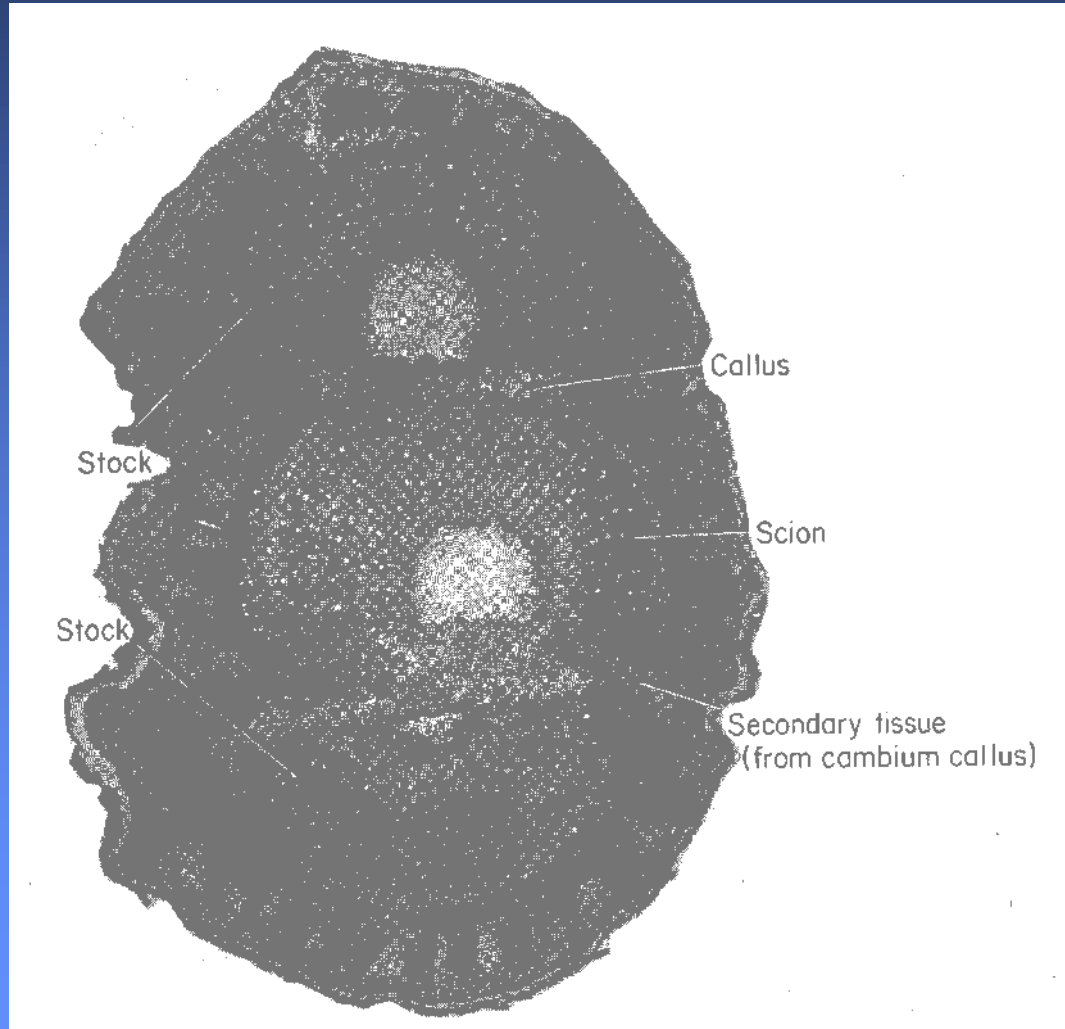




# Sequence of Healing of a Graft Union



# Callus & Secondary Tissue Growth after Cleft Graft



# Grafting Terms

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- Grafting – branch or bud of a plant inserted into the stem or trunk of another
- Budding / bud grafting - inserting a single bud (scion) onto a stock
- Budwood – current-season's shoot or 1-year-old branch used for budding
- Scion wood - 1-year-old branch for grafting
- Topworking – grafting onto large limbs to change the species or variety

# Budding and Grafting Reasons

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- Produce new fruiting tree from rootstock sucker of dead, injured, or fruitless tree
- Repair tree with dying trunk
- Add pollenizers
- Make fruit salad trees
- Make tree or shrub with different colored flowers



# Grafting Rootstock Suckers





# Multi-Graft Trees



Fruit Salad Tree - FOHC

Pluots





# Pink-Flowering Almond – FOHC

## Kiyo's Tree, Rancho Cordova



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# Knives

Folding T-budding knife with bark lifter



Knife with folding T-budding  
and grafting blades



# Simple budding knife



# Folding T-budding knife with separate bark lifter





# Simple grafting knife





# Popular Grafting Methods

## Budding

- T-budding
- Chip budding



## Grafting

- Whip graft
- Bark graft
- Cleft graft



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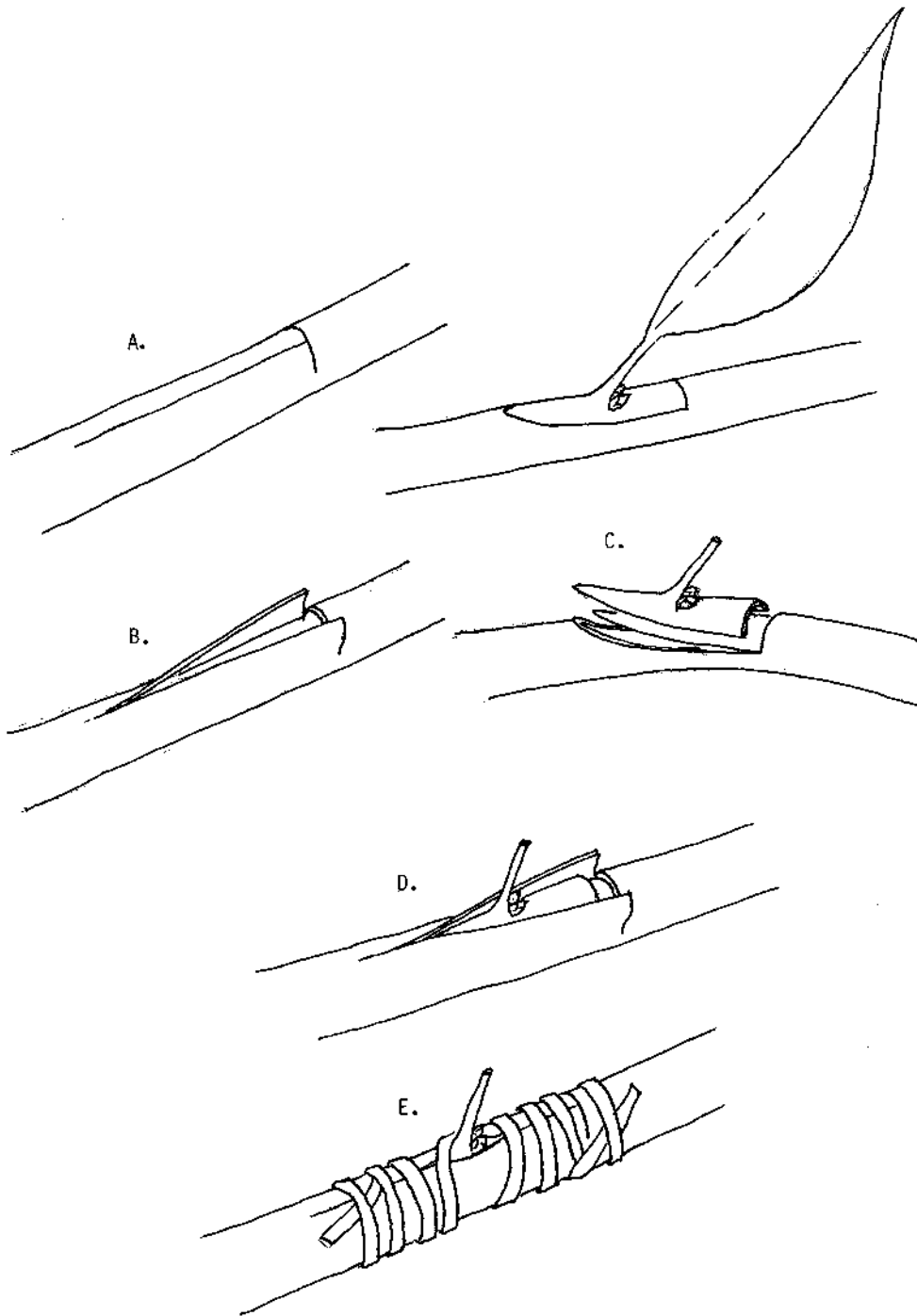


# T-Budding

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- Removal of bud of desired variety (without wood), insertion in stock
- Bark must be “slipping”
- Spring → branch for current season  
Late summer → branch for next season
- Use vigorous 1-year-old shoots,  $> \frac{1}{4}$  in.
- Cut branch  $\frac{1}{2}$  in. above top of bud to force growth

# T-Budding





# T-Budding

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Remove leaves from  
scion, leave petiole

# T-Budding

## Stock

Top of T cut into bark



Downward cut into bark



# T-Budding

## Stock

Peel back bark





# T-Budding Scion



Cut under bud,  
starting  $\frac{1}{2}$ " below bud



Cut through bark only,  
 $\frac{1}{2}$ " above bud



# T-Budding Scion



Squeeze bark, remove  
bud shield from wood



Or remove thin strip  
of wood too

# T-Budding

## Scion into Stock

Insert bud shield into T cut



# T-Budding

Wrap with budding rubber or parafilm





# T-Budding

Bud that “took”



Fall budded, headed in  
winter, new spring  
growth



# Popular Grafting Methods

## Budding

- T-budding
- Chip budding



## Grafting

- Whip graft
- Bark graft
- Cleft graft



# Chip Budding

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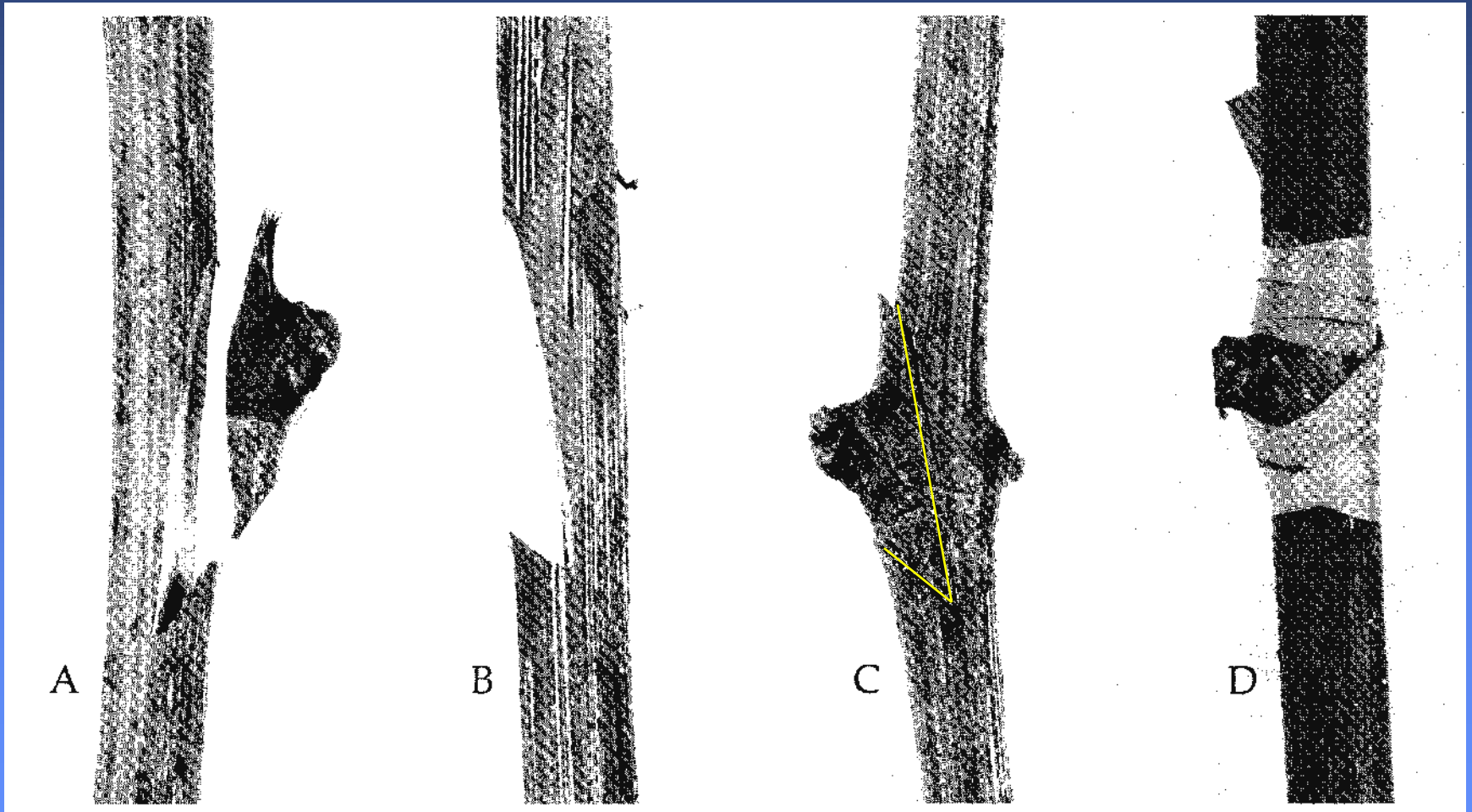
- Removal of bud of desired variety (with wood), insertion in stock
- Bark doesn't need to be “slipping”
- Done in dormant season, early spring (budwood stored in fridge), or late summer
- Use vigorous 1-year-old branches  $> \frac{1}{4}$  in.
- Cut branch  $\frac{1}{2}$  in. above top of bud to force growth

# Budwood for Chip Budding

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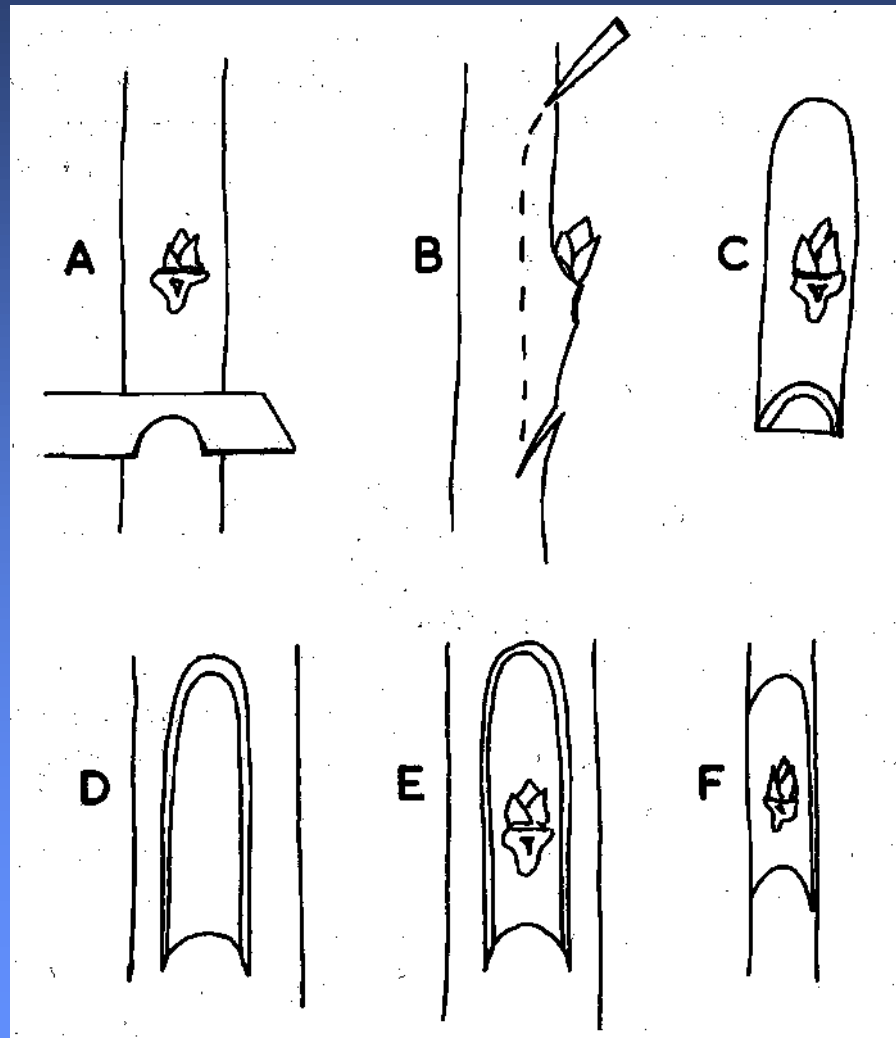
- Collect just before budding
- Base of current-season, fast-growing shoots (late summer) OR 1-year-old dormant branches (late winter / early spring)
- Buds that are mature, leaves removed
- Refrigerate immediately if needed, store in plastic bag with moist paper towel or newspaper

# Chip Budding





# Chip Budding



# Chip Budding Scion

Remove leaves from  
scion, leave petiole





# Chip Budding Scion

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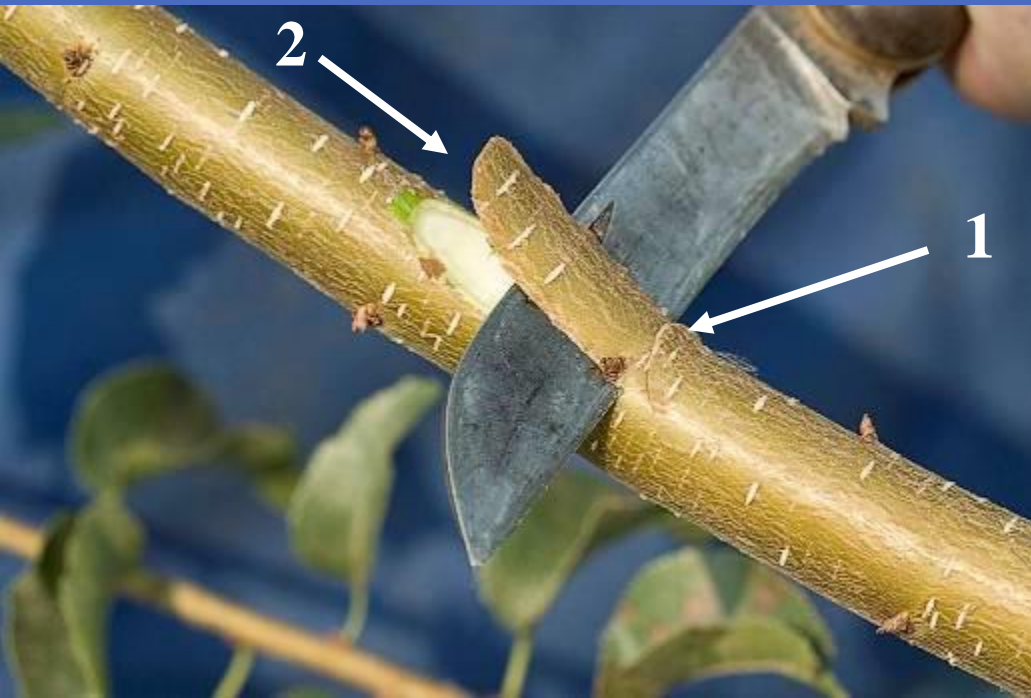
Angled cut  $\frac{1}{2}$ "  
below bud



Cut under bud to  
first angled cut

# Chip Budding

Chip (inverted) with  
angled cut  $\frac{1}{2}$ " below  
bud



## STOCK

Make the same two  
cuts in the stock



# Chip Budding Scion into Stock

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Chip inserted into  
stock



Smaller chip inserted  
on one side

# Chip Budding

Parafilm Wrapped (Single wrap over bud)



# Forcing Growth (if needed)

Girdling (Shown Here)  
and Notching



3 months after  
spring girdling

Dormant  
season





# Popular Grafting Methods

## Budding

- T-budding
- Chip budding



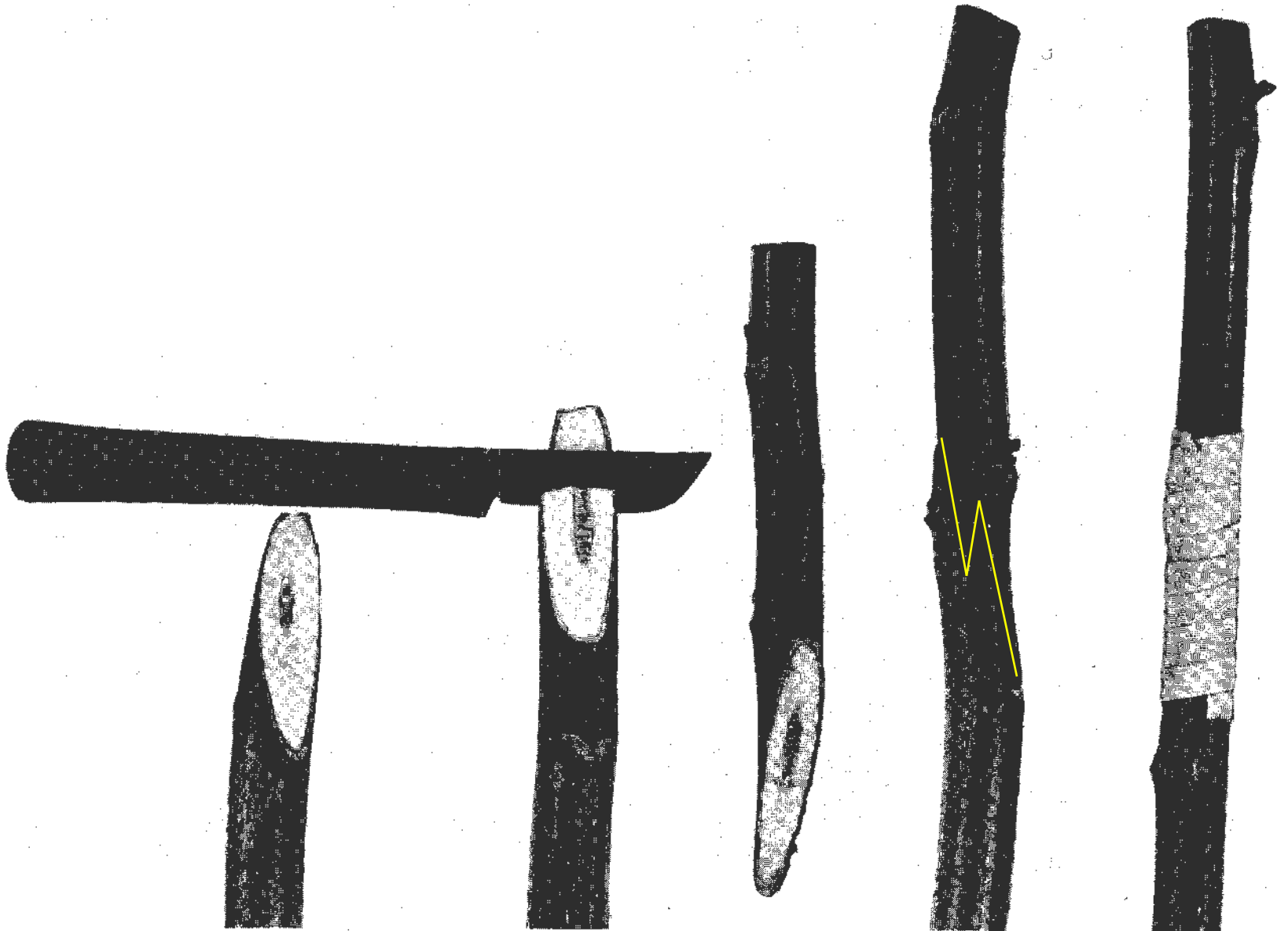
## Grafting

- Whip graft
- Bark graft
- Cleft graft





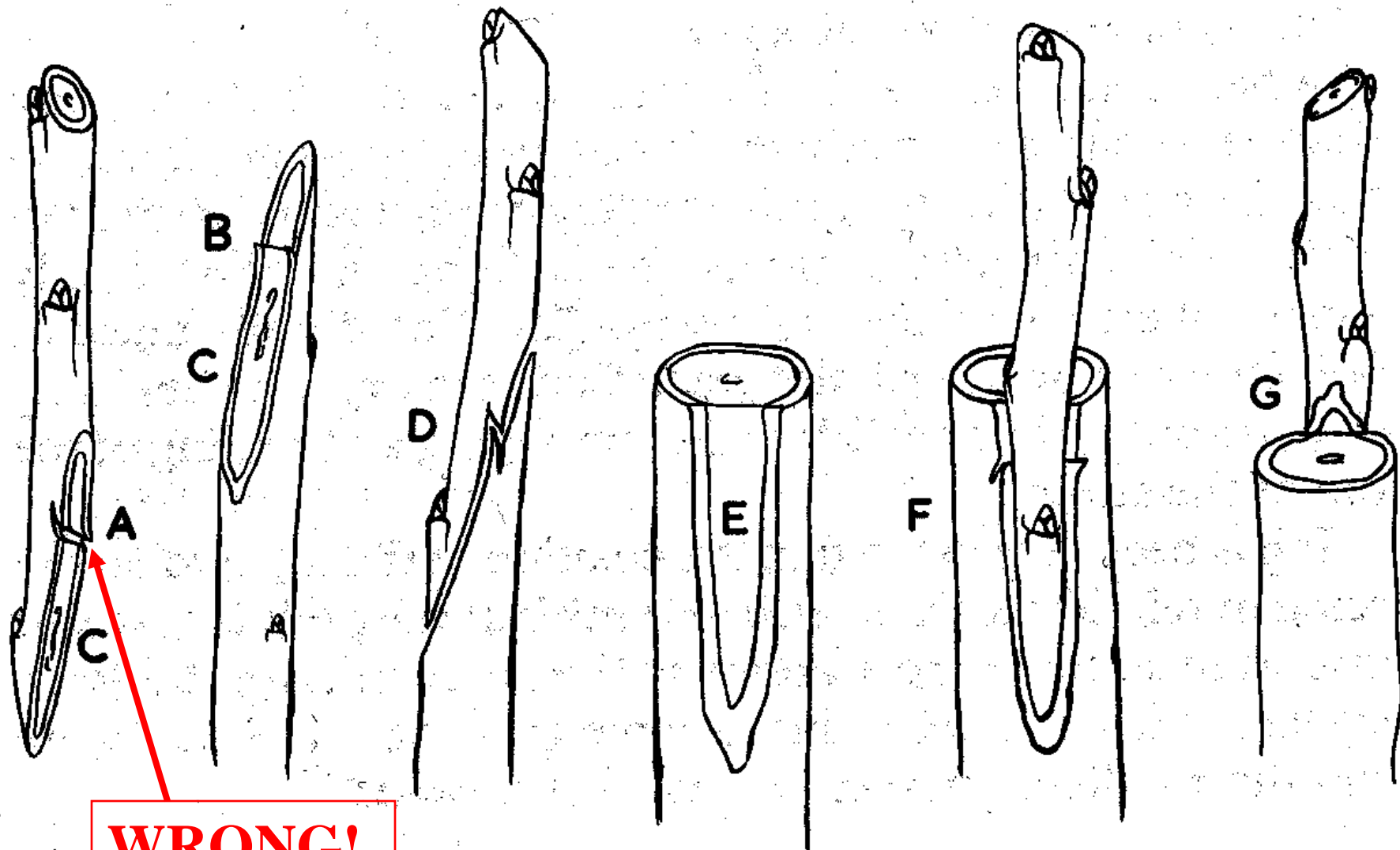
# Whip Graft



# Whip Graft

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- Removal of 1-yr.-old branch of desired variety, insertion in stock (tongue in groove)
- Done before bud swell
- 1-year-old wood – match size
- Angled cut 1-1½ in. long in stock, scion
- Vertical cut 1/3 the distance from cut tip



**WRONG!**

Fig. 57 Whip-and-tongue graft

# Whip Graft

Stock & scion of similar caliper

Make 1" to 1 ½" angled cuts in stock & scion





# Whip Graft

Slice off  
“tail”

Top of  
stock

Equal  
cuts in  
stock &  
scion

Bottom  
of scion



# Whip Graft



$\frac{1}{4}$ " vertical cut  
starting  $\frac{1}{3}$  the  
distance from the tip



Twist the knife  
outward to make  
insertion easier



# Whip Graft

Scion  
inserted  
into stock

Parafilm  
tape  
wrapped



# Whip Graft

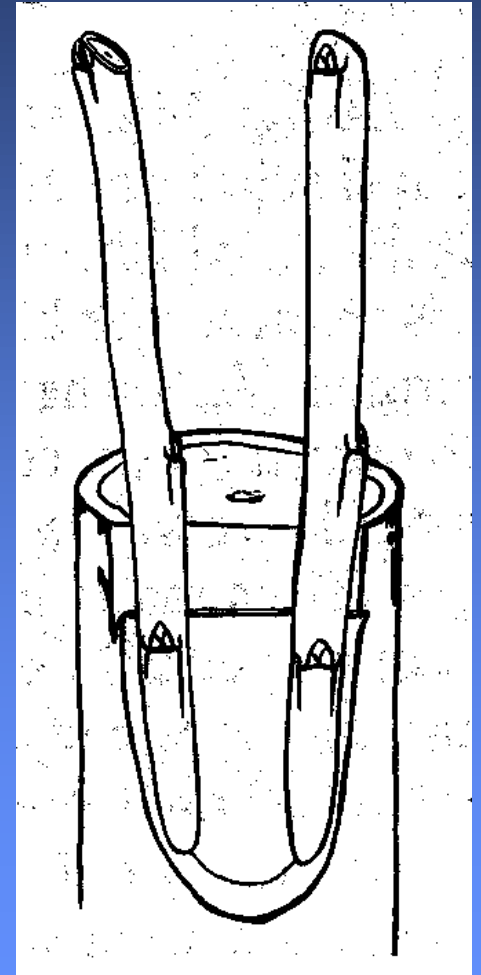
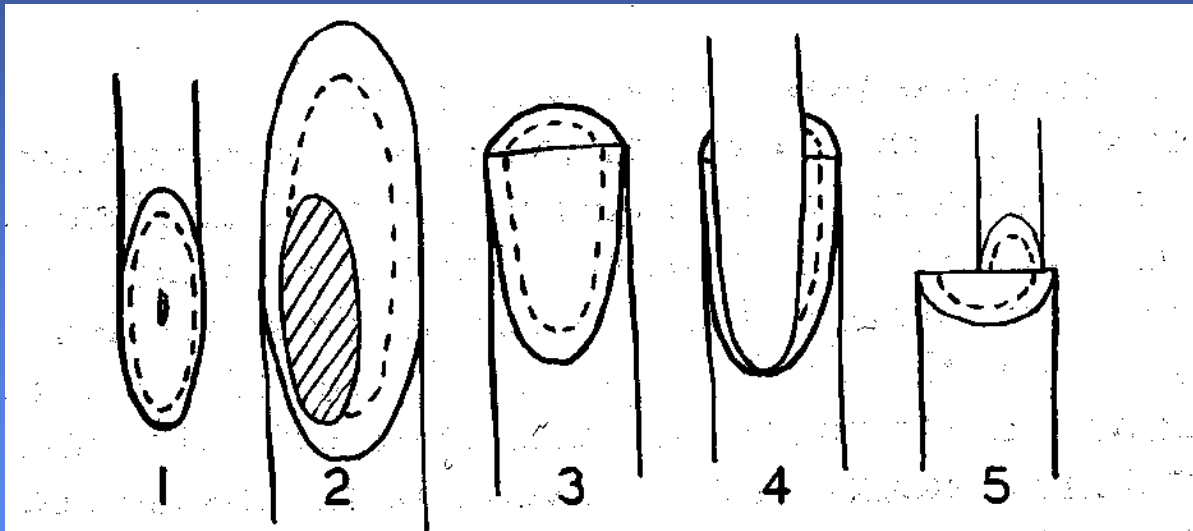
3 weeks later

Remove competing shoots





# Whip Grafting on an Older Branch or Trunk



# Whip Grafting on an Older Branch or Trunk



# Whip Grafting on an Older Branch or Trunk



# Whip Grafting on an Older Branch or Trunk





# Whip Grafting on an Older Branch or Trunk



# Commercial Walnut Grafting (early spring)

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Make cuts in bark a  
few days before  
grafting





Angled cut on stock



Vertical cut on stock



Angled cut on scion



Vertical cut on scion





Scion inserted into  
stock



Wrap graft union



Graft wrapped



Wax over tape if  
tape is not airtight;  
wax over top cut



Months later



Lower shoots weren't removed





Staked shoot



No stake was used



# Topworking



# Popular Grafting Methods

## Budding

- T-budding
- Chip budding



## Grafting

- Whip graft
- Bark graft
- Cleft graft





# Bark Graft

In spring:  
Cut off limb, scrape bark

In winter:  
Choose scion wood with  
plump buds





# Bark Graft

Choose 1-yr.old  
scion below bend



Make long  
sloping cut



Make small  
sloping cut  
on back  
side



# Bark Graft

Make 2 cuts through bark the width of the scion





# Bark Graft

Peel back bark  
between cuts



Cut bark flap,  
insert scion





# Bark Graft

Inserted scion, nail  
in flap & scion



Wax over all cuts



# Alternative Bark Graft Method

Dual sloping cuts



Use single cut in bark,  
push knife laterally

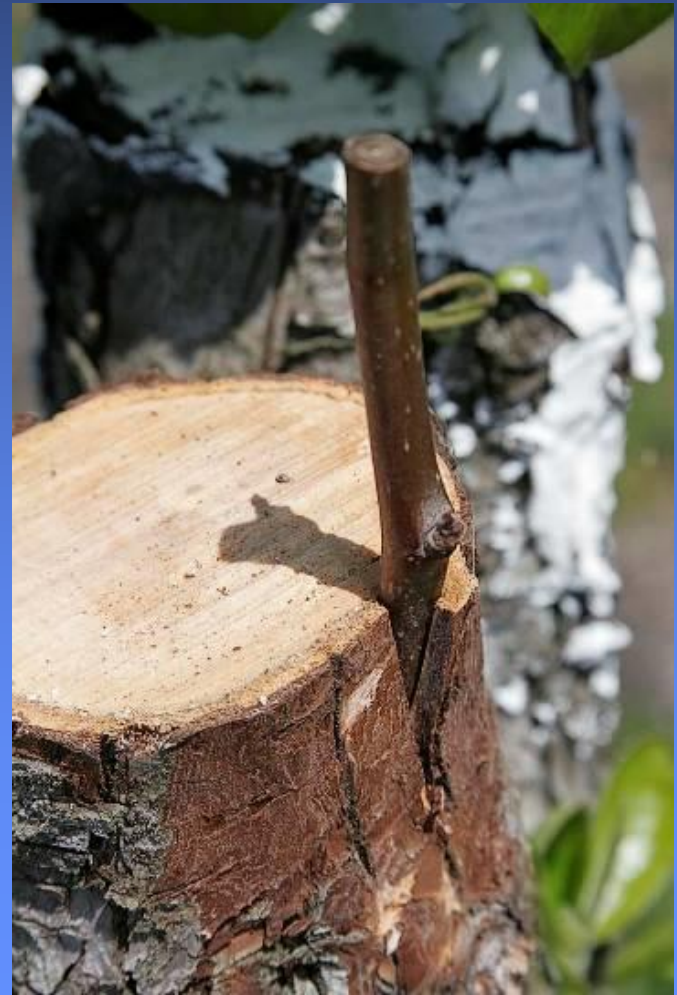


# Alternative Bark Graft Method

Insert scion



Inserted scion (no nail)





# Alternative Bark Graft Method

Wrap tightly with plastic tape



Wax over tape & all cuts



# Popular Grafting Methods

## Budding

- T-budding
- Chip budding



## Grafting

- Whip graft
- Bark graft
- Cleft graft



# Cleft Graft

Choose 1-yr.old  
scion below bend



Split stock



Hold stock  
open





# Cleft Graft

Make 2 slicing cuts at base of scion,  
slightly angled to each other



# Cleft Graft

Make angled cut at base



Insert scion in stock





# Cleft Graft

Scion inset  
in stock

Match cambiums

Use 2 scions for  
large stocks





# Cleft Graft

Wrap tightly with grafting tape



Pat on  
grafting wax



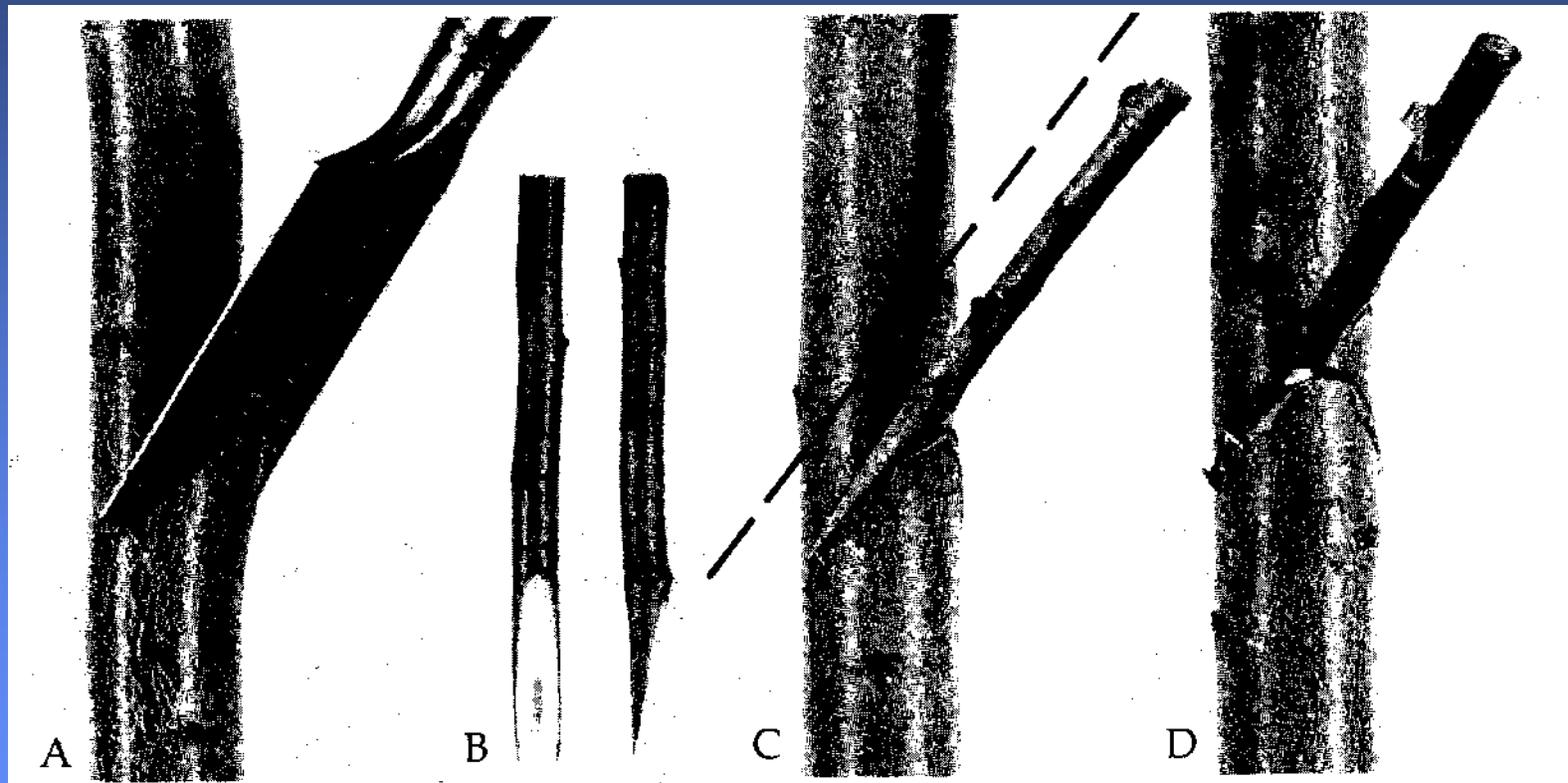
# Two Other Topworking Methods

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Side Graft

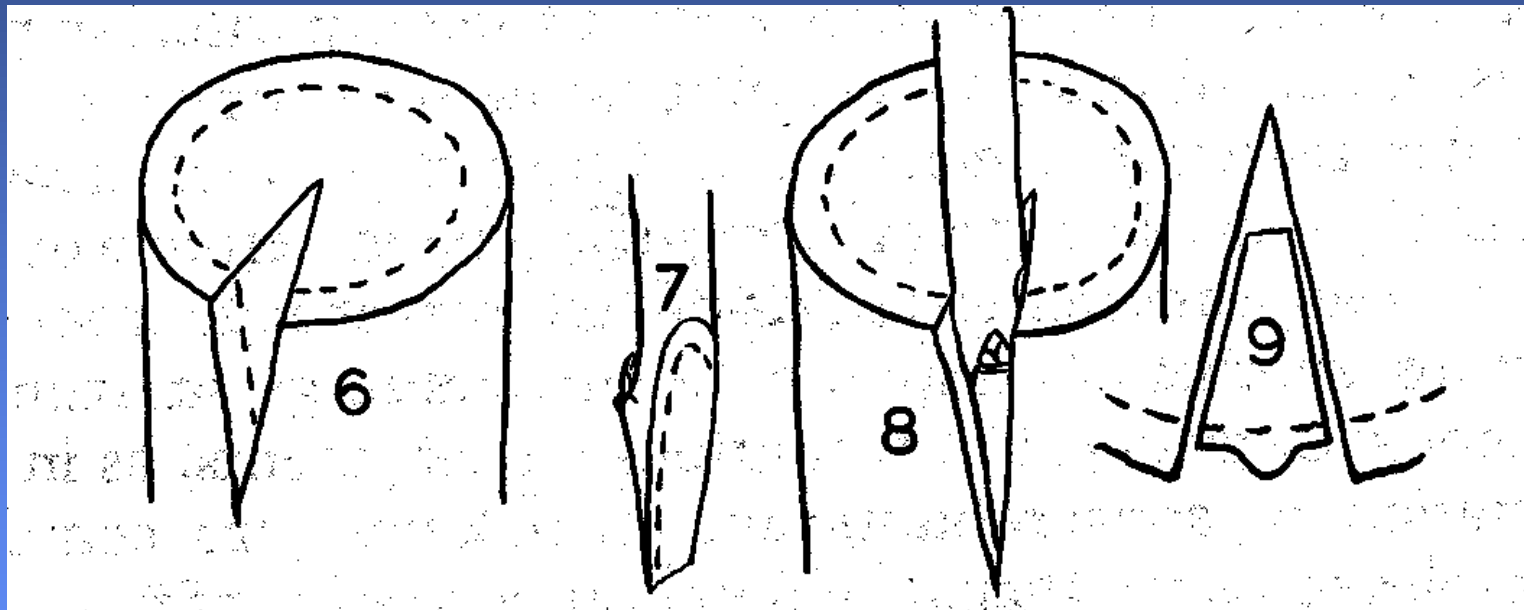
Saw Kerf Graft

# Side Graft





# Saw Kerf (Cut) Grafting













































# What Topworking Would You Do in This Situation?



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# Innovative Grafting

# Approach Graft

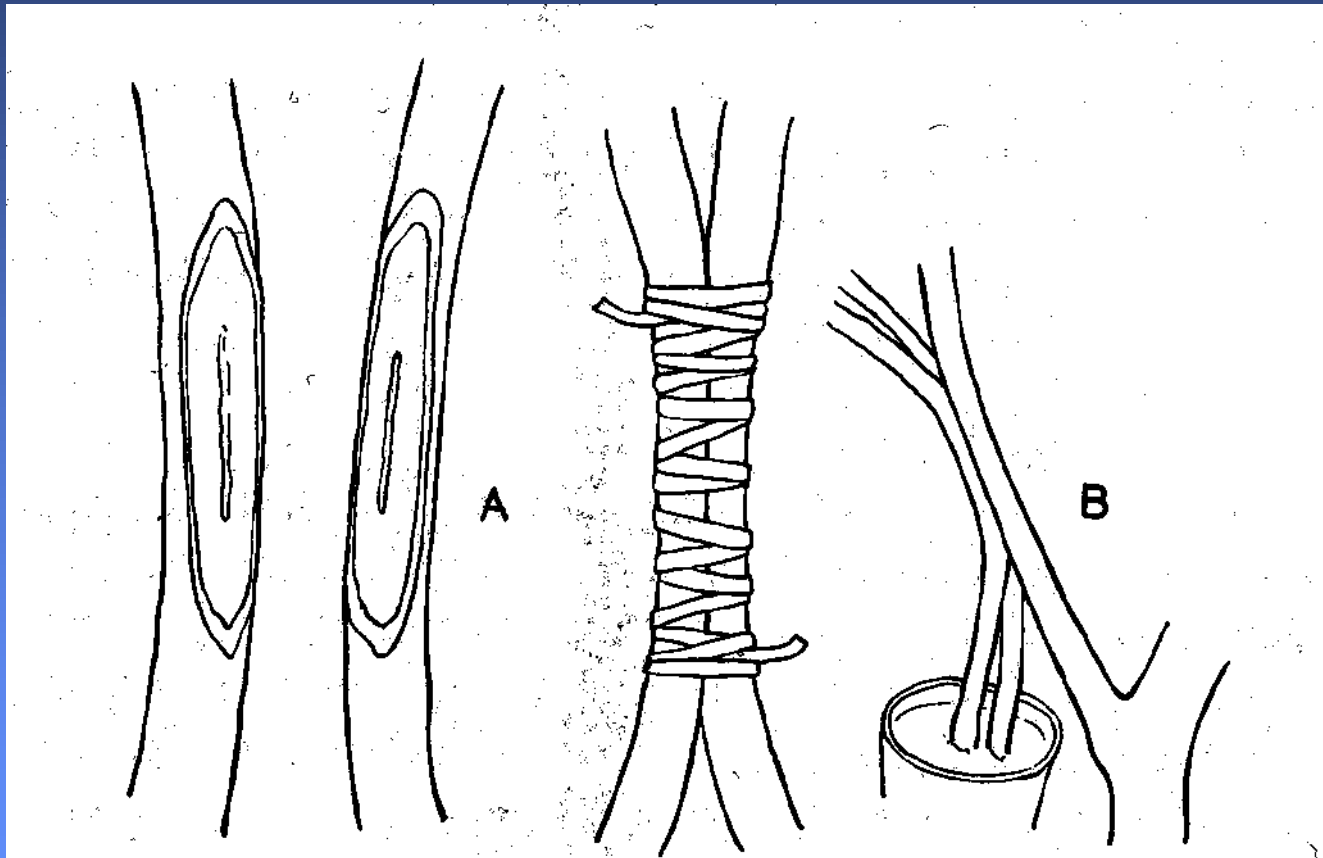
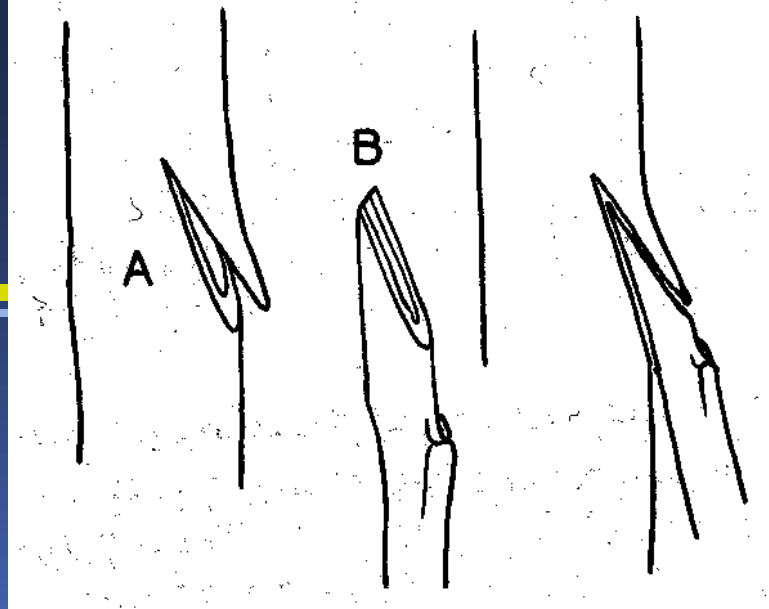
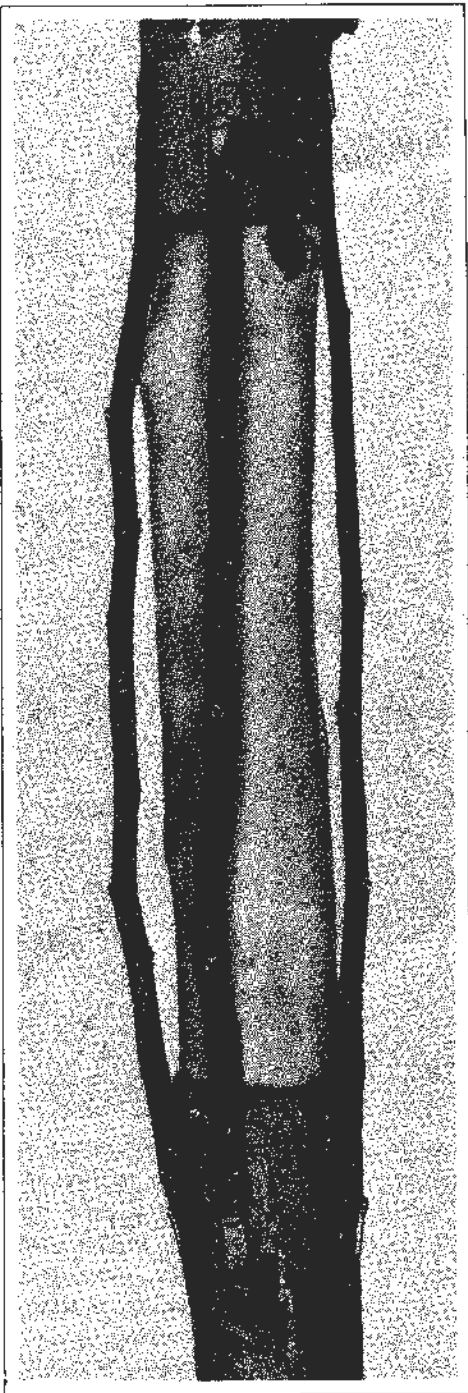


Fig. 23 Spliced approach graft



# Inarching





# Bridge Graft

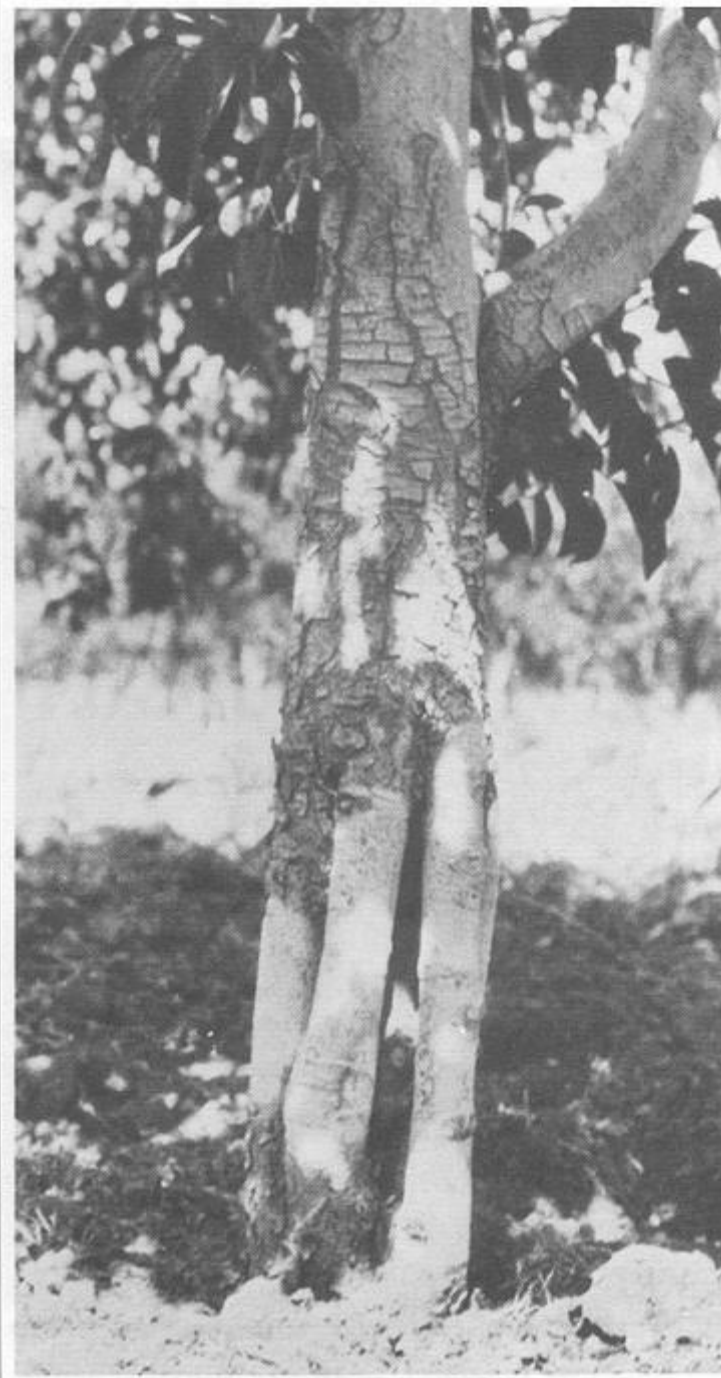


Fig. 1. Bridge graft for a broken limb.

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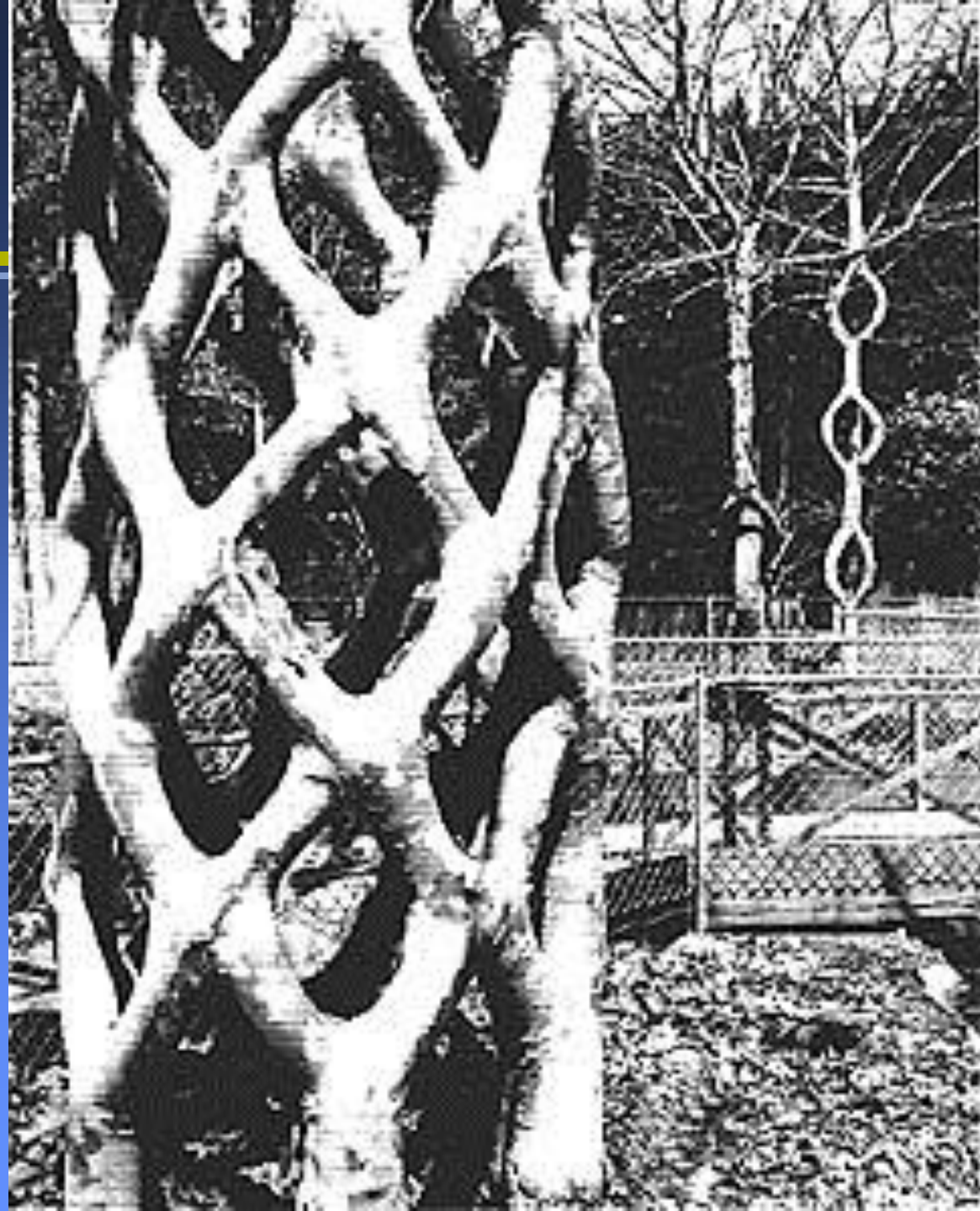
# Arborsculpture













# Tie Down Branch Beyond Graft





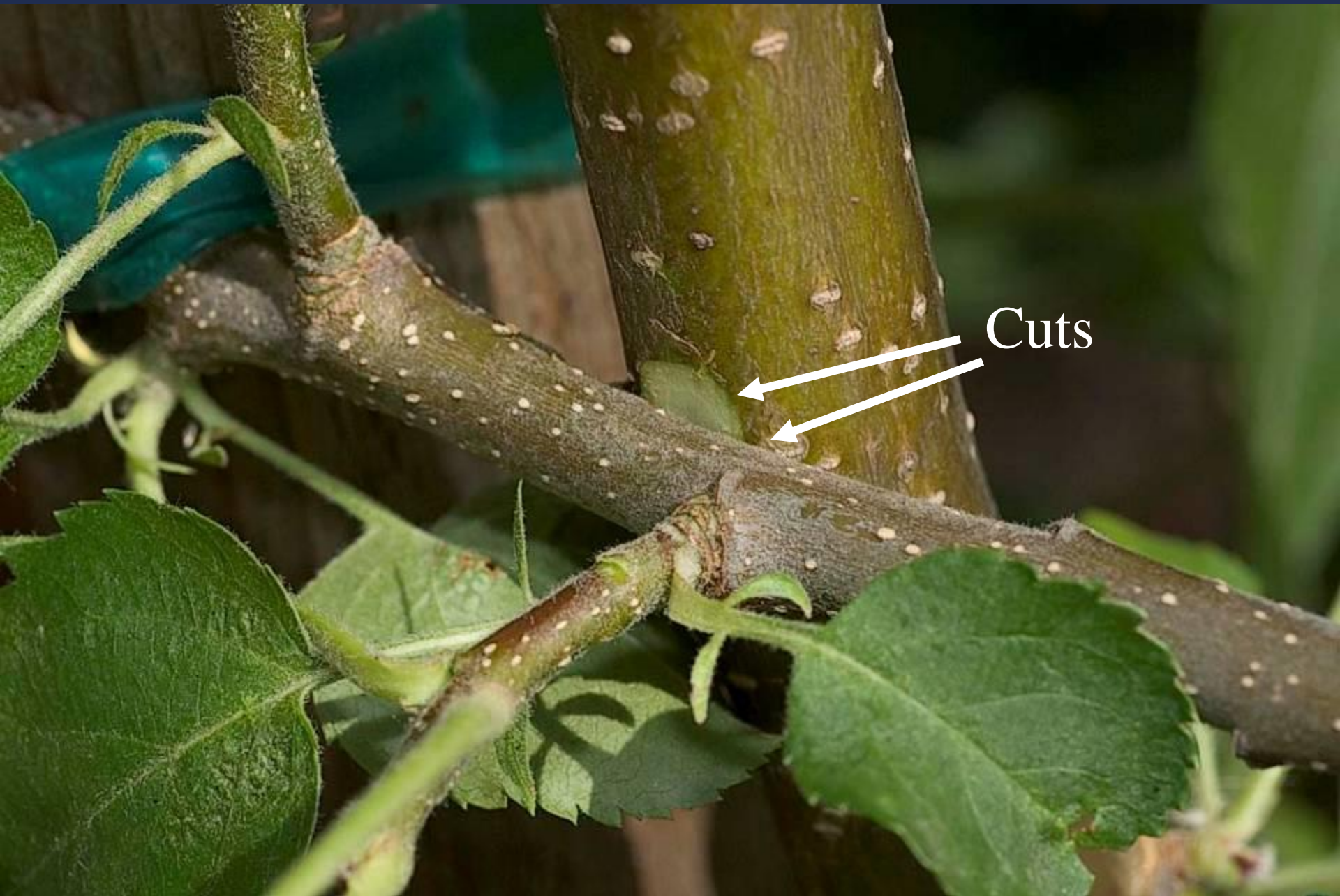
Slicing cut 1



Slicing cut 2







Cuts



The diagram shows a cross-section of a plant stem with a yellow outer boundary. Inside, two sets of white lines representing xylem and phloem rays intersect at a central point. A dashed white diamond shape is centered on this intersection. A white arrow points from the text 'Square of Cambial Contact' to the rightmost vertex of this dashed diamond.

Square of  
Cambial  
Contact



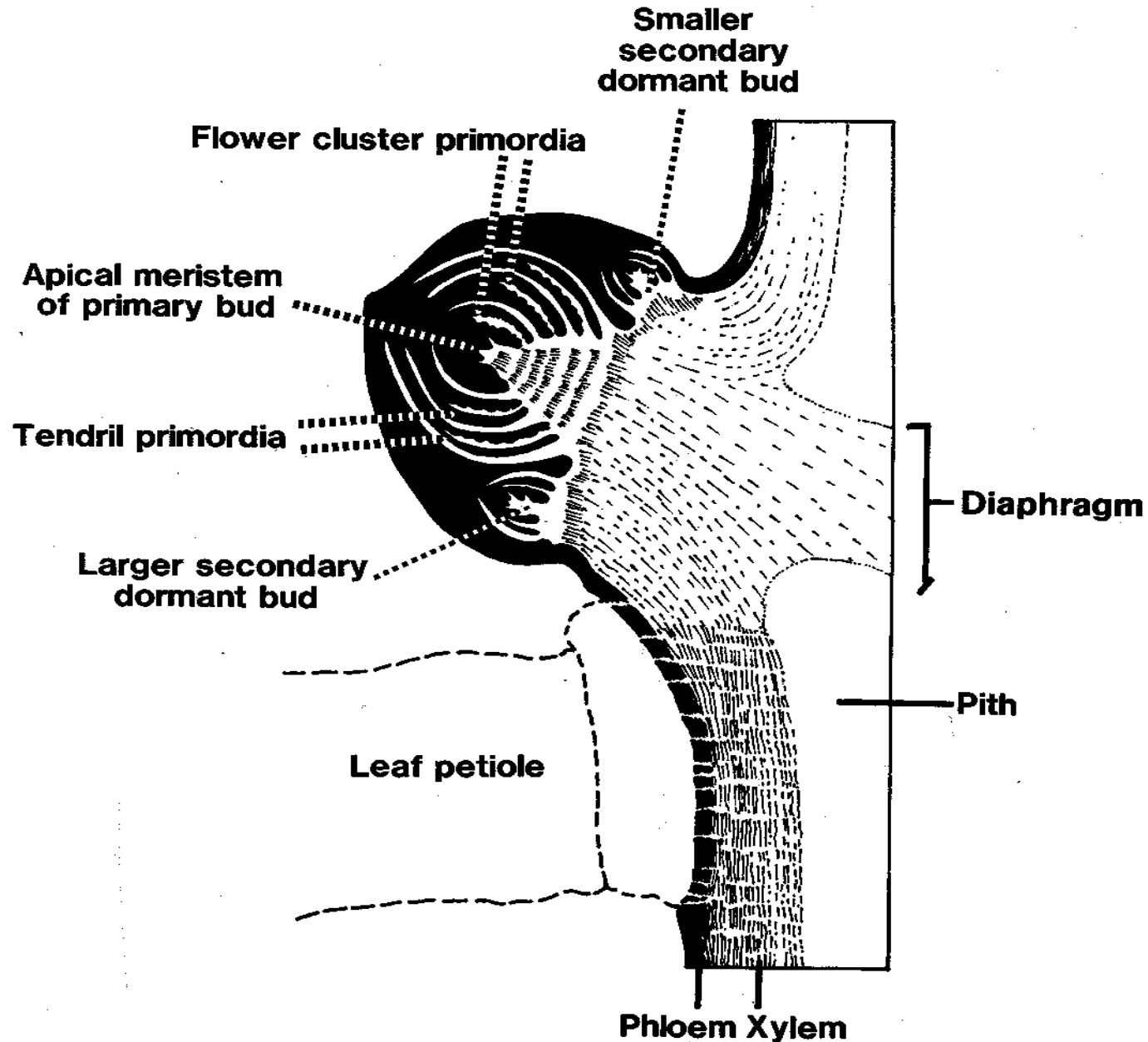




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# Grapevine Propagation

# Grape Bud





# Cane Stocks Debudded



# Scions





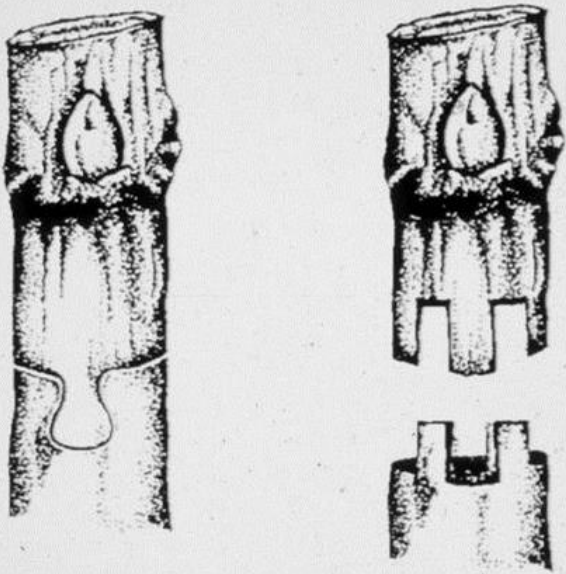


Figure 1.12. Omega cut graft (left) and revolving knife cut graft (right).

# Scions Cut





# Putting Scions Together



# Omega Grafting Machine

Figure 8. One type of machine used to prepare root grafts of grapevines and fruit trees. See figure 9 for an illustration of the graft made by this machine.

















# Growing Grapes from Cuttings

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- Take cutting from dormant vine, ½ in. dia.
- Cut to 18 in. long
- Cut off all buds but the upper 2
- Stick in loose soil, upper 2 buds exposed
- Plant 2 per hole, remove weaker one









# Questions?

