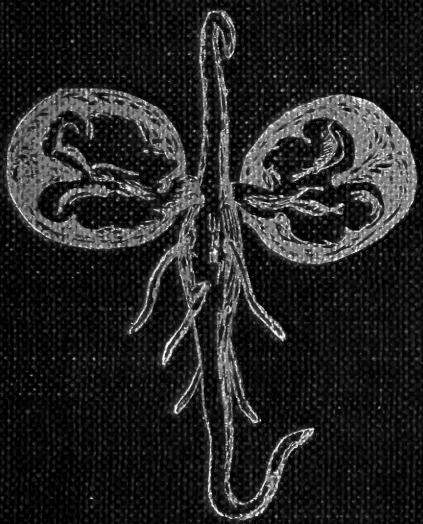
COMMERCIAL PLANT PROPAGATION



A. C. HOTTES

PLANT CULTURE

By GEORGE W. OLIVER. Propagator to the Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

THIRD EDITION

In this enlarged and revised edition Mr. Oliver gives the teachings gleaned and sifted from his experience as a practical working gardener, supplemented by that gained through many years in his specialty of plant propagating for the United States Department of Agriculture at Washington. He not only deals with those plants which are cultivated by the commercial florist, gardener and nurseryman for profit, but treats as well on the care and management of a diversity of other plants which are all interesting, but which do not generally receive the full or proper attention at the hands of authors of most horticultural works. Tells in language easily understood by the average reader the essential points in the methods of raising and caring for

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COMMERCIAL PLANT PROPAGATION

A Holland Bulb Farm

COMMERCIAL PLANT PROPAGATION

AN EXPOSITION OF THE ART AND SCIENCE OF INCREASING PLANTS AS PRACTICED BY THE NURSERYMAN, FLORIST AND GARDENER

By

ALFRED C. HOTTES

ASSISTANT PROFESSOR OF HORTICULTURE
OHIO STATE UNIVERSITY

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1918

PREFACE

A BOOK of this kind necessarily is a record of various opinions covering the ways of propagating plants. It is not a report of a discovery or discoveries, but a compilation of methods. Men have come to realize that every advancement in the art or science of doing things is for the benefit of not only themselves but for the good of all men.

Each book considers the subject matter from a different angle. This book attempts to briefly explain the art and science of increasing plants so that the florist, orchardist nurseryman, and amateur plant lover may have a guide for properly increasing his stock.

"There is no reason why every farmer, if he so desires, may not propagate all the fruits necessary for his own garden and orchard," writes W. L. Howard. "Such work can be done at little or no expense and, besides, it is pleasant and interesting."

The author acknowledges credit to all who, through their wide experience, have written of plant propagation, and especially to Thomas Meehan and George W. Oliver, both pre-eminent in their fields of nursery and greenhouse propagation. Credit is due Dr. L. H. Bailey for crystallizing the scattered information published in the "Nursery Book" of 1891.

The author welcomes suggestions and advice relating to the subject matter of this book to the end that when a new edition becomes necessary it may have increasing value.

ALFRED C. HOTTES.

Columbus, Ohio, December, 1917.

INTRODUCTORY REMARKS

THE ability to grow and multiply is characteristic of all life. The object of the life of every plant is to perpetuate its kind.

Flowers bloom with color and perfume in order that they may better produce their seeds. Plants spread their stems in the air and in the soil in order to dominate the earth as much as possible.

Darwin realized this struggle for existence and concluded that every fragrance, color, spine, tuber and adaptation contributes toward the natural ability of the plant to live.

Nature eliminates the weak; overwhelming those which cannot stand the cold or heat, those susceptible to attacks of insect and fungus and those which can not compete with their neighbors in reproductive powers.

Man shelters his favorites from the cold; improves their natural multiplication; supplies them with proper soil and the environment of their natural homes, places them on stronger roots and even crosses them to make combinations to his fancy. He produces the large fruits and the double flowers at the expense of seed production but he supplies another means of existence for the plant.

Men have noted how through accidents the tops of plants become broken and root to form a new individual; how, when roots are cut, often a new plant grows from them; how clumps of plants are broken up and each part produces a good plant; how trees rub against each other and are naturally grafted. Men have merely imitated Nature. A careful study of a plant will indicate its method of propagation.

There are two considerations in the propagation of plants: the art, and the science. The art is the craft or ability to multiply plants; the science tells why each operation is done. One is the practice; the other the theory. Each helps the other.

The gardener learns much from doing, but books lead him to see the reasons for his practice.

CONTENTS

GENERAL INDEX

AUTHORS CITED

INDEX OF PLANT NAMES

INDEX TO ILLUSTRATIONS

CHAPTER I

SEEDS

Plants not Breeding True from Seed — Germination — Longevity — Testing Seeds — Time to Sow — Annuals — Soil — Pots and Flats — Light — Suggestions for Sowing — Depth — Sowing Fine Seed — Firming — Watering — Time Required for Germination — Special Treatment — Soaking — Canna — Acid Treatment — Aquatics — Perennials — Florists' Seeds — Shrub — Tree — Scalding — Conifers — Damping-off Fungus — Broad leaved Evergreens — Easter Lilies — Cactus — Saving Seeds — Dicœcious Plants — Pollinating Tomatoes — Cucumbers.

PLANTS exist in order to produce their seeds; some die immediately after finishing this process. Seeds are entire plants in an embryonic stage and are so micrified that the oak tree is within the acorn.

The labor of seed production by a plant is trying and, when seed is not wanted, it is better to release the flowers from producing their seeds by picking the blooms as they pass their maturity.

Good looking seed is not always indicative of their ability to produce superior plants from that seed. Hidden within the sexual constitution of the seed is the secret of its real value.

It is the superior ancestry of the plant rather than the individual value of a single seed which counts. Baldwin Apples may produce good seed but they do not produce good Baldwin Apples. Many of the poor relation parents show up when the seeds are sown. In the same manner seeds from the blue Lobelias will often produce progeny with varying hues of blue flowers. Such hybrid plants whose parentage is much complicated and whose characteristics are not fixed must be propagated by other methods.

THE GERMINATION OF SEEDS

Whether a seed sprouts or not depends on four factors: water, air, heat and viability, or, the ability to live. Each seed has its proper or optimum moisture, atmospheric and temperature requirements. For example, Mistletoe seed will germinate on the trunks of trees where the conditions are often very dry. For seed germination ordinary outdoor flowers require a temperature of from 50° to 70°, conservatory plants 60° to 80°, and tropical or stove plants from 75° to 95°.

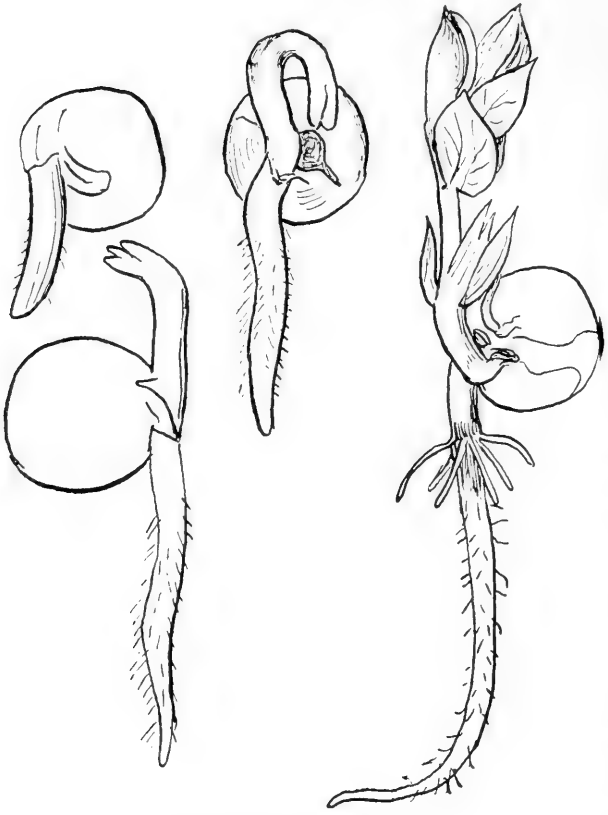


Fig. 1.—Pea seedlings

The viability of a seed depends upon a great number of factors. Seeds if immature when gathered are not so viable; they will germinate better immediately after picking than when stored for some time. Pansy seeds mature in such a way that only some of the seeds are perfectly ripe at one time. The best seed is hand-picked.

Frequently seeds are affected with insects or diseases; this will retard germination or make it impossible. The age of seeds is also important because every seed has a certain period of longevity. In some cases seeds must be sown immediately after ripening, else they do not start. Some seeds, such as those of Cucumbers, are better when two or three years old.

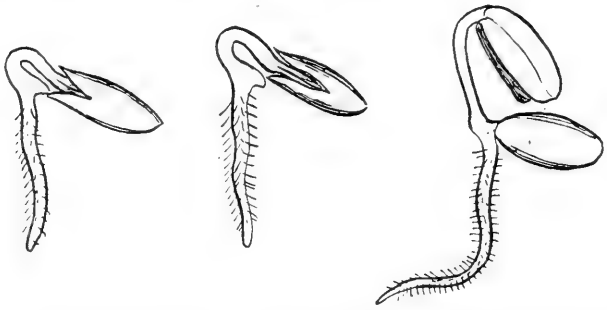


Fig. 2.—Melon germination. Note the knob on the root which catches the seed coat, holding it under the surface of the soil

LONGEVITY OF SEEDS

Regarding the longevity of seeds, H. A. Dreer, Inc., write:

"It has to be understood that in a favorable season and with perfect harvesting conditions, seeds of all sorts are liable to be of much stronger germination than they would in an unfavorable season, particularly if the conditions at the time of harvesting are not just right. The longevity of many seeds is materially increased because they are now grown in this country, particularly in California, where the conditions for their best development are nearly ideal.

The life of seeds is no doubt considerably influenced by the conditions under which they are kept over from one year to another. We believe that the proper conditions are a cool, airy place where the bags or receptacles in which the seeds are kept may be spread out, so that the air can circulate around them. This was tested out some years ago by the United States Department of Agriculture, and the result of their investigations seemed to show that seeds kept best under the same conditions that are preferred by most human beings. In other words a temperature of somewhere between sixty and seventy-five degrees is about right."

Commenting on longevity of seeds, Geo. W. Oliver writes: "Instances are common where seeds of various plants have germinated many years after they were gathered. Seeds of several leguminous genera have been known to remain in good condition for a number of years.

Among these are several which are well authenticated, notably *Desmodium gyrans*, which has been known to remain in good condition for twenty-five years, and *Gymnocladus canadensis*, which has germinated after a long time in storage. Some of the tropical tree legumes have seeds which lose their vitality only after many years when kept dry and cool. Some seeds are peculiar in that they sometimes develop only the cotyledons and the roots the first season. One or two species of *Ipomœa* have this peculiarity.

A well known instance of this nature also occurs in one or more of the common Oaks. The seeds of the Coffee plant develop the cotyledons which sometimes remain in this condition for several months before true leaves are developed."

Three *Cassia* seeds are known to have germinated when 85 years old. It is doubtful whether the wheat seed found several years ago in the pyramids of Egyt were as old as was claimed, and if so, it is hardly to be believed that they grew.

LONGEVITY OF FLOWER SEEDS IN YEARS

(Derived mainly from data furnished by H. A. Dreer, Inc.)

Abutilon	3-4
Achillea	2
Acroclinium	2-3
Ageratum	2-3
Agrostemma	3-4
Agrostis nebulosa	2-3
Alyssum	2-3
Amaranthus	3-4
Ampelopsis	1
Anchusa	2
Anemone	2
Antirrhinum	3-4
Aquilegia	2
Arabis	2-3
Armeria	2
Asters, China	2-3
perennial	1-2
Auricula	2
Balloon Vine	3-4
Balsam	6-8
Baptisia	3-4
Begonia	2
Bellis	2-3
Bocconia	1
Brachycome	3
Briza maxima	2-3
Browallia	2-3
Cacalia	2
Calceolaria	2-3
Calendula	3-4
Calliopsis	2-3
Campanula	2-3
Canary Bird Vine	3-4
Candytuft	2-3
Canna	3-4
Carnation	3-4
Cassia	2-3
Celosia	4-5
Centaurea	2
Cerastium	2
Chrysanthemum	3-4
Cineraria	3-4
Clarkia	2-3
Clematis paniculata	1
Cleome	2-3
Cobæa	1-2
Coix	2-3
Coleus	2
Convolvulus	3-4
Coreopsis	2
Cosmos	2-3
Cyclamen	2
Cypress Vine	3-4
Cyperus	1
Dahlia	2
Datura	3-4
Delphinium	2
Dianthus	3-4
Digitalis	2
Dimorphotheca	2
Dolichos	3-4
Dracæna	1
Echinocystis	4-5
Echinops	2
Eryngium	2-3
Erysimum	3-4
Eschscholtzia	2
Eupatorium	2
Euphorbia	3-4
Ferns	3-4
Gaillardia	2
Gaura	2-3
Geranium	3
Geum	2
Globe Amaranth	2-3
Gloxinia	2-3
Godetia	2-3
Gomphrena	2-3
Gourds	5-6
Grevillea	1
Gynerium	2-3
Gypsophila	2
Helenium	3-4
Helianthus	2-4
Helichrysum	2-3
Heliopsis	2-3
Heliotrope	1
Hibiscus	3-4
Hollyhock	4-5
Humulus	1
Hunnemannia	2
Iberis	2-3
Impatiens	5-6
Ipomœa	3-4
Iris	2
Kochia	2
Lantana	1
Larkspur—Annual	3-4
Lathyrus latifolius	3-4
Lavandula	2
Lavatera	3-4
Liatris	2
Linaria cymbalaria	2
Linum	5-6
Lobelia cardinalis	2-3
Lobelia erinus	3-4
Lunaria	3-4
Lupinus	3-4
Lychnis	2-3
Lythrum	2
Marigold	3-4
Marvel of Peru	2-3
Matricaria	2
Matthiola	3-4
Maurandia	2
Mesembryanthemum	3-4
Mignonette	2-4
Mimosa	2-3
Mimulus	3-4
Momordica	4-5
Musa	¼-½
Myosotis	2
Nasturtium	3-4
Nemesia	2
Nicotiana	3-4
Nierembergia	3
Nigella	2
Pansy	2-3
Papaver bracteatum	3-4
Pennisetum	2-3
Pentstemon	2
Petunia	3-4
Phlox Drummondii	1-2
Physostegia	2
Platycodon	2-3
Poppy	3-4
Portulaca	3-4
Primula chinensis	2
elatior	2
Forbesii	2
japonica	½
kewensis	2
malacoides	2
obconica	1

LONGEVITY OF FLOWER SEEDS IN YEARS—Continued

Primula polyanthus 2	Schizanthus.....2-3	Thunbergia..... 2
vulgaris..... 2	Smilax.....2-3	Torenia.....2-3
Pueraria.....3-4	Solanum.....4-5	Tritoma..... 1
Rhodanthe.....2-3	Solidago..... 2	Tunica.....2-3
Ricinus..... 3	Statice.....1-2	Verbena.....2-3
Rudbeckia..... 2	Stevia.....2-3	Veronica.....2-3
Salpiglossis.....4-5	Stocks.....4-5	Vinca.....1-2
Salvia..... 2	Stokesia..... 2	Viola.....1-2
Sanvitalia..... 2	Sweet Peas.....3-4	Wallflower.....5-6
Saponaria..... 2	Sweet Rocket....3-4	Xeranthemum... 2
Scabiosa.....2-3	Tagetes.....3-4	Zinnia.....3-4

LONGEVITY OF VEGETABLE SEEDS

(Revised from Vilmorin)

Angelica.....2-3	Grass, Millet..... 2	Rape..... 5
Barley..... 3	Orchard..... 2	Rhubarb.....3-8
Beans.....3-8	Timothy..... 2	Rosemary..... 4
Beets—garden. 6-10	Kohl-Rabi.....5-8	Rye..... 2
sugar..... 6	Leek.....3-9	Sage.....3-7
Broccoli.....5-10	Lettuce.....5-9	Salsify.....2-8
Buckwheat..... 2	Maize.....2-4	Sea Kale.....1-7
Cabbage.....5-10	Mustard.....4-9	Soy Bean..... 2
Carrot.....4-5	Oats..... 3	Spinach.....5-7
Cauliflower.....5-10	Okra..... 5	Squash.....6-10
Celery..... 8	Onion.....2-7	Strawberry.....3-6
Clover, red..... 3	Parsley.....3-9	Tomato.....4-7
Corn..... 2	Parsnip.....2-4	Turnip.....5-10
Cucumber..... 10	Pea.....3-8	Thyme.....3-7
Egg-Plant..... 6	Pepper.....4-7	Watermelon....6-10
Endive..... 10	Pumpkin.....5-9	Wheat..... 2
Flax..... 2	Radish.....5-10	Wormwood.....4-6

TESTING SEEDS

A federal law now in force prohibits the importation of adulterated seeds of most of our grasses, besides Alfalfa, Clover and many cereals. Weed seeds as well as seeds of lower commercial value are considered adulterations. The United States Department of Agriculture is doing much to enforce disseminating good seeds and will test any doubtful samples that may be sent to them. Each grower may test for impurity and adulterations by using a small hand-lens.

Much labor and space are frequently wasted by misjudging the value of seeds. The best test takes into consideration not only the percentage of germination but the growth during a whole season as well as the amount of impurity.

For the germination test, a soup plate may be conveniently used (see fig. 3). Circles of canton flannel or blotting paper are cut to fit the plate. By dividing the cloth into four divisions, four varieties of seed may be tested at one time. Either ten or twenty-five of the seeds to be tested are counted and placed upon the cloth which is moistened. The dish is then covered with another plate to prevent drying. Day by day the number of seeds in each division that germinate should be counted. If 50 per cent germinate the seeds must be sown twice as thickly.

Before using the cloth for a second test it should be boiled to kill molds which will interfere with the results.

Large seed testers may be purchased, which have space for many kinds of seeds, with which the temperature and moisture can be perfectly regulated.

Most reliable seedsmen conduct thorough tests of their seeds; not only germination tests but tests of varieties growing them on test gardens located in various latitudes. Many firms print a statement of the percentage of germination upon each seed package.

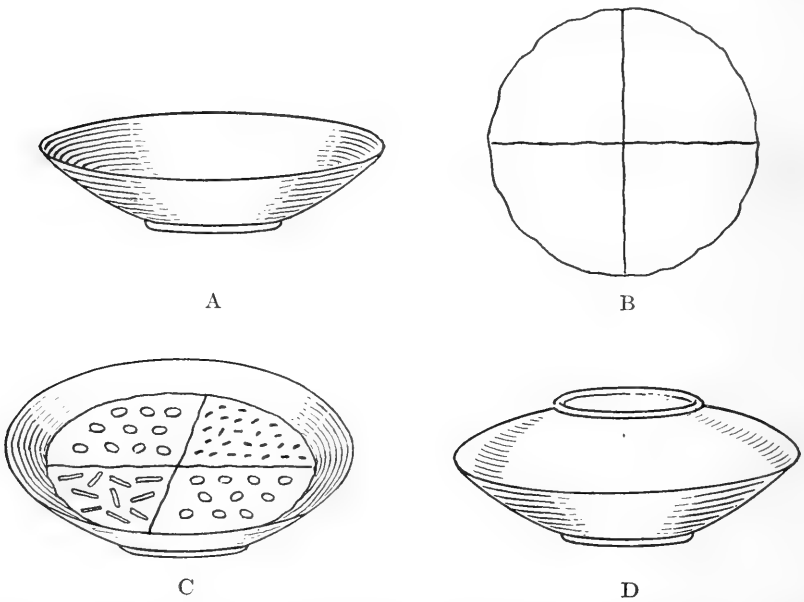


Fig. 3.—Seed testing. A, A soup plate. B, The piece of canton flannel. C, Canton flannel in plate with seeds in each division. D, The plate covered by another one]

TIME TO SOW SEEDS

It is highly important that seeds be sown in season so that the plants may mature at the proper date for their use or sale.

ANNUALS

Annuals are plants which make their entire growth in one season, usually producing their bloom and seed before the frost. In the list following are certain annuals which will stand much cold and may be sown in the open soil as soon as it can be worked; those marked with an asterisk (*) are best sown in flats under glass in late March and later transplanted and sold in small boxes or pots. Plants marked with a dagger (†) are not easily transplanted; they are sown where they should bloom. Plants marked (z) are sown also in June for a later or second crop. The earlier sown annuals are:

Vegetables

Beet	Kale	Parsley*	Spinach; also in Autumn
Cabbage*z	Kohl-Rabi	Parsnip	
Carrot	Leek	Pea†	Swiss Chard
Cauliflower*z	Lettuce	Radish†	
Celery z	Onions	Salsify	Turnip

Flowers

Alyssum*	Dianthus*	Morning Glory†	Sweet Peas, may be sown near Easter; being early.†
Bachelor's Button	Dimorphotheca	Nasturtium*	
Candytuft*	Hollyhock	Petunia*	
	Marigold*	Poppy†	

Certain other flower seeds may be sown at this time but it is best to start them in the coldframe or greenhouse because the growth is slow in the cold soil.

The following annuals are not sown in the open ground until danger of frost is passed. The plants marked with an asterisk (*) and intended for sale, benefit by being sown in flats under glass in March. Plants marked with a dagger (†) are not easily transplanted.

Vegetables

Beans, Bush, Lima and pole sorts†	Corn†	Melon†	Okra
	Cucumber†	New Zealand Spinach	Pepper*
	Egg-Plant*		Pumpkin†
		Tomato*	

ANNUALS—Concluded

Flowers

Antirrhinum*
Arctotis
Balsam
Bartonia†
Brachycome*
Cacalia
Calendula*
Castor Bean*
Celosia
Centaurea*
China Aster*
Chrysanthemum
Clarkia
Collinsia
Cosmos*
Dianthus*
Eschscholtzia†
Gaillardia
Gilia
Godetia*
Gourds†
Gypsophila
Larkspur*
Leptosiphon
Linum
Mexican Poppy†
Mignonette†
Nemesia
Nemophila
Nierembergia
Nigella
Nolana
Phlox*
Portulaca
Salpiglossis*
Salvia
Sanvitalia*
Scabiosa
Schizanthus*
Statice
Sunflower
Sweet Sultan
Torenia*
Verbena*
Virginia Stock
Zinnia*

SOIL FOR SEED SOWING

Soil for sowing seed must always be finely pulverized and in the best physical condition. A sandy loam suits most seeds the best. Soils which are too heavy should be lightened by the addition of sand or even coal ashes. It always pays to use the best soil for starting the seedlings and if this is not available, where the plants are to grow permanently, the seed may be sown in a good place and transplanted later.

Seed beds, if in the proper physical condition, need no manure. The young seedlings are not able to take up much food. In fact, much humus or organic matter may be actually detrimental to the seeds, even hastening disease.

POTS AND FLATS FOR SOWING SEEDS

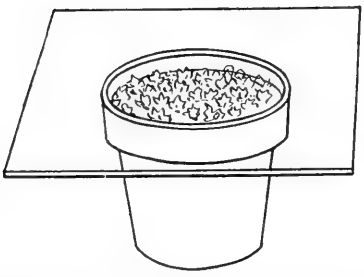


Fig. 4.—Seedlings in pot covered by pane of glass

When a limited quantity of plants are wanted, flower pots (see fig. 4) may be used for seed sowing. Broken pottery and ashes should fill the pot half full. The remainder should consist of finely-sifted soil. Where it is desired to sow a larger quantity of seeds, wooden flats (see fig. 5) will be found more useful. Do not make them much over twelve by eighteen inches, and three to four inches deep. Larger flats are cumbersome and when used for more than one kind of seed, are hardly ever as serviceable because of the uneven germination. The flats should also be lined with some sort of roughage for good drainage.

The soil must be perfectly level and slightly compacted. Make the rows from one inch to two inches apart, according to the seed, and sow the seeds usually from one-quarter inch to an inch apart, according to the variety. Seeds which are sown too thickly are sure to cause spindling plants which are difficult to transplant. Only sow seeds requiring like conditions for germination in the same flats. For example: Sweet Alyssum sown in the same flat with Cockscomb is unsuccessful; the Alyssum will be ready for transplanting before the Cockscomb is above the soil.

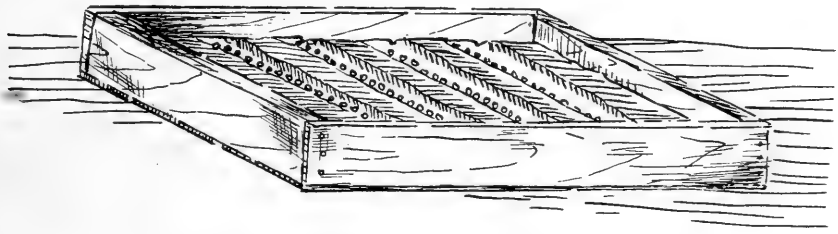


Fig. 5.—Seeds sown in flats (See page 24)

LIGHT AND SEEDS

Most seeds do not prefer light while germinating. In fact, Larkspur, Adonis and Poppies are somewhat deterred in germination by bright conditions. It is usually customary, therefore, to afford some shade to seed beds or pots. Out of doors such shade is supplied by lath screens; indoors, newspapers placed over the pots and seed boxes will be serviceable.

SUGGESTIONS FOR SEED SOWING

Plant in rows. It would seem best to sow most seeds in rows or drills rather than broadcast. (See fig. 5.) By this method they are easily cultivated for the removal of weeds, at the same time transplanting can be more simply done.

DEPTHS OF SEED PLANTING

Deep planting is a common blunder and a great cause of failure. The supply of oxygen is cut off from the seeds and if the seedlings are small, difficulties are encountered in trying to push up the heavy clod above.

The majority of larger seeds should be covered about two or three times their diameter, but in the case of outdoor sown seeds much depends upon the time of the year they are sown.

FIRM THE SOIL

In order to bring the moist soil into contact with the seeds, the soil should be firmed over the rows by slight pressure of the hands or with a hoe. In sowing seeds out of doors late in Summer, this is especially necessary because the soil to some extent, has lost its moisture.

SOWING VERY FINE SEEDS

An excellent method of getting the best results from very small seeds is to use a mixture of leaf mold and loam and cover with a thin layer of sifted sphagnum moss. The seeds are sown on the sphagnum and are not covered with soil. A pane of glass is placed over the pot. By this method plenty of moisture is available for good germination, but later the watering must be diminished.

Such seeds as those of Petunias, Salpiglossis, Ornamental Tobacco, Begonias, Thyme, Gloxinia, Gesneria, Tydæa, Lobelia, Mimulus and Calceolaria, may be sown in this manner. The water should be supplied from below by placing the pot in a pail of water.

When the sphagnum moss is not used, W. N. Craig* suggests cutting a piece of tissue paper and laying it over the surface of the soil and watering over this. The paper keeps the seeds from washing to the side of the pot and prevents the soil from drying out. The paper decays readily and allows the seedlings to push through it. For young seedlings to become dry for a few hours in the hot sun would be fatal and if too much moisture is available there is danger of decay.

"There is an old-fashioned method† of seed sowing specially applicable for seeds which are slow in germinating, such as Primulas and Streptocarpus, though it is also an ideal plan for all fine seeds, including Begonias, and as the writer first saw it in operation many years ago in an old lady's window, he designates it *Grandmother's Method of Seed Sowing.*

It is simplicity itself, while results are almost certain.

One and one-half inches of fine soil is placed on top of an ordinary building brick, pressing the soil fairly firm. Sow the seed thinly, and very fine seed must only be slightly pressed into the soil, or covered

* Craig, W. N. Seed Sowing Suggestions. From Trans. of Mass. Hort. Society, Part I, 1917, p. 20

† Suggestions for Seed Sowing, published by W. Atlee Burpee & Co.

not more than one-sixteenth of an inch. The brick is then placed in a large plate, or flat, containing one inch or so of water, which will keep the brick and soil continually moist, thus eliminating the danger of washing out the seed or of the soil becoming dust dry, as so often happens when using pots or boxes.

It is well, however, to guard against overwatering; therefore, if the soil at times appears to be too wet, remove the brick from the water for a few hours until it partly dries out."

WATERING

Great care should be exercised in watering, not only because the seed may be washed out of the drills, but excess water may cause the spread of the damping-off fungus. This disease is especially bad when the seedlings lack air. Small dribblings applied frequently, rather than proper applications of water at needed intervals, cause the formation of a crust which will interfere with the ease of germination; later it will cause an unbalanced and shallow root system.

TIME REQUIRED FOR GERMINATION

Seeds vary greatly in the number of days required for germination. Many gardeners make a grave blunder by discarding a seed bed before an opportunity has been given the seed to come up under normal conditions. As new seeds will often germinate more rapidly than older ones, when old and new seeds are mixed the seedlings may continue to germinate for weeks.

Many of the first seedlings of florists' flowers are the strongest and the poorest in floral quality. The gardener is careful to save the later and more puny seedlings, for they are often the doubles and the finer or newer colors. This is especially true of Petunias and Primroses. T.D. Hatfield† writes: "Among Rhododendrons the first in a batch to bloom are always the strongest growers and the poorest in flower."

Refer to the following table for the number of days required for germination of flower seeds:

Number of Days Required For Germination.

	Days		Days		Days
Abutilon	20	Ageratum	5	Aquilegia	15
Acroclinium	15	Alyssum	5	Arctotis grandis	20
African Golden Daisy	15	Ampelopsis	15	Asparagus	30
Agapanthus	20	Anchusa	20	Asters	8
Agathæa cœlestis	20	Anemone, St. Brigid	15	Asters, Perennial	15
		Antirrhinum	20	Baby's Breath	20

† Hatfield, T. D. Methods Used in Propagation of Plants. From Trans. of Mass. Hort. Soc., 1916, p. 100.

NUMBER OF DAYS REQUIRED FOR GERMINATION—Continued

	Days
Ball of Fire	15
Bachelor's Button	*5
Balloon Vine	25
Balsams	10
Begonias	15
Bellis perennis	5
Boston Ivy	15
Blanket Flower	20
Blue-eyed Daisy	20
Blue Day Flower	20
Blue Salvia	*15
Brachycome	8
Brazilian Morning Glory	8
Browallia	20
Brugmansia arborea	15
Bush Eschscholtzia	8
Butterfly Pea	15
Cactus	30
Calendula	10
California Poppy	8
Campanula	8
Canary-bird Flower	*
Candytuft	5
Cannas	*15
Canterbury Bells	*15
Cardinal Climber	5
Carnations	8
Carnations, Perennial	8
Castor Beans	15
Celosia	20
Centaurea	*5
Centrosema	15
Chinese Bellflower	30
Christmas Orchid Flower	20
Chrysanthemums	5
Cigar Plant	*8
Cineraria	5
Clematis, Tuberous	*30
Cleome pungens	20
Cobæa scandens	15
Cockscomb	20
Coix lachryma	*
Coleus	20
Columbine	15
Commelina	10
Coreopsis	20
Cornflower Aster	*
Cosmos	5
Crimson Flax	8
Cuphea	*8
Cyclamen	25
Cyperus alternifolius	25
Cypress Vine	5
Dahlias	5
Daisies	20
Daturas	15
Delphinium	15
Dianthus	5
Digitalis	20
Dimorphotheca	15
Dolichos	15
Dusty Miller	*5
Echinocystis	*30
English Double Daisy	5
Eschscholtzia	5
Euphorbia	20
Evening Primrose	5
Everlasting Flowers	*
Feverfew	20
Fire-Cracker Plant	*8
Fire-on-the-Mountain	20
Forgetmenot	15
Four O'Clock	5
Foxglove	20
Fuchsia	*30
Gaillardia	20
Geraniums	20
Gloxinia	15
Godetia	15
Gourds	15
Grass Seed	*
Gypsophila	20
Helianthus	15
Helichrysum	5
Heliotrope	15
Heuchera sanguinea	20
Hibiscus	*15
Hollyhocks	5
Hop, Japanese	15
Horn of Plenty	15
Humble Plant	8
Hunnemannia	8
Hyacinth Bean, Japanese	15
Ice Plant	*5
Impatiens Sultani	15
Ipomœas	5
Iris	*50
Ivies	*
Jack-and-the-Beanstalk	15
Japanese Bean	15
Japanese Hop	15
Japan Iris	*50
Jerusalem Cherry	*20
Job's Tears	*
Kenilworth Ivy	5
Kochia scoparia	15
Kudzu Vine	15
Lantana	15
Larkspur	15
Lathyrus	25
Lavender	20
Lemon Verbena	8
Linaria	5
Linum	8
Lobelias	8
Love-in-a-Mist	8
Lychnis	20
Mallow Marvels	*15
Marigold	5
Marvel of Peru	5
Maurandia	*25
Mexican Fire Plant	20
Mesembryanthemum	*5
Mignonette	5
Mimosa	8
Mimulus	8
Mina lobata	5
Mirabilis	5
Monkey Flower	20
Moonvines	20
Morning Glory	5
Mountain Honeysuckle	20
Mourning Bride	20
Musk Plant	20
Nasturtium, Dwarf Tall	8
Nicotiana	20
Nigella	8
Œnothera	5
Ornamental Grasses	*
Ostrich-Plume	20
Oxalis	20
Palm	15
Painted Tongue	5
Pansies	8
Passion Flower	50
Peas, Sweet	15
Pelargoniums	20
Pentstemon	20
Perennial Peas	25
Petunias	20
Pheasant-Eye Pink	5
Phlox	20
Pinks	5

* Indicates an indefinite number of days.

NUMBER OF DAYS REQUIRED FOR GERMINATION—Concluded

	Days		Days		Days
Platycodon	*30	Schizanthus	20	Sweet Sultan	*5
Poppies	20	Sensitive Plant	20	Sweet William	10
Portulaca	20	Shasta Daisy	20	Ten-Weeks Stocks	5
Primroses	*15	Smilax	15	Umbrella Plant	25
Primulas	*15	Snapdragon	20	Verbena	8
Pueraria Thunbergiana	15	Solanum	*20	Vinca	*
Ragged Robin	20	Spider Plant	20	Violas	*
Ricinus	15	Stocks	5	Violets	*
Rose	*	Stokesia	*	Wallflower	5
Rose, Moss	20	Straw Flower	5	Water Lilies	*
Salpiglossis	5	Summer Bush Cypress	15	Wedding Bells	15
Salvia	*15	Sunflower	15	Wild Cucumber Vine	*30
Scabiosa	20	Sun Plant	20	Youth and Old Age	5
Scarlet Runner	8	Swan River Daisy	8	Yucca	*
Scarlet Sage	*15	Sweet Peas	15	Zinnias	5

From the Catalog of Conard & Jones Co., West Grove, Pa.

* Indicates an indefinite number of days.

SPECIAL TREATMENTS FOR GERMINATION

Certain seeds germinate very slowly when left to the ordinary methods of treatment. For example, in sowing seeds of Parsley and Celery the rows should be covered with burlap which will conserve the moisture and hasten germination.

SOAKING SEEDS

Garden seeds, especially Beans, Peas, Beets, Squash, Cucumbers, Celery, Parsley, and Parsnips, are soaked in water. Such soaking should only be continued until the seed coats are softened; further soaking injures the seeds, causing them to decay when sown in the moist soil. Proper soaking hastens germination and is beneficial, but it is better not to soak them at all than to allow them to remain in water too long.

CANNA SEED

Canna seed is as hard as shot. F. P. Avery describes an experience with starting seed. He says: "March 22d I received some seed. I have access to an emery wheel, and I ground down to the white meat on every seed. That same evening I poured hot water on them, and kept them in hot water until the evening of March 27th, giving the seeds a five days' bath. I found four seeds showing

a white germ the size of a pin-head. I put the lot in a big dish of sand, covering them about an inch. The dish stood in a hot place over a stove, where the seeds luxuriated in bottom heat and had hot sunshine. Fifteen days after I put the seeds to soak there were more than two hundred plants, averaging two inches in height." Instead of using an emery wheel, the seeds are frequently nicked with a file.

ACID AND ALKALI TREATMENTS

The bony covered seeds are frequently treated with weak acids which serve to soften the seed coat. If Raspberry or Blackberry seeds are soaked in vinegar their germination will be hastened. Sweet Peas are treated with sulphuric acid, commercial strength, for half an hour, then thoroughly washed. Old seeds or those with a very hard coat will frequently germinate after this treatment when they would not otherwise. In the *Agricultural News* of Barbadoes, West Indies, we read: "If seeds are treated with chlorine water (two drops of chlorine to 60 c.c. of water) and then stood in the sun, they will germinate completely in six hours. The seeds must be removed from the chlorine water, and washed, however, directly the radicle appears. Chlorine has a decomposing effect on water in the presence of light, breaking it up into hydrogen and oxygen, and the rapid germination is due to the action of the nascent oxygen liberated by the chlorine. Hard seeds need a preliminary soaking in water before steeping them in chlorine solution. Alkaline substances, e. g., ammonia, soda, etc., in highly dilute solution, also aid the process of germination.

Another curious method consists in watering the seeds with a solution of formic acid (1 in 5000) at a temperature of 25° to 30° C. This treatment dissolves the integument, and plants which normally require eight or ten days will germinate in as many hours.

In some experiments carried out last year in France, and described in *Le Jardin*, seeds of Radishes and other Cruciferae were made to germinate in less than eight minutes by plunging them in hot water, and then laying them between rags soaked in boiling water in a small flower pot nearly filled with moist earth, and kept at a warm temperature."

AQUATICS FROM SEED

Certain seeds of aquatic plants when not kept in water must be artificially treated by acid or nicking. Sow each seed in a separate thumb pot, submerging the pots in tanks of warm water. Many

of the sorts, if started in early Spring, flower the first year. Seeds of the following water plants should be treated as suggested: *Acorus* (Sweet Flag), *Aponogeton* (includes *Ouvirandra*, the Lace Leaf), *Cabomba* (Prince's Feather), *Caltha* (Marsh Marigold), *Cyperus* (Sedges and Umbrella Palm Grass), *Eichhornia* (Water Hyacinth), *Limnanthemum* (Floating Heart), *Limnocharis* (Water Poppy), *Ludwigia*, *Nelumbium* (Egyptian Lotus), *Nymphæa* (Pond Lily), *Orontium* (Golden Club), *Pontederia* (Pickerel Weed), *Sagittaria* (Arrowhead), *Typha* (Cattail) and *Zizania* (Water Oats).

Many of these seeds may be sown in larger pots as other perennials but they should be submerged.

Geo. W. Oliver writes: "Seeds of the Gigantic Water Lily, *Victoria regia*, should be sown in February in the warmest house. The water must be clean and free from the lower forms of aquatic growth. The seeds should be sown in thumb pots, one to a pot. The first leaves of the seedling Victoria are grass-like, then halberd-shaped, but eventually assume the peltate form. In Washington when properly grown the leaves of the seedling should be 12 inches in diameter by the 10th of May.

Many attempts to grow this, the queen of Water Lilies, are frustrated because the young plants are taken from a warm temperature and placed in water out of doors, the temperature of which is much below that of the hothouse. To grow the Victoria successfully the receptacle for the plant should be large enough to hold at least several cartloads of rich soil and hold a good sized frame and sash on top of the soil. The water in the frame by this device will be kept warm and the young plants will develop rapidly by this treatment. When the plant has made a start the frame and sash are removed.

Subsequent attempts to grow this queen of aquatics without the protecting frame always resulted in poorly developed plants. When a good flower of the Victoria opens about Midsummer or later save some of the pollen from it and dust it over the stigmas of the succeeding flowers. This will result in the ripening of many seeds.

The size of this plant, the first one grown in Washington, was much larger than any other plant grown out of doors in this country, the diameter being 6 ft. 6 inches. During the following Summer the frame was discarded and the result was a much smaller Victoria."

SOWING SEEDS OF PERENNIAL FLOWERS

For sowing the seeds of perennial flowers, coldframes are used. The seeds are sown in rows about six inches apart. After sowing, the frames should be watered and the soil mulched with cut grass or a

layer of finely sifted, well decayed, manure. This mulch will serve to keep the soil from drying out, thus preventing the formation of a crust over the seeds. If the manure is used it will supply the seedlings with food.

Many perennials bloom the first year from seed; these may be sown in early Spring (see list p. 139). The other sorts, of which plants are wanted for the succeeding year but which are not expected to bloom during the current season, are sown in July or August. The late sown perennials will be just germinating during the hot, dry season; moisture must be supplied and some kind of screen (see figs. 7 and 8) used to shade the bed, especially, when the seedlings are very small.

The seedlings when transplanted may be placed in 2 inch or 2½ inch pots or they may be planted in frames (see fig. 6). If the rows are planted 5 inches apart ample room for their growth is available by removing, from alternate rows, the plants for Fall or early Spring sale. Some of the perennials remaining in the frames may be left to bloom as the rows will then be 10 inches apart.

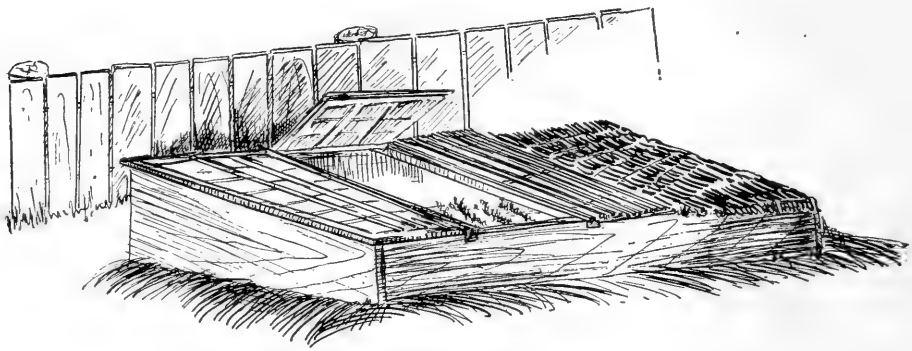


Fig. 6.—Coldframe for sowing perennials. The first and second sections are provided with sashes, the third has a lath screen for shade and the fourth is covered with a straw mat for Winter protection

FLORISTS' SEED TIME TABLE

Acanthophœnix. Many remain two years before germination. 70°.
Ageratum. February. In flats.
Annuals, half hardy for bedding. March. Sown in flats or pots.
Hardy. April, or later out of doors.
Antirrhinum. February and March for outdoor plants; April for Winter bloom.
Ardisia. Early Spring.
Areca lutescens. January or when seed can be procured. 75° to 80°.
Asparagus. February or any time. Sow in flats.
Asters. March or April. Coldframe.

FLORISTS' SEED TIME TABLE—Continued

Begonia semperflorens. January and February in flats or pots; use leaf mold in the soil.
Bellis. August. In coldframe. Give shade until seedlings are well up.
Buddleia. February cuttings are preferred.
Calceolaria. January and February or June. (See p. 26.)
Carludovica. Same as Kentia.
Castor Bean. April and May. Sow each seed in separate pot.
Centaurea. January and February. Use flats and light soil.
Cineraria, First sowing, May.
Second sowing, August 15.
Last sowing, September 15. (See p. 26.)
Cocos Weddelliana. January. In flats.
Cyclamen. July to January. Use leaf mold and light soil. Flats.
Dracæna indivisa. February. Sandy soil. 65°.
Dusty Miller. January to March. Light soil.
English Daisy. (See Bellis.)
Gesneria. January. (See p. 26.)
Gloxinia. January to February. In flats. (See p. 26.)
Grevillea. December to March. In flats.
Hollyhock. July. Flats.
Jerusalem Cherry. January to March. In flats.
Kentia. July. In greenhouse. 75° to 80°.
Mignonette. March to April, in pots in greenhouse; April to May, in field; August, for Winter forcing.
Myosotis. August 15. In coldframe.
Pansy. August 1-10. In coldframe.
Perennials. May to August. In flats or coldframe. (See pp. 30 and 139.)
Primroses, obconica (early and second sowing). Early sowing, March. Second, in May.
chinensis. April.
malacoides. June.
Salvia. February. In flats.
Schizanthus. September to November.
Smilax. February to April. In flats.
Solanum. February. In flats.
Sweet Peas. According to Dr. A. C. Beal, who has given extensive study to the Winter-flowering Sweet Peas, seed sown:

August 20	blooms	Christmas
September 1	"	January
September 15	"	Main crop February
October	"	March
November	"	Latter part of March
December	"	April
January	"	April to May
February	"	From May on
March	"	May and June

Verbena. February. In flats.
Vinca rosea. Late August. Sow in frame; or sow in December indoors. Winter indoors in flats or pot in 2-in. pots.
Violas, bedding. August. In coldframe.

SHRUB AND TREE SEEDS

When the fruits of many of the berried or juicy fruited shrubs are thoroughly ripened, they should be gathered and placed so that the mass of berries may ferment. This will allow the pulp to be washed from the seeds.

In this group we are especially thinking of the Hawthorn, Regel's Privet, Rhodotypos, Roses, Barberries, Boston Ivy, Euonymus and Viburnums. The seeds are often sown immediately in flats, placed in coldframes and in many cases are subjected to the Winter freezings which will soften and crack their seed coats. Some growers prefer to wait until February before subjecting the seeds to the frost. This method is known as stratification.

Sand is frequently used instead of soil as the material in which to sow the seeds. When the ground can be worked in the Spring the seeds are sifted from the sand and sown in rows. If planting is delayed the seeds will have sprouted and will suffer injury by handling.

Maples, Ailanthus, Birch, Catalpa, Chestnut, Beech, Ash, Hickory, Butternut, Locust, Black Walnut, and Basswood should be stratified. Besides these trees, the seeds for raising stocks of Apples, Cherries, Peaches and Plums are also subjected to the frost.

Jenkins in the "Art of Propagation" gives excellent notes on the practice of raising trees from seed. He writes: "As a general rule, forest trees, and many other seeds, should be planted in the Fall soon after they ripen, or, if reserved for Spring planting, should be mixed with earth, moss, leaves, or other material, to prevent drying; imitating, in a measure, the conditions and protection as observed in nature.

For seeds of the nut-bearing tree class, as Acorns, Chestnut, Hickory, black and white Walnut, the open field, if of mellow, rich soil, makes a good and sufficient seed bed.

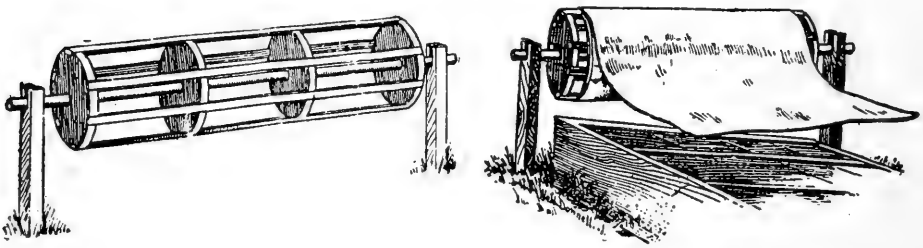


Fig. 7.—An excellent method of having a screen which can be rolled over the seedlings in a coldframe

After the ground is thoroughly cultivated, mark out with a plow as for Corn or Potatoes, planting the seeds closely in the light furrows or drills.

The drills may be made at any convenient distance. If cultivated with a hoe they need be but a foot apart; but, unless cramped for room, they had better be sown in broader drills, and the drills three or four feet apart, so that the space between them may be stirred with the horse hoe or cultivator.

If the planting is done in the Fall, it is better to mulch the ground with straw, leaves, marsh-hay, or any like material; this will prevent baking of the soil after the Spring rains, and keep it in a nice mellow condition. The mulching should be removed in the Spring, or, at least so much that it will not interfere with the growth of the young seedlings.

The smaller seeds, such as Maple, White Ash, Tulip, Linden, Magnolia, etc., require greater care in planting.

Let the soil be thoroughly pulverized, then throw up into beds a few feet wide, and any desirable length. Mark out and plant in drills by placing a board across the bed, making the drill along the edge of the board with a sharpened stick, or, with the corner of the hoe; then sow the seed in the drill as you would Peas, or Beet seed; cover lightly, and then turn forward the board for a new drill. The width of the board regulates the distance apart of the drills, and as such seedlings are not usually allowed to grow more than one year before transplanting, the board need not be more than eight or ten inches wide. Mulch with straw if planted in the Fall, removing the same in the Spring.

Gathering of Tree Seeds. Seeds of the nut-bearing trees are easily gathered, but with Maple and other small seeds, gathering from the ground is exceedingly tiresome. Many of the small seeds, when fully ripe, may be shaken from the tree on large sheets of canvas spread underneath.

With Maples, if the tree can be spared it may be cut down when the seed is nearly ripe and first begins to fall. They can be rapidly stripped from the branches by hand. On small trees they may often be gathered from the branches without cutting the tree. In gathering, after they have fallen on the ground, the leaves must first be raked off, and the seed gathered up mainly by hand picking.

Tulip seed is gathered when the cones first begin to open. The cones, which are made up of seeds, are usually picked from the tree by an active climber. Our northern *Magnolia acuminata* seed grows in pods, closely resembling a young green Cucumber; hence the name, Cucumber Tree. These pods may be gathered after they

have turned a red or pink color, and begin to open, showing the red seeds. Spread them out in the air after they are gathered. In a few days the seed is readily shelled out."

SCALDING SEEDS

Seeds which are not affected by freezing are frequently scalded. Boiling water is poured over them and allowed to cool. This process is used with Honey Locust, the Kentucky Coffee Tree and Chorizema.

CONIFERS FROM SEED

Few American nurserymen grow Evergreen seedlings. More profit is usually gained by importing them from countries where labor is cheaper and the climate is more generally suited to them. There is, however, a real need for the small nurseryman to sow a few flats of certain kinds. Evergreen seeds may be sown in the greenhouse in the Autumn which will make a larger plant by the following Autumn than those sown out of doors. Such seedlings should be transplanted either in small pots or flats.

The greenhouse may be shaded during the Summer, in which case the seedlings may be kept indoors during the Summer. Lath-sheds or frames covered with lath or cloth screens (see figs. 7 and 8), will also be useful. During the Winter a protection of partially decayed leaves should be given. The following Spring the seedlings may be set in the field or kept in the frames for another year.

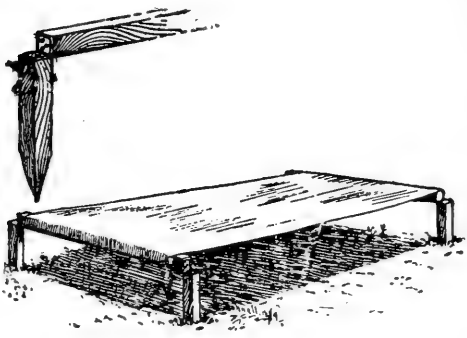


Fig. 8.—Convenient shading for young seedlings, especially shrub and evergreens. Note that frame is hinged so that it can be turned back when watering or caring for the plants

When the seeds are sown in seed beds rather than in the greenhouse, the beds are best covered with burlap to retain moisture and keep out animal pests.

The following conifers are grown from seed:

Abies	Cryptomeria	Picea	Retinispora
Biota	Juniper	Pine	Sciadopitys
Cedrus	Larix	Pseudolarix	Taxus
Chamæcyparis	Libocedrus	Pseudotsuga	Thuya

In raising seedlings of *Picea pungens*, the Colorado Blue Spruce, many of the plants are not of the desired deep blue. These must be discarded because even from the best plants the seed does not come perfectly true.

In sowing seeds of *Juniperus virginiana*, the Red Cedar, Joseph Meehan writes that the best success is obtained when "seeds were planted in the Fall, twelve months after being gathered. When planted in early Spring, eighteen months after being gathered, there always seemed to be a big loss. I have for three years in succession sowed one part in Fall and the other part in early Spring. The seeds were all the same and all stratified in the same manner, but the Fall sown were always far the better. In the main, this agrees with what is known of Juniper, Holly and other seeds in what refers to its taking a year for the seeds to be in the ground before germinating, but the point that it is better to sow in the Autumn rather than in Spring is not well known, and this will be of value to those who have such seeds to sow.

The best plan to follow is to procure the seeds as soon as ripe, mix them with fine soil and place outdoors, letting them remain until the following Autumn. Then separate the seeds from the soil, if possible; if not, sow all as it is. The next Spring should see the seedlings appear. There is no use in sowing at once as soon as gathered, as some do. This means a wait of a year for the seedlings, and, in the meantime, the waste of the ground for a year and the loss of time in keeping the bed free from weeds has to be considered."

DAMPING-OFF OF CONIFER SEEDLINGS

Many seedlings of conifers are killed by the damping-off fungus even before they make their appearance above the seed bed. Poor germinations are frequently due to this cause rather than to inferior seed. Evergreen seed ranges from fifty cents a pound for yellow Pine to two or four dollars for the native Spruces and five to ten dollars for Norway Pine.

Useful facts are given by Hartley and Pierce in "Professional Paper No. 453" of the United States Department of Agriculture.

Following is the summary of the 32-page bulletin devoted to this topic:

(1) By damping-off is meant the killing of very young seedlings by parasitic fungi. It is the most serious difficulty encountered in raising coniferous seedlings.

(2) To decrease losses from the disease excessive moisture and shade should be avoided. Caution must be used in following this

recommendation or many seedlings may be killed by drought or by white-spot injury to the base of the stem. Damping-off can often be decreased by putting beds on very sandy soil. Seed should not be sown any thicker than necessary. It appears better to sow broadcast than in drills. Late Fall sowing results in decreased losses at some nurseries and is worth trial. Proper attention to all of these measures will decrease the losses from damping-off, but at most nurseries they are not sufficient really to control the disease.

(3) The addition of lime, wood ashes, and in some cases nitrogenous fertilizers seems to increase damping-off. Soil alkalinity appears to favor the disease. No effect has been noted from green manures. The use of unrotted stable manure has had very bad results; properly rotted manures seem less objectionable. Tankage, charcoal, and cane sugar are the only nondisinfectant substances which have to date given any hope of disease control.

(4) Soil disinfection has so far proved the best method of combating damping-off. Of many methods tested, treatments with sulphuric acid, copper sulphate, zinc chlorid, and formaldehyde have proved the most satisfactory. The disinfectants, however, behave quite differently at different nurseries. The acid has on the whole given the best results. Heat disinfection has been only partly effective. Disinfection by acid or copper sulphate is cheaper than by the other methods commonly recommended.

(5) In addition to decreasing damping-off after the seedlings come up, the chemical disinfectants above mentioned, when properly used, cause an increase in the apparent germination and are very helpful in controlling weeds. This latter effect alone at some nurseries pays the entire expense of the treatment. Sulphuric acid has, furthermore, at some places resulted in marked increases in the late season growth of Pines.

(6) In some soils formaldehyde kills dormant seed, and the other three most satisfactory disinfectants at some nurseries kill the root tips of germinating seedlings. By proper precaution, all such injury may be prevented.

(7) The results obtained to date show that it is entirely possible and practicable to control damping-off by soil disinfection. Unfortunately, the varying behavior of disinfectants at different places renders it impossible to recommend any single treatment which will be everywhere successful.

BROAD LEAVED EVERGREENS

Rhododendrons, Kalmias, Andromedas, Callunas, Ericas and Azaleas are best sown in a mixture of peat and sandy loam over

which is placed a thin layer of screened sphagnum moss. The seed is sown over the moss and covered by glass. Give a temperature of about 55 degrees.

When they attain some size they are transplanted to frames out of doors and in the Winter given a shading and protection.

EASTER LILIES FROM SEEDS

Geo. W. Oliver, of the United States Department of Agriculture, who has conducted many experiments upon raising Easter Lilies from seed, writes as follows:

"Seeds of the Easter Lily are not for sale by any of the seedsmen so far as known, therefore it must be produced as wanted by the grower. This is not attended by any serious difficulty, provided the grower knows what to do at the proper time. The plants selected as seed bearers should be strong and absolutely free from disease. This condition will be indicated by the absence of discoloration of any kind on the foliage.

To produce seeds of the best quality the mother bulbs should be planted out in beds, where they are less liable to be neglected in watering. It is preferable not to use the pollen on its own stigmas but on the stigmas of a separate plant. Several hundred good seeds may be secured from each plant. All of the flowers on a plant will set seeds if the stigmas are pollinated, but three or four capsules to a good sized plant will give larger and better filled seed capsules and make stronger seedlings.

The seed should be sown during August in boxes. Allow three leaves to develop before putting the seedlings in two-inch pots then shift to three-inch when they have five or more leaves. By the middle of February they should be put in five inch pots and placed in an open frame as soon as the weather permits. Those which show signs of flowering in May should be thrown out. During August the strong plants should be in seven inch pots.

When cool weather sets in, the sashes should be put on, giving air as they require it. These plants should be at their best by Easter. If everything goes well most of the plants should give from 25 to over 30 flowers per plant (see figs. 9 and 39). The highest number we have secured on one plant was 37. If liquid manure be given occasionally the flowers will be much larger than those produced by the foreign grown seedling bulbs.

The results arising from the use of American field-grown bulbs of the Easter Lily are not always as satisfactory as they should be. It has been the practice of bulb growers to burn the candle at both

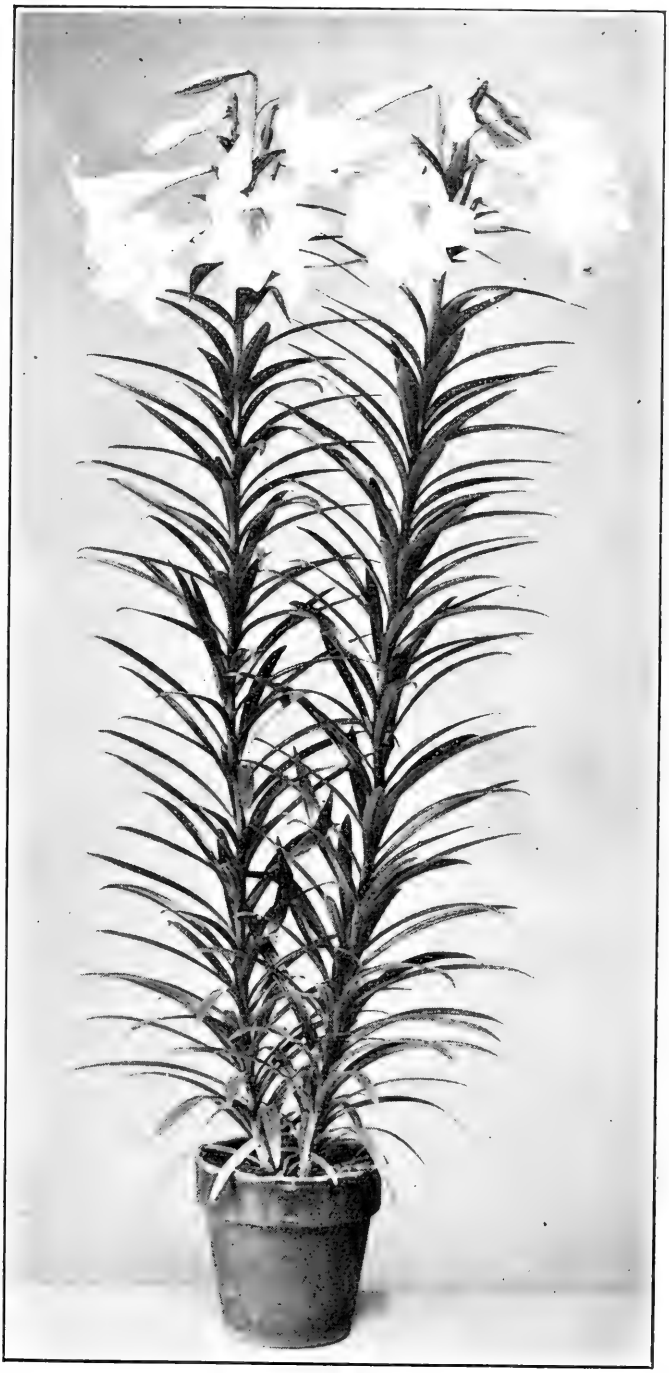


Fig. 9.—Easter Lily grown from seed. The photograph was taken seventeen months from seed sowing (See page 39)

ends; that is, to dispose of the flowers and, later on, the bulbs. In order that the field-grown flowers may command good prices it is necessary to cut considerable length of stem and leaves along with the flowers. The consequence is that the bulbs do not mature as well as they would if the leaves were left on the plant until the maturity of the bulb, and the result of this practice is always unsatisfactory.

If the seedling method is given a fair trial the Lily will pay handsomely. I understand the seedling bulbs grown in Japan are always disbudded to give strength to the bulb. But in so far as I have seen this is not always the case in Bermuda."

CACTUS FROM SEED

Most Cactus seed is very fertile but few growers have known how to have the best conditions for germination and growth. Chas. H. Thompson* has determined the proper method.

The best soil consists of equal parts of a well decayed sod and pure sand. The soil should not be rich in humus because this is a medium for germs of decay. Four-inch pots are used. They should either be new or else carefully burned or sterilized, otherwise Algæ will choke out the young seedlings. The drain hole at the bottom of the pot should be enlarged and the pot filled one-fourth full of finely broken pots, on which the soil is carefully placed and pressed lightly.

The seeds are sown and covered with a very thin layer of soil upon which is spread a one-fourth inch layer of gravel. The gravel will serve to keep the soil from washing, facilitates the passage of moist air and by shading prevents the surface soil from drying. When the seedlings grow they force their way through the gravel and for some time appear small and globular. They are tender, juicy and readily damp-off. The temperature should be about 70 degrees. Transplant into flats of same soil when several spines have formed on the plants.

SAVING SEED FROM DESIRABLE PLANTS

The normal flower of a plant must have at least two parts, the male part (see fig. 10), or the stamens which are the pollen bearers, and the female part, or the pistil which has an ovary at its base and will bear the seeds. A flower may have brightly colored petals, but these are not necessary for seed production.

* Thompson, Chas. H. Ornamental Cacti; Their Culture and Decorative Value. U. S. Dept. of Agr. Bur. of Plant Industry, Bulletin 262.

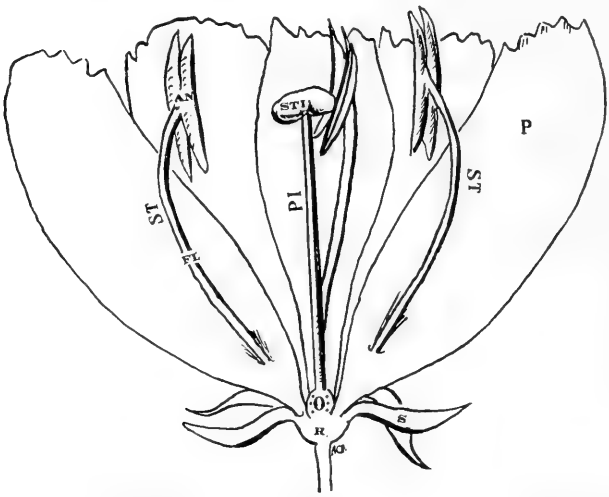


Fig. 10.—Section of typical flower. P, Petal, all the petals taken together is the corolla. S, Sepal, the sepals taken together is the calyx. ST, Stamen, the male part of the flower; AN, the pollen producing part or anther; FI, the filament or thread-like portion. PI, Pistil, the female part of the flower. STI, its sticky stigma which receives the pollen; O, the ovary which bears the seeds. R, Receptacle, a portion often making part of a fruit (See page 41)

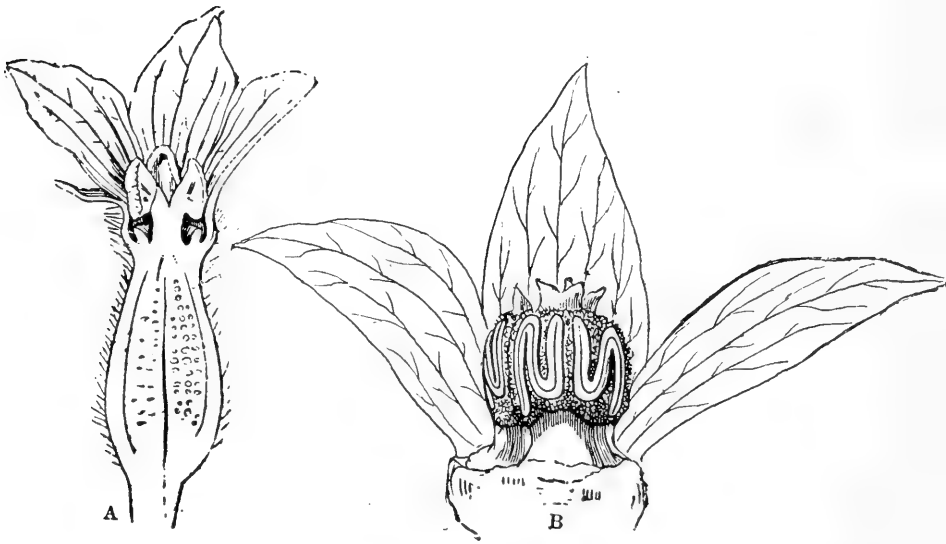


Fig. 11.—Squash blossoms. A, The female flower; note the bulge beneath the corolla; this is the undeveloped Squash. B, The male flower. All such plants as Melons, Cucumbers, Gourds and Pumpkins bear these sorts of flowers (See page 43)

For every seed which grows in a seed pod there must have been a pollen grain upon the pistil. In the Orchid where thousands of seeds are produced, thousands of pollen grains must have lodged upon the pistil.

Some plants do not need to be crossed or pollinated; as an example, Beans, Sweet Peas and such flowers are so constituted that the pollen is shed on the pistil and seed is formed. In the Cucumbers and Squashes certain flowers are male and others are female (see fig. 11). No seed is produced unless a bee or a man places some pollen from the male flower upon the pistil of the female. In other words, the flowers which some persons have called sterile flowers in the Cucumber are just as essential as the other flowers. In the Corn plant the pollen is produced by the tassel and falls on the silks; any silk which does not receive a grain of pollen fails to produce a kernel of corn.

When the grower notices a particularly superior plant, let us say a fine Cyclamen of good colors and excellent habit of plant, the best method to use is to take pollen from one flower on the plant and place it on the pistil of another. It is best not to depend on its producing seed without pollinating. Pollination may be

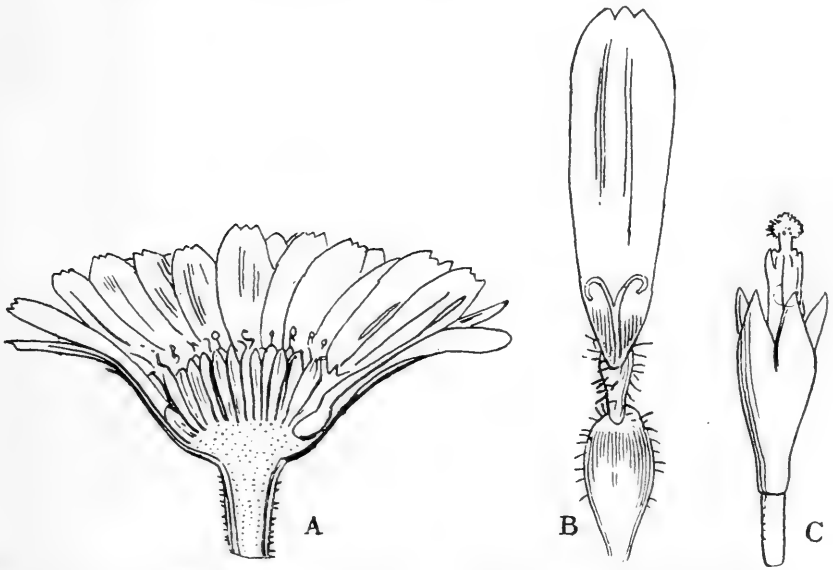


Fig. 12.—A Daisy-like flower. A, A head of pot Marigold. Note that this is not a single flower, but a bunch of small florets, the showy sorts at the outside are ray florets; those toward the center are tubular and called disc florets. The ray florets are often only female flowers, but the disc florets are bisexual. B, A ray floret. Note the two forked stigma of the pistil, the single petal and the large ovary. C, A disc floret. Note the feathery stigma of the pistil; the ring of stamens surrounding the pistil, and the five parted corolla (See page 44)

carried on with a camel's hair brush, or the whole flower may be picked and shaken over the other flower.

Better results will be attained by most persons if the above method is used rather than trying to cross two different plants. Crossing diverse plants will give surprising results, but they are not always commercial. Hybridizing is a different process from saving seed of a known good variety. The good variety may, frequently, be intensified by crossing it upon itself or upon another flower on the same plant.

In saving seeds of Asters, Cinerarias, Gerberas, Calendula, Cosmos, Ageratum and all the Daisy-like flowers, merely place a bag over the flower and it will ripen its seed without crossing. Each Daisy-like flower (see fig. 12) is really a bunch of small flowers which will shed pollen upon each other.

Do not make the mistake of saving seeds of Lettuce, Radishes or Celery from any plant which goes to seed too rapidly. It is apt to inherit this quality. The fact that the Radish often seeds so rapidly is due to its not producing a good root. We grow Radishes for the root, not the seed.

Seed should thoroughly mature before gathering and must be kept rather cool in storage.

DIOECIOUS PLANTS

The following plants have the two sexes on separate plants. Unless both sorts of plants are in close proximity no seeds nor fruits are produced. Plants of this sort are called *dioecious*.

AILANTHUS. Male flowers have objectionable odor; only female trees should be propagated.

BROUSSONETIA. Male plants produce flowers in pendulous catkins, greenish in color; female plants produce the flowers in globular heads, showing purplish hairs until August, when the surface becomes dotted with orange pustules a quarter of an inch long.

CERCIDIPHYLLUM. Both male and female flowers are very small; inconspicuous. The female tree is more beautiful, being very spreading; the male is columnar, according to F. Canning.

CHIONANTHUS. Only certain plants bear fruits.

CYCAS. The male flower is a cone-like structure; female flowers are clusters of modified leaves (see figs. 13 and 14).

ELÆAGNUS. Certain bushes are sterile, although the flowers bear both sexes.

GARRYA ELLIPTICA. Greenish white male catkins; ornamental. Black berries are also showy.

DIOECIOUS PLANTS—Concluded

Fig. 14.—Female flower of Cycas revoluta. The ovules are borne in the notches of the deeply cut, modified leaves

GINKGO. Male trees only should be propagated; female fruits smell badly.

HIPPOPHAE. Without both sexes planted together, the beautiful fruit display is lost.

IDESIA. Flowers are greenish yellow; fragrant. Male flowers ½ inch across; the female flowers ⅓ inch. Fruit in September. Orange red and very showy when leaves are gone.

ILEX. Holly. In some Hollies the flowers are fertile; in others, plants of both sexes are necessary if berries are to be formed.

MACLURA. (Toxylon) The sterile flowers are in racemes, the fertile are crowded in a large spherical head.

MORUS. Usually monœcious; both sorts of flowers in catkins.

PHELLODENDRON. Flowers greenish and inconspicuous, but the fruit is berry-like and hangs through the Winter.

SHEPHERDIA. Plant both male and female plants for fruit.

SKIMMIA. Flowers are often dicœcious.

ZANTHOXYLUM. There is little difference in the ornamental value of male and female trees.

Fig. 13.—Male flower of Cycas revoluta. Globular pollen sacs are found on the lower side of each scale

POLLINATING TOMATOES

In the Tomato the stamens are in a ring (see fig. 15) surrounding the pistil which protrudes beyond it. In the bright sunshine, the blossoms open, the stamens ripen their pollen and shed it. It is a simple process to use some sort of small wooden spoon which is held beneath the flower. Tap the flower with the other hand, the pollen will be shed into the spoon; the pistil is then carefully dipped into the pollen.

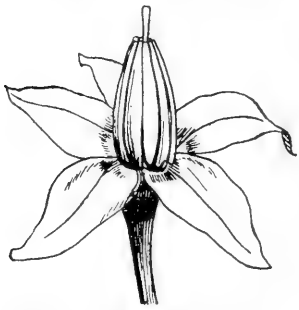


Fig. 15.—Tomato blossom. Note the ring of stamens surrounding the pistil

When Tomatoes are forced, artificial pollination of this sort is necessary. The worker goes through the house about noon and pollinates all flowers which are open. If the Tomatoes are being grown during the Winter it will be found that on sunny days more pollen is produced. On these bright days the pollen should be put in a small glass bottle and used during the sunless period; pollen will keep, in a bottle lightly corked, for several weeks. In the Springtime hand pollination is not necessary if the vines are vigorously shaken.

Certain varieties may be pollinated by the slightest jar of the vines. Bonny Best rarely requires hand pollination except in the dullest weather.

POLLINATION OF CUCUMBERS

Hand pollination of Cucumbers is a laborious process so that bees are often used for the purpose. C. W. Waid advises a strong hive to a half acre of Cucumbers. The bees are often restless when first placed in the house, but soon become quite at home.

CHAPTER II

CUTTINGS

Soft Wood — What Wood to Use — Medium for Rooting — Inserting Cuttings — Temperature — Damping-off — Callus — Monocotyledonous Plants — Sand and Water Method — Wardian Case — Florists' List — Perennials — Hard Wood — Summer Cuttings of Shrubs — Greenhouse — Frames — Large Stem Conservatory Plants — Evergreen — Leaf — Root.

Fig. 16.—Condition of wood for cuttings. Note that in making soft wood cuttings certain portions of the stem are brittle and break with a snap; this is the best part to use. Wood that is hard and stringy does not root as readily (See page 48)

CUTTINGS OR SLIPS

ANY part which has been severed from a plant is a cutting and if we were clever enough any portion of a plant should produce a new individual. If we knew the method, Maple leaves could be made to root. At the present time slips or cuttings from the stems of plants is the simplest method, although root cuttings and leaf cuttings may be made.

The European notion of a florists' cutting is that a cutting is a thoroughly established young plant. American growers have disappointed their foreign neighbors by sending them merely an unrooted slip.

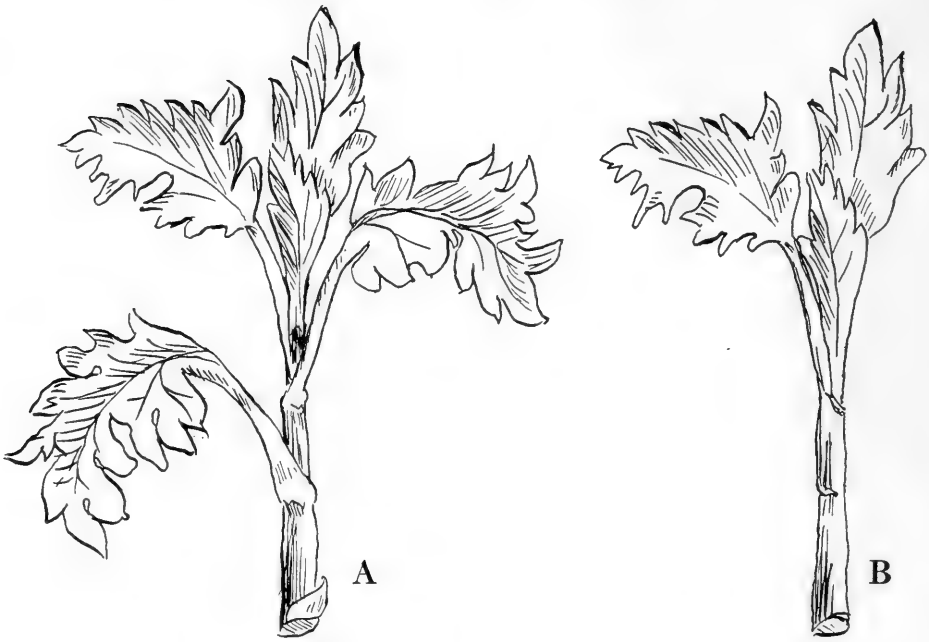


Fig. 17A.—Chrysanthemum cutting. This is untrimmed as cut from the plant
Fig. 17B.—Chrysanthemum cutting. The two lower leaves are removed to reduce the loss of moisture from the cutting. Note that the cut at the base of the cutting is through an eye, or node; it is, therefore, called a node cutting (See page 120)

SOFT WOOD CUTTINGS

Cuttings or slips are taken of most commercial plants because this is a rapid method of propagation; besides, the variety is propagated perfectly true, a dependence which can not be placed on growing stock from seeds. Favorable stem, leaf and flower characters are perpetuated exactly as in the parent plant. Some plants produce no seed; these must be propagated by some other means, such as cuttings.

WOOD TO USE

The wood should be brittle, not stringy; when bent it should snap, not bend. (See fig. 16.) If too immature the cuttings damp-off readily; if too old, the slips are slow to root. The best material is the first one to three inches of the tips of the shoots. Two or more eyes should be found on each slip. The cut should preferably be made through an eye at the base, although many plants will root from cuttings made at other points than an eye, or node. Clematis roots better when cut at an internode. The growth

activity is considered to be greater at the nodes and rooting should be more sure. The cutting will have no roots to supply the food and water to the leaves, so that most of them should be removed or much shortened. It will be the food stored in the stem and remaining leaves which will produce the new roots.

Some propagators argue that the leaves should not be removed, because the lower leaves aid in the manufacture of food and they as well as the stem may root. By retaining the leaves the cutting is saved the healing of the wounds necessarily made. For some species it will be best to remove most of the leaves, and for others it will not be advisable to disturb them in any way.

Most amateurs blunder by wishing a large plant at the start and do not shorten the cuttings enough. In other words, too long a cutting will be difficult to root and may make an unshapely plant. Never allow flower buds to remain on the cutting; they will only exhaust the vitality.

As soon as the cuttings are made they should be dropped into a pail of water or wrapped in moist paper to keep them fresh. They should not be kept in the water too long, however, else the bark will be loosened. From time to time, as sufficient cuttings are made, they should be placed in the cutting bench.

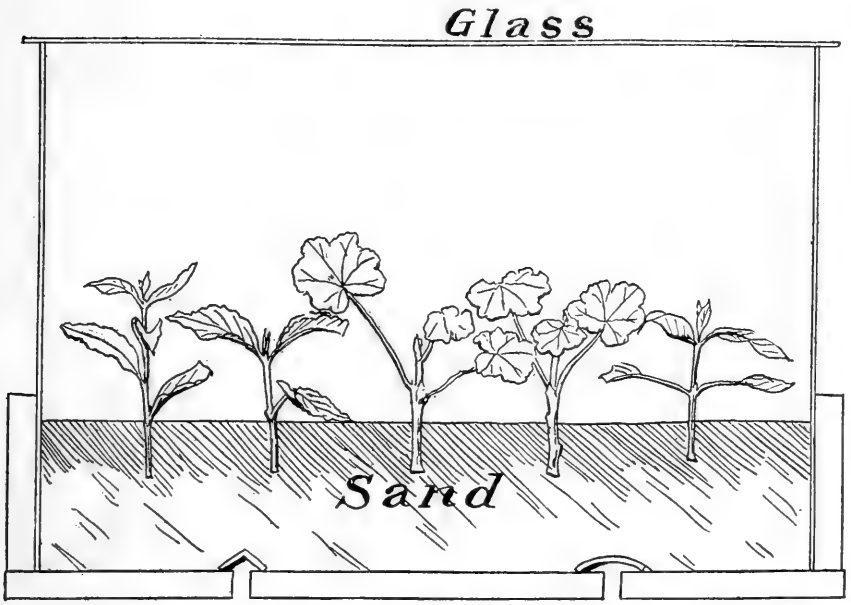


Fig. 18.—Propagating case. Shows cuttings inserted in the sand of a propagating case. The glass at the top confines the air. Such a case is useful in propagating many conservatory plants

MEDIUM FOR ROOTING CUTTINGS

Coarse sand, free from all organic matter, has proved to be the best material for using in the rooting of cuttings. The sand furnishes good drainage, but at the same time it allows for a free passage of water up from below. To eliminate dangers from diseases the sand is usually sterilized.

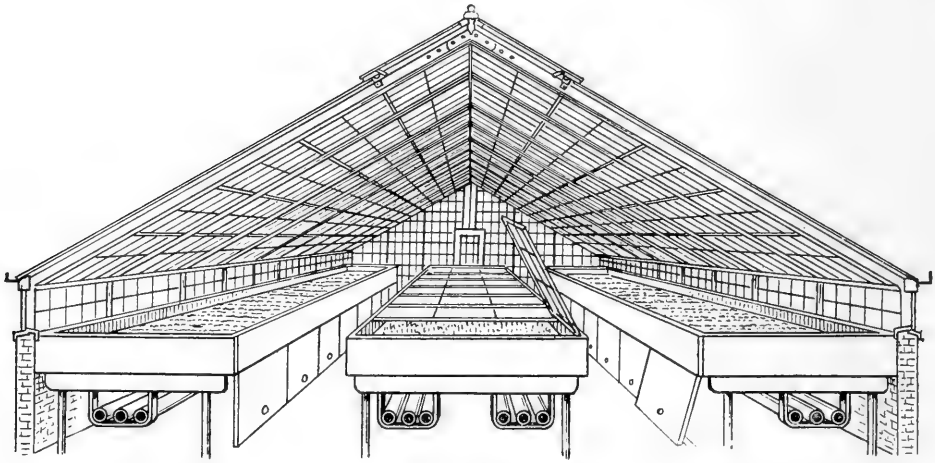


Fig. 19.—A propagation house. The roof should be shaded. The benches are boarded in below to retain the heat, an advantage in maintaining a higher temperature in the sand than in the atmosphere. The sash-covered center benches may be used for propagating such plants as require a confined atmosphere. By building up the benches and covering with glass, this house could be used for grafting Roses

Before inserting the cuttings the sand should be thoroughly watered and tamped, or pounded hard with a wooden mallet or brick.

INSERTING CUTTINGS

By the use of a straight edge and a large, heavy knife, a groove is cut into the sand. Cuttings are inserted and firmed tightly. The commercial method is to place all the cuttings in the rows first, then, with the fingers, the sand is compacted about them. The straight edge is then placed along the rows and several raps of the mallet will serve to further set them firmly. Unless cuttings are so treated the air will get into the sand, and the base of the cutting will dry. After setting the cuttings, water them thoroughly and cover with newspapers or a cheesecloth screen.

TEMPERATURE FOR ROOTING CUTTINGS

To induce root action rather than top growth, it is agreed that there should be some sort of bottom heat; that is, the temperature of the sand should preferably be greater than that of the air. In greenhouses this is attained by running several pipes under the cutting benches. For Summer rooting out of doors hotbeds may be used and fresh and fermenting manure employed as the source of heat. The florist and nurseryman prefer to have a difference of from 5 degrees to 10 degrees between sand and air.

DAMPING-OFF FUNGUS

The "damping-off" fungus is very often encountered in the cutting bench. The cuttings decay at the surface of the sand, the tops often remaining green some time after the stem has blackened. Excess of water in the sand or air favor the spread of the disease. Higher temperature than the plant requires and close conditions are other factors. Formalin, used at the rate of one part formalin to fifty of water, using two quarts to a foot of sand, will kill the fungus, but the cost is rather prohibitive. Allowing the sun to enter the house and letting the bench become rather dry, will help the control when the plants are in the bench. It is suggested that peroxide of hydrogen be used to supply oxygen to the sand and air. Definite proportions have not been accurately determined.

CALLUS

When the cuttings start to root they will gradually produce a layer of spongy tissue over the cut surfaces. This is a callus and usually precedes rooting. Leaf callus forms on the veins (note fig. 26). The callus is first a wound protection, but later the cells are absorptive and even go so far as to produce organs lost by wounding.

MONOCOTYLEDONOUS PLANTS

The monocotyledonous plants, such as the grasses, lilies, Asparagus and aroids, root in a different way than the dicotyledonous plants. Callus is rarely formed, but the cut-surface becomes corky in appearance. No roots are sent out from the stem, but one of the buds in the axils of the lower leaves enlarges and sends out roots.

The bud continues to grow and becomes the new plant, the cutting is soon withered away and the new plant is independent.

POTTING CUTTINGS

Most plants should be potted or transplanted before the roots get a half-inch long, using small pots or flats of a friable, not too rich, soil. Allowing the cutting to remain in the propagating bench will be detrimental, because it will only use up its own stored food and can get no food from the sand. Certain plants, for example, Clematis, have a tendency to produce a great deal of callus but roots may be tardy to appear. By paring off some of the excess, the roots may be induced to grow.

THE SAND AND WATER METHOD OF ROOTING CUTTINGS

By the sand and water method many a tree may be rooted which is difficult to increase in other ways. It consists in using a pan, or a pot with the hole closed, filled with sand. Half-ripened wood is used for cuttings and placed in the pot. The sand is kept in such a wet condition that the water itself is almost visible on its surface. The pan or pot can then be placed in the sun, the excessive moisture preventing wilting, and rooting soon takes place. *Gordonia pubescens* is rooted by this method.

WARDIAN CASE

Every conservatory and general flower growing establishment should have a frame in the greenhouse, in which the atmosphere can be confined and good bottom heat maintained. Such a frame is called a Wardian case.

Robert Shore, gardener to the Cornell University Department of Botany has devised a sash-covered frame which is maintained at a relatively high temperature by boarding up the heating pipes. A pan of water sets upon the pipes and tends to equalize the temperature. The bottom of the frame is provided with a number of holes to allow for the free passage of the heat upward. There is a layer of three or four inches of sphagnum moss over the holes; this serves to retain the moisture.

Many plants, such as Crotons, Dracænas, Nepenthes and other tropical plants, are readily propagated in such a frame. Mr. Shore propagates these plants successfully by placing the end of the cutting through the drainage hole of an inverted flower pot which is placed upon the moss. The roots start in the moisture-laden air inside the empty pot, for the pot is not filled with moss, sand or soil.

THE FLORIST MAKES CUTTINGS ACCORDING TO THIS TIME TABLE

ABUTILON. Autumn. Green wood. 55° to 65°.
ACACIA. June or Winter. Half-ripened wood. 60° to 70°.
ACALYPHA. Autumn to Spring. 60° to 70°.
AGATHÆA. Autumn and Spring. 55°.
AGERATUM. February and March. 60° to 65°.
AKEBIA. Midsummer; half-ripened wood. Winter; hard wood. 45° to 50°.
ALLAMANDA. Winter or Spring when pruning. Ripe or soft wood. 50° to 60°. Give a little bottom heat.
ALOYSIA. See Lemon Verbena.
ALTERNANTHERA. August; place in sand. When rooted place in flats. Pot in April for sale. 60°.
ARAUCARIA. Cut back plants. Use leaders only for cuttings. Lateral cuttings make asymmetrical plants keep cool until rooted. 60°.
ARDISIA. Half-ripened shoots. 50° to 60°. Usually by seed.
AUCUBA. Summer to Autumn. Half-ripened wood. 50° to 60°.
BEGONIA. (Lorraine group.) Before January. Usually leaf cuttings. 65° to 70°.
BOUGAINVILLEA. Early Spring. Half-ripened wood. 60°.
BOUVARDIA. March. More difficult by stem cuttings than root. 60° to 65°.
BUDDLEIA. Summer; soft wood in greenhouse. Autumn; hard wood, keep through Winter, out of danger of frost.
CAMELLIA. Late Summer. Ripened wood. 60° to 70°. Often grafted.
CARNATION. See page 119.
CHORIZEMA. Winter or early Spring. May be rooted in sand bench, or in pots in mixture of sand and leaf mold. Place in Wardian case or under bell jar. 65° to 70°.
CHRYSANTHEMUM. See page 120.
CODIÆUM. Place under bell jar or in Wardian case (see page 52). 70° or above. Bottom heat.
COLEUS. September to Spring. 60° to 65°.
CROTON. See Codiæum.
ENGLISH IVY. August to September; also, from indoor plants, December to January. 50° to 55°.
ERICA. December to Spring. Use strong plants. Cuttings short. Cover with bell jar. Never above 60°.
EUPHORBIA FULGENS. Midsummer. (See Poinsettia, page 128.)
FITTONIA. Early Spring. Pot in leaf mold and sand in 2-in. pots. 65°.
FUCHSIA. February to Spring. Use only newest wood from plants cut back some time previously. 50° to 55°.
GARDENIA. Winter. December to February. Use soft wood. Keep close. 65° to 70°. Bottom heat.
GENISTA. Early Spring. Soft wood. 45°.
GERMAN IVY. January to March. 60°.
HEATHS. See Erica.
HEDERA. See English Ivy.
HELIOTROPE. July, for Winter use. Soft wood. 60°.
HYDRANGEA. February and March. 50° to 55°. Slight bottom heat.

TIME TABLE FOR MAKING CUTTINGS—Continued

IPOMÆA. Bona-nox. See Moonvine.
IRESINE. Mid-September. 60° to 65°.
JASMINUM. Autumn and Winter. Ripened wood. 50° to 55°.
LANTANA. January to Spring. Green wood. 60° to 65°.
LEMON VERBENA. February to April. 50° to 55°. Slight bottom heat.
LINUM TRIGYNUM. March. Plants set in open in May. Pinch for compactness. Pot in September.
LOBELIA. Pot selected plants from field and propagate through Winter. Good habits and colors are perpetuated.
METROSIDEROS. Half-ripened wood, with heel. Place in pots of sand; keep moist.
MOONVINE. September. Keep cool. Continue propagating through Winter.
NEPENTHES. (See Wardian case, page 52.)
NERIUM. Spring. Either sand or water. Keep moist and warm.
PACHYSANDRA. Midsummer to Autumn. Green wood.
PELARGONIUM (Geranium). September to May. 56° to 60°.
POINSETTIA. See page 128.
ROSES. See page 129.
SANTOLINA. January to Early Spring. Soft wood. 50° to 55°.
SNAPDRAGON. January to March. Many growers believe that seedlings make more floriferous plants, less liable to disease and with greater vigor.
STEVIA. Late Spring. Half-ripened wood. 50° to 55°.
SWAINSONIA. January to March. Green wood. 50° to 55°.
VERBENA. February to March. Green wood. 50° to 55°.
VINCA MAJOR. Autumn; or January to March. Half-ripened shoots. 60° to 65°. Can layer in field.
VIOLETS. See page 138.

MAKING CUTTINGS OF PERENNIALS

Cuttings can be made of hundreds of perennials. If you wish to increase your stock, merely take little slips in the Spring when the plants are six or seven inches tall. Be sure to leave a few buds below where the cutting is taken; it will not injure the plants in the least, but will cause them to become branchy. Choose wood that is a little ripened.

Some of the perennials which are readily propagated by cuttings are here given; others are found on page 139.

AJUGA
ARABIS
ASCLEPIAS
BOLTONIA
CENTAUREA
CERASTIUM
CHRYSANTHEMUM
CLEMATIS
DAHLIA
EUPATORIUM
HELENIUM
HESPERIS
HEUCHERA
HOLLYHOCK
IBERIS
LARKSPUR
LOBELIA
LOOSESTRIFE
LOTUS
MONARDA
PENTSTEMON
PERENNIAL SUNFLOWER
PHLOX
PINKS
PLUMBAGO
POTENTILLA
SALVIA
SEDUM
VERONICA

Fig. 20.—Dahlia cuttings. Such shoots make excellent material for cuttings, each one besides being of the proper length is also provided with a heel or "meat" at the base. Heel cuttings are thought to produce better tubers

In the Summer the cuttings may best be rooted in coldframes prepared much like the propagating benches in the greenhouse. Cheesecloth screens should also be erected over the frames. Care must be taken that the cuttings never dry out and the ventilation must be perfect. Damping-off is sure to result if the conditions are stuffy and moist.

HARD WOOD CUTTINGS

Most of our shrubs and many of our trees may be propagated by hard wood cuttings. The wood of the last season's growth is taken in the Autumn or early Winter, when the leaves have dropped (preferably before heavy freezes) and cut into approximately six inch lengths. The cuts at the base and tip should be through an eye, although this is not absolutely necessary (see fig. 21.) They are usually tied in bunches of fifty or one hundred cuttings. After making the cuttings they may be placed in boxes of moist soil or sand and placed in a cellar, or they may be buried upside down in a sandy knoll deep enough so that they are below the frost. A mulch over the top will also retain the heat. Take special care to keep the tops all one way and have the butts in one plane so that they may callus uniformly.

Fig. 21.—Hard-wood cutting. Note that the top is cut just above the buds, and that the basal cut is made through the buds. Such cuttings should range from 4 to 8 inches long

Early in the Spring the cuttings, which will have rooted, or callused, should be planted in rows far enough apart for cultivation, and 6 to 8 inches apart in the rows. They should be so planted that one or two eyes are above the surface of the soil. In the Autumn they should be dug and sorted for size. Some shrubs will require planting in nursery rows again; others will be salable the first year.

The Climbing Roses are easily propagated by this method. Grapes are so multiplied; cuttings 5 to 7 inches long is sufficient. Some growers also use one-eye cuttings of Grapes (see also Vitis p. 177.)

SUMMER CUTTINGS OF SHRUBS

Many trees and shrubs are readily propagated by taking soft wood or half-ripened wood cuttings in June and July. This furnishes a very cheap method of propagation. Such cuttings will resemble the cuttings of the herbaceous or soft-wooded plants.

Greenhouse rooted. The cuttings are best rooted in flats, in the greenhouse, where they may be easily handled. The cuttings may also be placed in the bench. A house should be used which gets the sun. "Thoroughly renovate the benches and give a coating of white-wash which will sweeten the boards and destroy the disease spores.

Four inches of sand will be necessary. Put a thin shading of lime on the glass and hang a piece of muslin inside the entire width and length of the bench. Tack the upper edge fast to the rafter, and arrange it so that the muslin will slide up and down upon a series of wires. The object of this is, that on dull days and in the early morning and late in the evening the curtain can be pulled up, admitting the light. The reason for putting the curtain on the inside is to allow the sun's rays to pass through the glass, thereby furnishing the necessary heat to cause root action, without allowing the direct sunlight to strike the cuttings, which would be fatal."* Such parts of the house not used for cuttings should be screened with muslin hung from the sash bars. Because the work is done in hot weather, evaporation will take place rapidly from the cuttings, so that there must be as little circulation of air as possible.

As the cuttings are made, keep them moist by placing in damp paper. Insert in the sand, about two to two and one-half inches apart and one-half to three-quarters of an inch apart in the row. Firm the sand and thoroughly water, covering the cuttings with newspaper during the bright sunlight. Syringe the cuttings every morning, but only water them when they become dry. When the cuttings have rooted take off papers and continue to spray. A muslin shade will now be necessary. When well rooted, place in flats under a slat frame house out of doors and give plenty of water. Many kinds will make a foot of growth in the season. Protect for Winter. Set in open soil in Spring.

FRAMES

No bottom heat is necessary indoors, but in the frames some bottom heat will be needed. A foot of fresh horse manure, well trodden, will furnish the heat. Over the manure spread a layer of 4 to 6 inches of sand. Cover the frame with a tight-fitting sash. Build a muslin canopy above the frame about 3 to 4 feet high to protect the young stock from the sun.

Lilac cuttings should be made early in June as the wood ripens earlier than some other sorts. By this same method may also be propagated such shrubs as Andromeda, Hydrangea paniculata, Tamarix, Syringa, Forsythia, Robinia hispida, Akebia, Kerria, Symphoricarpos, Cornus, Clematis flammula, Berberis, Calycanthus, Viburnum, Exochorda, Weigela, Deutzia, Lonicera, Ligustrum, Althæa, Sambucus and Lycium.

* Trillow, Wm. Propagation of Shrubs. Proc. of Soc. of Iowa Florists, 1912, pp. 75-80.

LARGE STEM CONSERVATORY PLANTS

Alocasias, *Dieffenbachias*, *Dracænas*, and some other conservatory plants are readily propagated by cutting the old stems into four-inch pieces, which are placed in the propagating bench with bottom heat but not too great moisture. The Wardian case is useful for this purpose; when rooted they are potted in sandy loam and peat.

EVERGREEN CUTTINGS

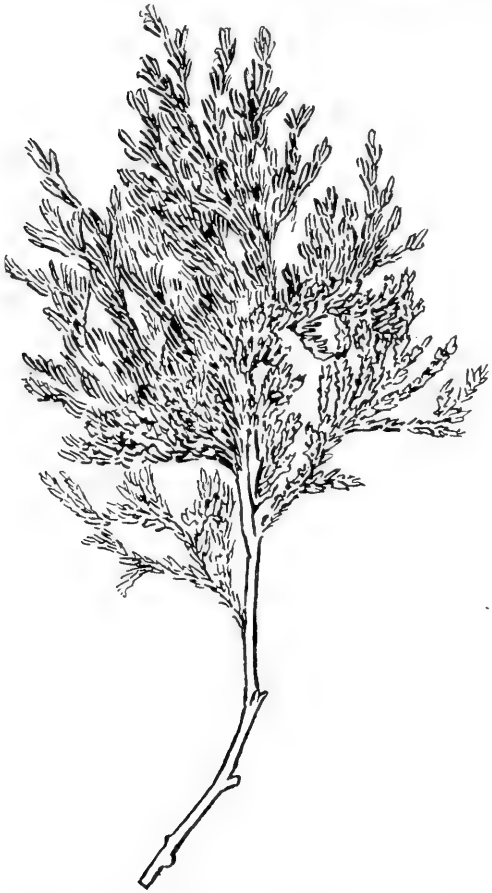


Fig. 22.—A simple conifer cutting. The cut shows a species of *Retinispora*. The leaves are cut from that portion of the stem which is to be placed beneath the surface of the sand

Many of the evergreens are propagated by stem cuttings in the early Fall or Midwinter. The cuttings are usually made a bit shorter than hard wood cuttings of deciduous-leaved plants. They are best placed in sand, using cold-frames or nearly-spent hot-beds. They usually produce a callus before freezing. Cold weather makes it necessary to cover the frames with sashes and a heavy coating of straw. In the Spring it will be noted that many of the cuttings have not only produced a large callus but they will have made some top growth. Those made in Midwinter are placed in flats under the bench of a cool house.

Three types of cuttings are used: simple, heel and mallet. The simple cutting (see fig. 22) is the sort mentioned previously in the case of soft wood and hard wood cuttings. The heel cutting (see fig. 23) differs in one resepct only, in that it has a small slice of the parent stem attached at its base. The mallet cutting (see fig. 24), as

the name infers, has at its base a small or large piece of the entire stem to which it was attached. The two latter sorts of cuttings are thought to be better because of the food stored in the parent stem. Especially necessary are the mallet cuttings to those evergreens which root very slowly.

Only well ripened shoots should be used; the softer branches are inclined to damp-off.

The lighter colored branches are quite apt to be immature.

Sometimes the cuttings are made in Spring, which do not root as well as those taken in the Autumn.

The following evergreens are propagated by mature wood cuttings as described above:

AZALEA
CALLUNA
COTONEASTER
CRYPTOMERIA
CUPRESSUS
HEDERA HELIX
JUNIPERUS—about New Years
MAHONIA
RETINISPORA OBTUSA
TAXUS
THUYA

Fig. 23.—A heel cutting. The sketch shows a cutting which has been made so that a portion of the parent stem is attached to the base. This is a species of Juniper

Some Evergreens, such as Pines and Spruces, grow readily from seed, which method alone is used.

Writing of the rooting of conifers, Mr. Balfour* says that "the

* Balfour, I. Bayley. Problems of Propagation. Journ. of Roy. Hort. Society, Vol. XXXVIII, part III, pp. 447-461.

Evergreens often produce calluses very poorly but they all form some. The obstacle to the rooting is the resin which covers the cut surfaces and hardens. If the resin skin is scraped from the cutting they will often form abundant callus. Should the callus become too large it may be pared down in which case roots will be encouraged. In Pine the flow of resin is great; it is also thought very difficult to root from cuttings. The ends of the cuttings should be plunged in nearly boiling water; this seals the resin canals and the heat promotes the formation of a callus."

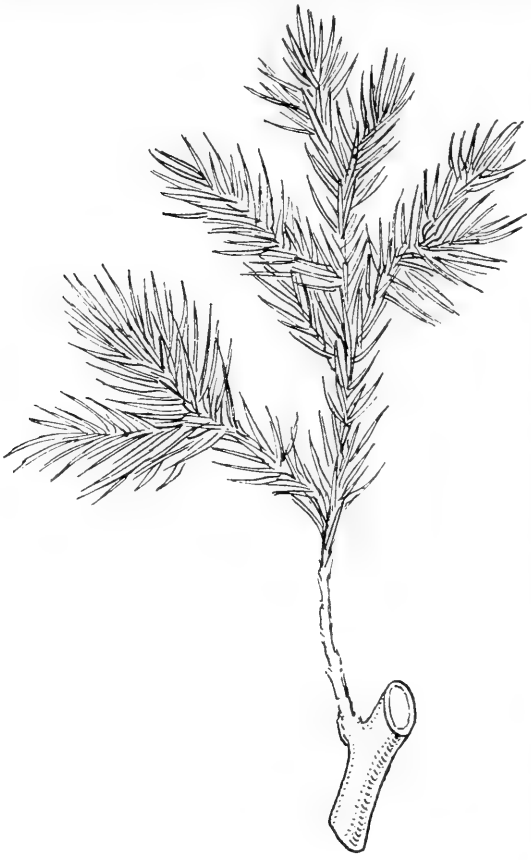


Fig. 24.—A mallet cutting. In making the mallet cutting a piece of the entire stem of the parent plant is left at the base. This mallet is a storehouse of food; such cuttings often root when the simple cutting does not (see page 59)

Chamæcyparis nootkatensis and *Lawsoniana pendula* are best propagated by cuttings made in early Winter placed in heat under glass. Pot after rooting and grow for a year or more before planting out of doors.

Cunninghamia lanceolata should best be rooted from half-ripe wood in late Summer under glass. *Libocedrus* cuttings are rooted in late Summer under glass, but they root very slowly.

LEAF CUTTINGS

Plants with fleshy leaves or thick petioles may frequently be propagated by leaf cuttings. The Rex Begonia is the most familiar example illustrating this method. The leaves may be cut into a number of more or less triangular pieces (see fig. 25), each of which has a large piece of one of the main veins of the leaf. When such pieces are inserted half their depth into the sand, the veins will callus and the young plantlet start from this point. (See fig. 26.)

Another method of making a leaf cutting of the Begonia is to cut through the main veins at various points and pin the entire leaf upon the sand of the propagating bench (see fig. 27), so that the cut ends of veins must be in contact with the sand. A confined atmosphere and slight bottom heat are beneficial to rooting. A bell jar, placed over the leaves, will serve to give the proper conditions so that the leaf blade will not dry out.

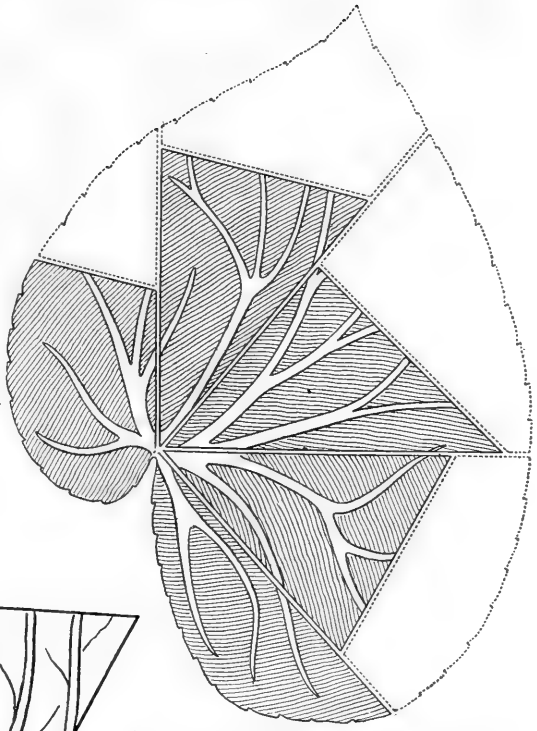


Fig. 25.—Rex Begonia leaf cutting. The leaf is so cut that each portion has a piece of a large vein. Each section of the leaf when placed in the sand will root. The parts around the outside of the leaf are thin and are thrown away (shown by white in sketch)

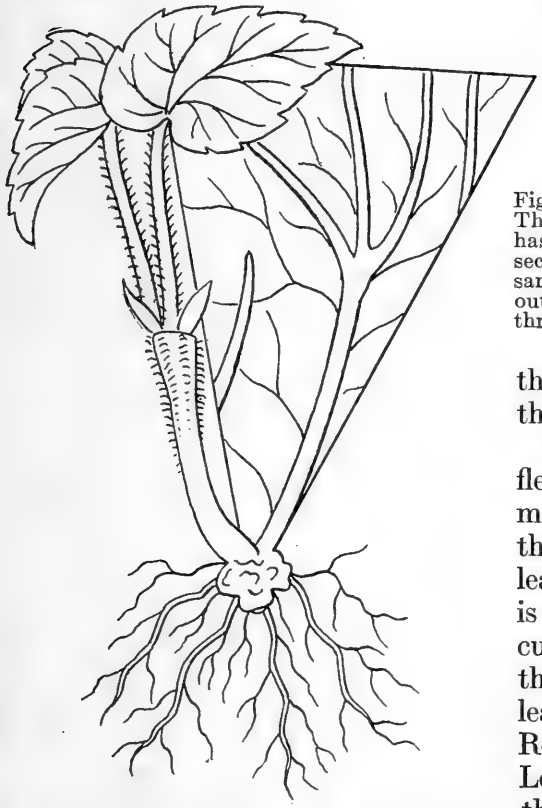


Fig. 26.—Rooted leaf cutting. The second cutting of the leaf shown in figure 25 has callused, rooted and produced a young plantlet

Many plants with very fleshy petioles and leaf blades may be propagated by placing the petiole, or stem of the leaf, in the sand. The blade is often reduced in area by cutting away the outer and thinner parts of the leaf. The leaves of such plants as the Rose, Lilac, Cabbage, and Lemon, will root by this method, but this is not practiced commercially. *Achimenes*, *Begonia* (*Lorraine group*),

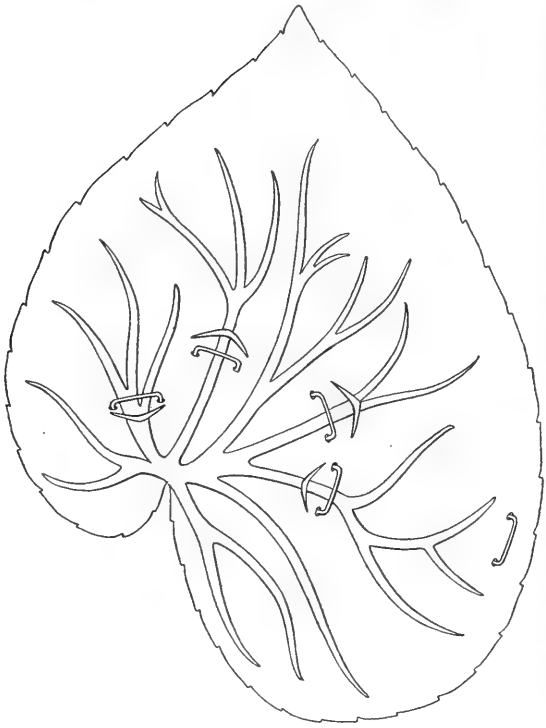


Fig. 27.—Another method of making a leaf cutting of Begonia Rex. The leaf shown in figure 25 might have been pinned to the sand by bent wires. Near the pins the main veins when cut would have produced small plants (See page 61)

Gesneria, Gloxinia, Streptocarpus, Hoya and *Peperomia* (see fig. 28), however, are successfully rooted.

With the leaves of certain bulbous plants, as the Hyacinth, small bulbs are produced at the base when they root.

Sanseviera leaves are cut into three inch lengths and allowed to dry for a day or two. They are then placed perpendicularly in the sand where they must not be overwatered, in which case they start new plants nicely.

Bryophyllum leaves when placed on the sand bench will send out young plantlets at every notch in the leaf

Sphærogyne or *Tococa*, a beautiful broad-leaved conservatory plant, has a peculiar method of propagation which is described by Geo. W. Oliver: "Its propagation is very simple but requires bottom heat. Cut the stems about two inches below the leaves, trim the leaves to within two inches of the petioles. Split the stem down the middle and place the cuttings in sand where there is a brisk bottom heat. Make sure that the under part of the small piece of leaf lies close to the sand, then every piece will root provided the leaves are neither too young nor too old. The rooted pieces should be placed in 2-inch pots. Replace the potted cuttings in the sand with the under part of the leaf again close to the sand. The young growth from the axil of the leaf will furnish the stem of the future plant. Too much water at any one time is apt to be hurtful.

When the small pots are full of roots the rooted cuttings may be placed into 3-inch pots, without in any way removing any of the soil This can easily be done if care be taken. All of the rooted

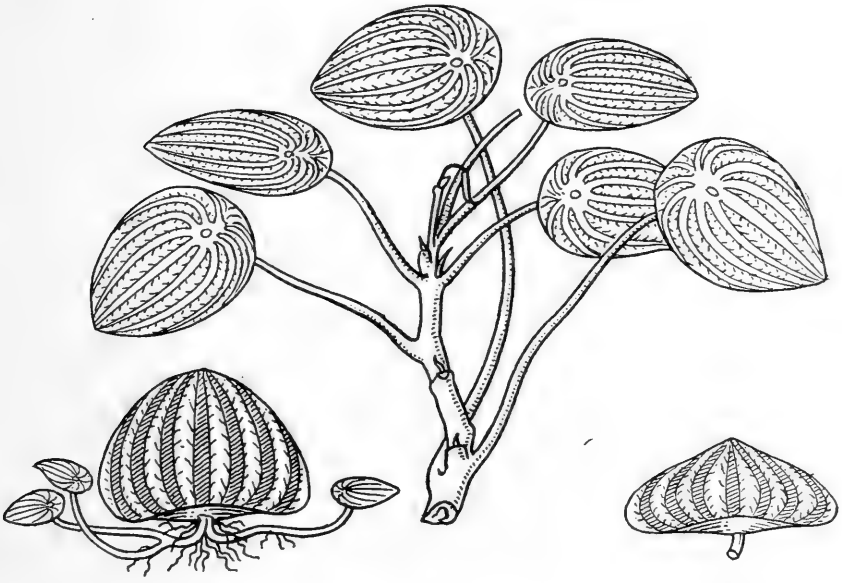
cuttings will not make symmetrical plants and those which refuse to do as we wish can be brought under subjection by using them for propagation. The full grown plants do not look well when the leaves are irregularly developed, but the symmetrical plant is a thing of beauty. When old plants approach the flowering stage they should be cut down and used for propagation They are seldom handsome when over four feet tall."

I. Bayley Balfour remarks that plants grown from a leaf taken near the flowering region, of the Begonia, for example will bloom more quickly than one obtained otherwise.

ROOT CUTTINGS

Many plants with thick roots may be propagated by cutting the roots or root stocks into small pieces. But, curiously, variegations are often not reproduced by this method. Some are propagated indoors in the greenhouse, others, the stronger growing sorts, are propagated out of doors

In propagating plants by root cuttings in the greenhouse, flats or shallow boxes filled with light loam and leaf mold are used



C A B

Fig. 28.—Leaf cuttings of Peperomia. A, A simple cutting of *Peperomia Sandersii*. B, A leaf properly cut prepared for making a leaf cutting. C, The growth from such a cutting as B. The young plantlet starts from a callus at the base of the leaf stem, or petiole (See page 62)

Section I. The smaller and more delicate rooted sorts are cut into lengths of one to two inches, and scattered over the surface of the soil, after which they are covered with about a half inch of finely sifted light loam. Cover the flats with newspaper and start cool. Adventitious buds will soon form. When the growths have started a bit, the plantlets should be transplanted to other flats about two to three inches apart each way.

The following perennials are so propagated:

ACHILLEA
ANEMONE JAPONICA
BOUVARDIA
CERATOSTIGMA
CORONILLA VARIA
EUPHORBIA
PLUMBAGO LARPENTÆ
POLYGONUM
ROMNEYA
SAPONARIA

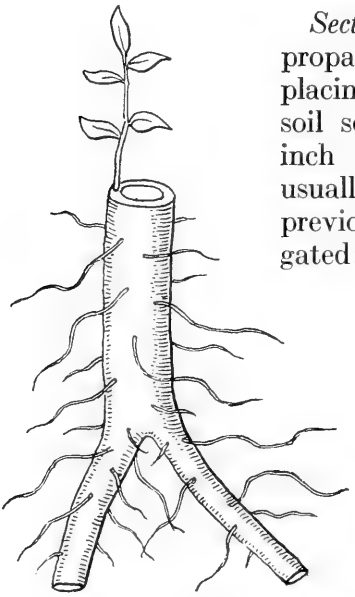


Fig. 29.—A root cutting. A fleshy root which has produced a tiny sprout

Section II. Some other plants, although propagated indoors, are best handled by placing the cuttings perpendicularly in the soil so that the upper end protrudes a half inch (See fig. 29). This class of plants usually has fleshier roots than those in the previous group. The following are so propagated:

ANCHUSA
BOCCONIA
DICENTRA SPECTABILIS
DODECATHEON
GAILLARDIA
GYPSOPHILA
HELIANTHUS RIGIDUS
MONARDA
PÆONIA
PAPAVER; fleshy root species
PHLOX, PERENNIAL
STATICE
STOKESIA
THERMOPSIS

Section III. Root cuttings when planted in the open ground are usually large in diameter and four to six inches long. They are planted almost horizontally in trenches and covered two inches deep.

A few of the trees and shrubs propagated by this method are:

BLACKBERRIES
CALYCANTHUS
CLADRASTIS
HYPERICUM
PHELLODENDRON
ROBINIA
ROSES
SASSAFRAS
SYRINGA
XANTHOCERAS

CHAPTER III

BULBS · LAYERS · DIVISIONS

Bulbs — Hyacinths — Tulips — Bulblets — Easter Lily — Corms — Tubers — Tuberous Roots — Dahlias — Fancy Leaf Caladium — Offsets — Suckers — Layers — Simple — Tip — Serpentine — Continuous — Air — Chinese — Preparing Plants for Layering — Runners — Mound — Rhizomes — Conservatory Plants — Division of Perennials.

BULBS are actually entire blooming plants telescoped together. Upon the approach of proper environmental conditions they start to grow and bloom. There are two types of bulbs: the tunicated and the scaly bulbs. The tunicated bulbs illustrated by the Onion and Tulip are clothed in a tight-fitting dry skin or tunic (see fig. 37). The scaly bulbs, illustrated by those of the Lily (see fig. 31), are composed of thick, overlapping scales.

Many bulbs propagate naturally by the production of small bulbs, or bulbels inside of the other bulbs, in which case the small bulbs gradually become larger and larger until they are of blooming size. (See figs. 30 and 33.) Observation of the behavior of the Narcissus to produce double-nose bulbs will illustrate this method. When bulbs propagate by this method, frequent transplanting is necessary to keep the old and new bulbs from crowding. A number of our bulbs

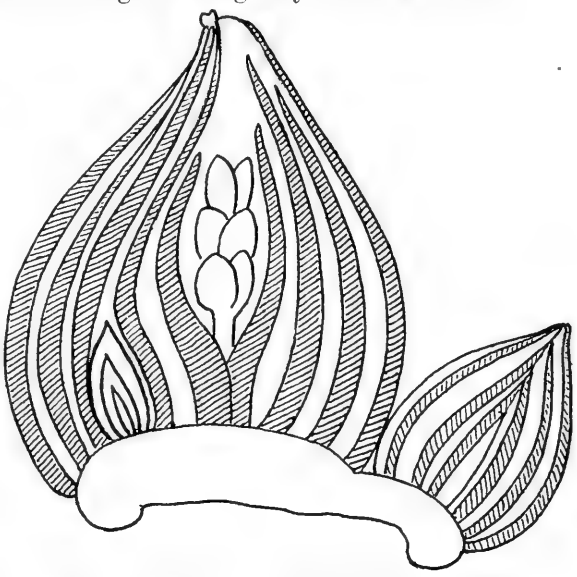


Fig. 30.—Diagram of bulb structure. Note the thick fleshy scales which compose the main part of the bulb; the flower stem and true leaves at the center of the bulb; the two small bulbs, or bulbels, produced between the scales but gradually pushed outside as the bulb grows; the white area at the base of the bulb corresponds to the stems of plant parts above the soil

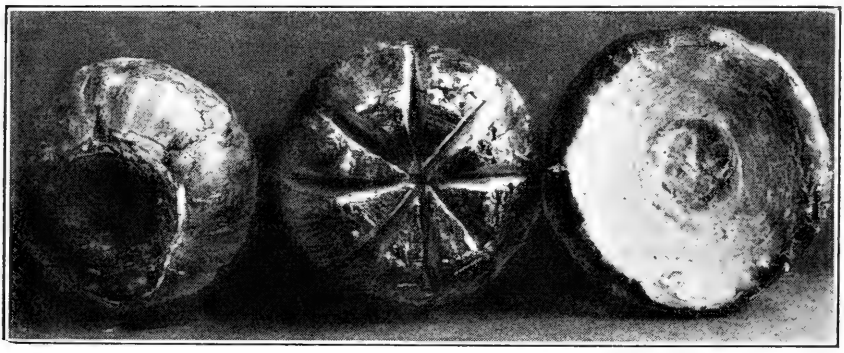
Fig. 31.—Easter Lily bulb. This illustrates the scaly type of bulb (See page 65)

in the garden are multiplied by taking the bulbels and starting them in sandy soil in small pots boxes. Notably are *Begonia Evansiana* the hardy Begonia, *Oxalis*, *Tuberose*, and many of the Dutch bulbs. A great number of our Spring flowering bulbs are grown mostly in Holland and are there propagated. For list of bulbs and their propagation see page 141.

HYACINTH PROPAGATION

The propagation of Hyacinths is about as interesting as that of any bulb. The Dutch have two commercial methods, known as "notching" and "scooping." In notching (see fig. 32, B) cuts are made transversely in wheel or star fashion across the base of the bulb. Just how far to cut is learned by experience. If the cut is made too deep the young bulbs will not start, and if not deep enough too little increase is obtained.

By the second method, that of scooping, the base or stem of the bulb is cut out, leaving the bottom scooped so that each layer of bulb scales is cut through. (See fig. 32, C.)



A B C

Fig. 32.—Hyacinth bulbs. A, Base of a bulb. B, The base of the bulb notched for propagation. C, A bulb scooped

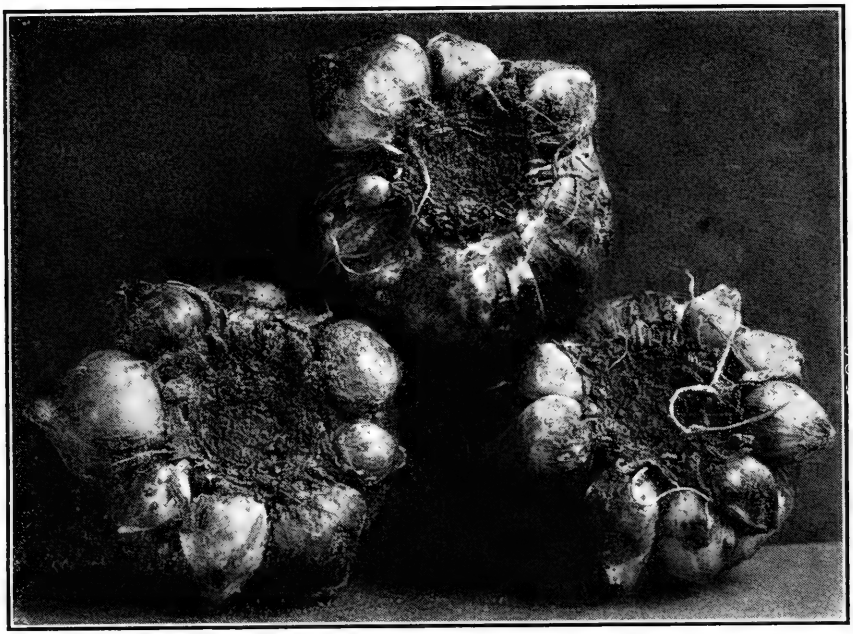


Fig. 33.—Hyacinth bulbs. This cut shows the natural method of producing bulbels at the base of the bulbs

Each method has drawbacks. The notched method results in few bulbs (see figs. 34 and 35) of a large size in a short time; by scooping (see fig. 36) three times the number of bulbs are produced, but they are tiny and of superior vitality. Offspring of notched bulbs flower in three to four years, scooped bulbs require at least four or five.

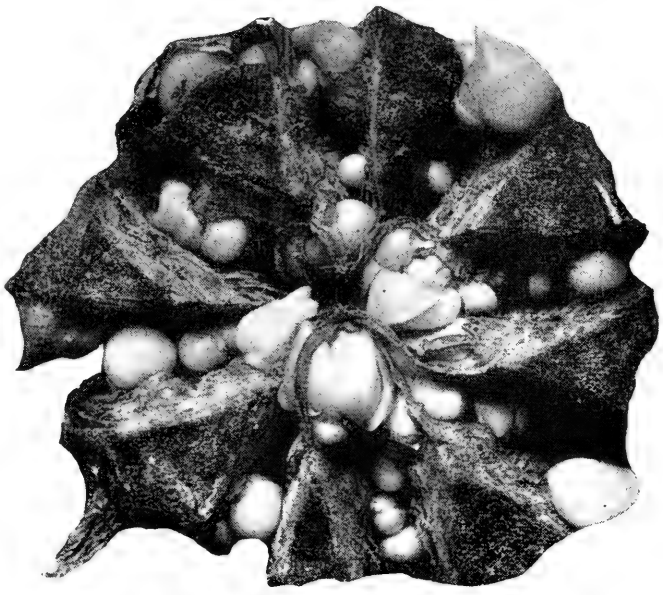


Fig. 34.—The first stage of a notched bulb

PLANTING AND CULTURE OF HYACINTH

Fred de Meulder, of Lisse, Holland, in the *Florists' Exchange* for April 17, 1915, gives the following notes on the culture for propagation:

"Both classes of bulbs undergo practically the same treatment in the 'nurse-room,' a place in the bulb store reserved for them and kept at a high temperature. Here they remain until after a fortnight or so—about one hundred bulbels in the case of scooped bulbs, and thirty in that of the notched ones are formed upon them. They are left until after all the other bulbs are planted so as to give them the care of the nursery as long as possible. Then usually in the last week in October or the first week in November they, too, are taken to the fields and planted. The ground has been carefully prepared for their reception; it has been well dug up and liberally dressed with well-rotted cow-dung earlier in the year. This kind of fertilizer is preferred to the others, such as lime, etc., both because it is more economical and because it is less harmful to the Hyacinth, whose extremely sensitive bulb would be burned up by lime or similar substances. Hyacinths cannot be set in the same ground except at two-year intervals, or at one-year intervals if the soil has been turned up from a much greater depth. Both Tulips and Hyacinths thrive on a piece of ground if it is used for each of them in alternate years, and this is what is usually done.

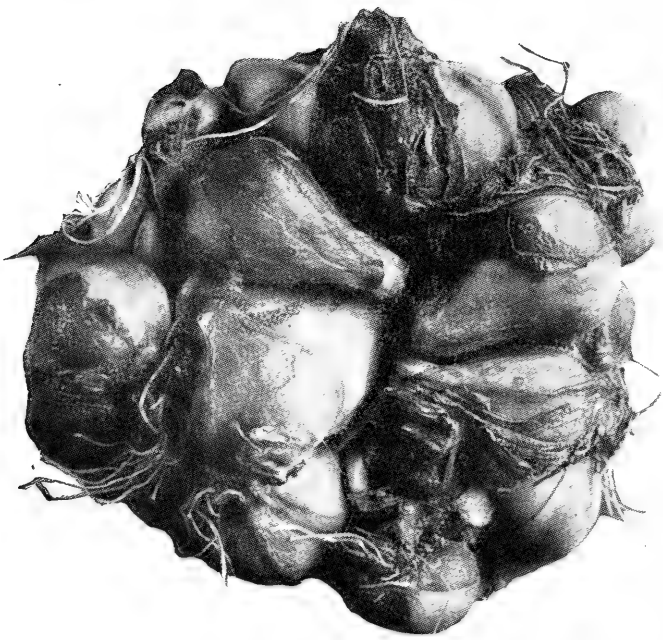


Fig. 35—A notched Hyacinth bulb. The bulbels are few but larger than those obtained when bulbs are scooped (See page 67)

Taken to the field, the bulbs are set in the ground at a depth of about five inches, and an area of about five square inches is allowed for each. The flower beds, one of which stretches almost the entire length of the field, are so disposed that each shall be three feet wide and that a path one foot wide shall be left between them. When all is ready the whole field is covered with about ten inches of hay or straw; a necessary precaution, for the Hyacinth is very susceptible to the cold. The fields lie thus till Spring,

and then with the sun and rain the leaves, and later the flowers, appear.

Generally the first Sunday in April, if the weather has been fine, or the second if it has not, finds the fields in bloom. Then it would be hard to find a more beautiful place on earth than this stretch of thirty miles from Haarlem to Leiden. The natives are not less appreciative of the attraction than the stranger. On this Sunday the highway from Hillegom to Leiden is one mass of people on foot, on bicycles, in motors, carriages and trams The great concern of the people to see the annual flower show is better understood when we know that this one day is probably the only chance they have to visit it. The flowers are not more attractive to the people than to the grower, but his love of beauty must yield to his business interests, so the flowers are cut off to allow the additional nourishment thus gained to go to the bulb. The clipping usually takes place ten days after the flowers appear.

The bulbs now begin to enlarge and are left to grow during April and May. About the middle of May, with fair warm weather, the leaves turn yellow, a sign that the bulb is matured and can be taken out. Wet, cold, weather at this time of the year retards the ripening process, bringing the harvest up to June.

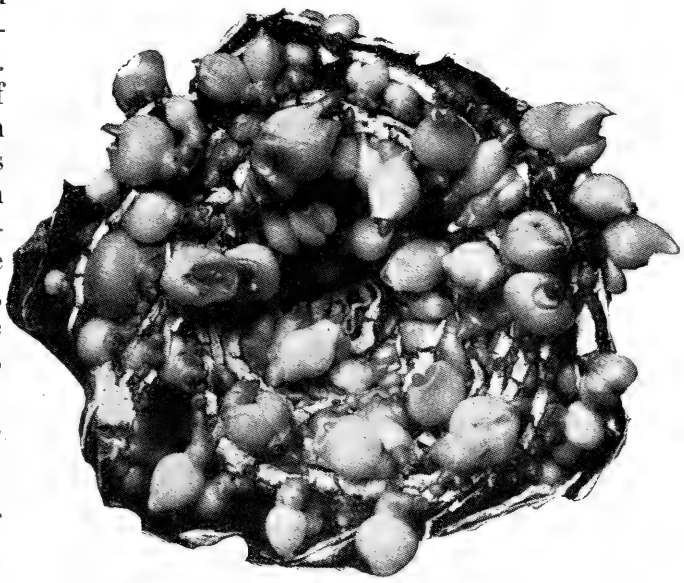


Fig. 36.—A scooped Hyacinth bulb. Compare the great number of small bulbels produced by this method with those produced by notching (See page 67)

In the event of a protracted spell of wet and cold, some method of hastening the bulbs to maturity must be resorted to. One recently adopted is to remove the bulbs from the ground before they have reached the proper stage and keep them in a warehouse at the temperature of fine Summer weather. Forced in this manner they mature at the proper time and it is thus possible to meet the demands of those

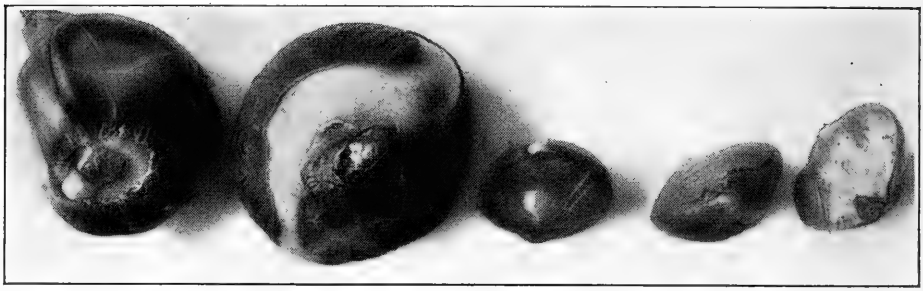


Fig. 37.—Tulip propagation. It is the natural method of propagation for tulips to send out bulbels at their base (See page 71)

customers who want flowers in bloom at Christmas. Only with Hyacinths was this procedure found impracticable; but with Tulips it gave indifferent results.

HARVESTING

When the bulbs are taken up from the ground the new bulbels are found to have grown to the size of an acorn; the mother bulb has almost entirely disappeared, having served as food for her numerous progeny. These are now taken to the warehouses and placed on laths to dry. This is merely a matter of plenty of air and the ordinary Summer temperature. This is also the case with the old bulbs of the 'notched' class. The opinion prevalent in some quarters that it is necessary to apply absorbent material to all the bulbs after treatment experience has shown to be without foundation. Only in the case of 'scooped' bulbs have we found the application of an absorbent at all necessary.

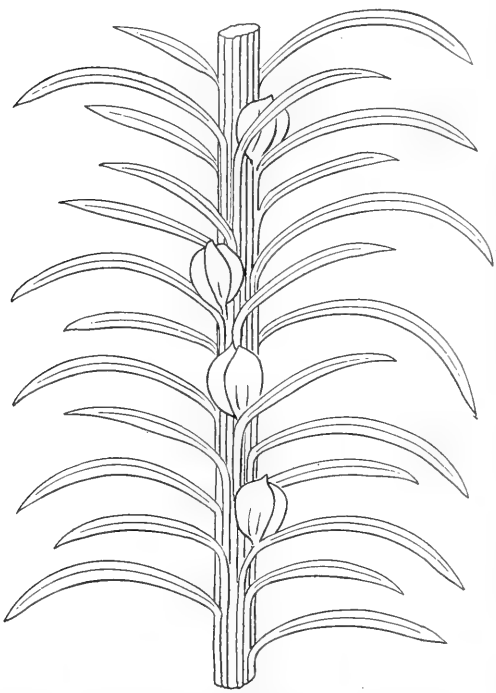


Fig. 38.—Bulblets. The sketch shows a Lily stem upon which small bulbs, or bulblets, are produced (See page 71)

The cleaning of the

bulbels, a process always attended with a good deal of danger of damaging them, is deferred till the Fall, when any injury the tender plants might sustain will be speedily healed by the earth wherein they are soon after placed. Set in the ground again in October, the new bulbs bear leaves in the following Spring. The second year those of the 'notched' class flower, while the others want still another season."

NARCISSUS AND TULIP PROPAGATION

Most Narcissus and Tulip propagation must be left entirely to nature (see fig. 37); no cutting of the bulbs can be done to increase the production. Left to themselves each bulb produces three or four bulbels, of which two or three develop to good size, and the old bulb disappears. The following Autumn the young bulbs are taken up, cleaned, and replanted. It thus takes two years to get Narcissus and Tulip bulbs.

BULBLETS

Certain bulbous plants, as the Tiger Lily, *Dentaria bulbifera*, certain Ferns, *Ranunculus Ficaria*, and the Multiplier or Potato Onion, produce small bulbs in the axils of their leaves above ground. These are bulblets. (See fig. 38.) They can be planted immediately after ripening and will multiply the particular plant true to variety.

EASTER LILY PROPAGATION

Easter Lilies have been propagated for many years by the rooting of bulb scales and by the natural division of the bulbs, but recently a method of raising Easter Lilies from seed (see page 39) is strongly advocated as a method by which certain diseases may be avoided.

With rare or unusual species of bulbs there is still an advantage in propagating by bulb scales. The scales are treated like cuttings and are placed in benches of sand or a sandy loam at a temperature between 45 degrees and 60 degrees; small bulbels will be produced. Some tender sorts need bottom heat.

Division is the commonest method, as it is the natural tendency of Easter Lily bulbs to divide after flowering.

CORMS

Corms are much shortened rhizomes or thickened bases of stems, usually subterranean, in which food is stored. A corm differs from a bulb in that the greater share of the bulk of a bulb is not stem, but bulb scales, which are really thickened bases of leaves, the stem being merely a much-flattened plate from which root and bulb scales arise. Corms also are covered with shells, or scales, but these are scarious, or dried, and are called husks, or tunics. These scales are bases of leaves, but are not thickened as they are in bulbs. Botanically considered, a bud or the potentiality for a bud exists in the axils of all leaves. There should be

Fig. 39.—Seedling Easter Lily. This seedling Lily is in its second year and has thirty-six buds and flowers. It was raised by Geo. W. Oliver

one bud for each layer of tunics or husks. Because of the manner of growth of the Gladiolus, a cormous plant, which is in one plane, these buds should have an opposite arrangement (see fig. 41), thus causing them to lie in one straight line through the center of the corm.

With the Gladiolus, it takes from one to four years, according to the variety, for a seedling to produce a corm of blooming size.

Every stem that makes vigorous growth has at its base a corm. Each corm has several buds, of which each one that grows will produce a new corm on top of the one planted. Seven Gladiolus bulbs of blooming size in one season has been reported. In this way the grower's stock is not only reproduced each season, but also rapidly increased, provided good soil and proper cultivation are given.

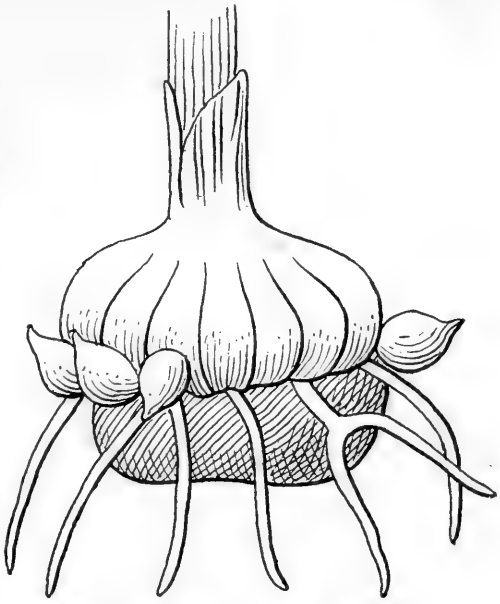


Fig. 40.—Gladiolus corm. The sketch shows the method of producing new corms above the old one. Between the two corms small corms, cormels or spawn, are produced
(See page 74)

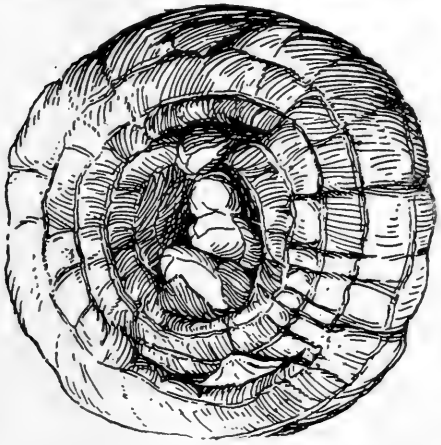


Fig. 41.—Gladiolus corm from which the tunic has been removed. Note the scars due to the bases of the old leaves. The buds are in a straight line, and there is one bud for each ring on the corm. Sketch taken from Cornell Extension Bulletin No. 10

The vigor and the thickness of a corm depend much on the proper maturing of foliage. If in cutting the spike little vegetative growth is left above the soil, only small quantities of food can be manufactured by these abbreviated leaves, and the base of the stem, or corm, in which the food is stored, suffers. The failure to carry over stock is often due to cutting the flower stems near the surface of the soil, the corms thus being able to make little or no development The suggestion, then, is that if one wants an annual renewal of corms, care must be exercised to leave

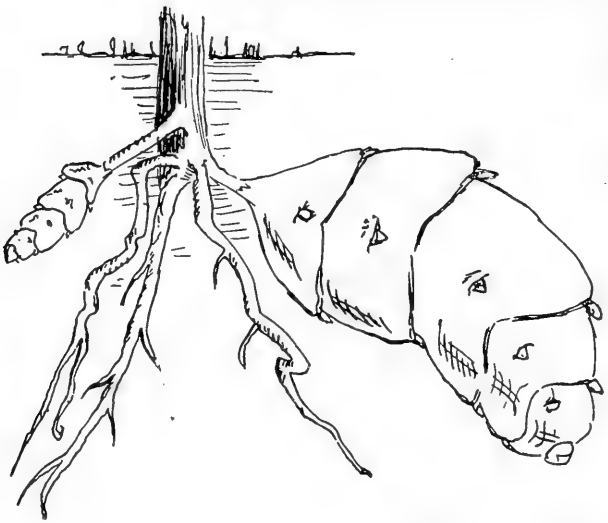


Fig. 42.—Tuber of Jerusalem Artichoke. Note that the eyes, unlike those of the Dahlia, are on the tuber
(See page 75)

sufficient foliage after cutting the spike.

It is the general opinion that corms which have been allowed to bloom every year for three or four years become thinner and thinner.

Soon after the base of the growing stem of the Gladiolus has begun to thicken, small corms are found to have formed between the old and the new corm. These are properly called cormels. (See fig. 40.) They are covered with a hard shell, thus differing from seedling Gladioli of the same size, which have a covering more like a husk, composed of the dried bases of the previous season's leaves. A more rapid method of multiplying new varieties is to cut the corm into several pieces so that each piece has one or more eyes.

Other examples of corms are *Crocus*, *Cyclamen*, *Antholyza*, *Colchicum*, *Arum*, *Arisæma*, *Ixia*, *Montbretia*, *Moræa*, *Sparaxis*, *Tigridia*, *Watsonia*
(For additional list see page 141).

TUBERS AND TUBEROUS ROOTS

Certain plants produce thickened portions of their stems beneath the soil. These are tubers. Tuberous roots differ from tubers in that there are no eyes from which growth starts. The eyes of

Fig. 43.—Tuberous roots of Dahlia. Note that the sprouts start at the base of the old stem and not on the tuber itself. The line marked C-C shows how the Dahlia should be divided, each new plant having a piece of the parent stem, a tuber and a sprout

the tuberous roots are at the base of the old flowering stem. Examples of tubers are: Potatoes, Jerusalem Artichoke (*Helianthus tuberosus*) (see fig. 42), *Begonia Evansiana*. Tuberous roots are found in the following plants: *Dahlia* (see fig. 43), Tuberous Begonia, *Boussingaultia*, *Caladium*, *Hemerocallis Dumortieri* and Poison Hemlock.

Fig. 44.—Offsets of Anthericum. Note how these plantlets are produced upon pendulous stems. (From Milady's House Plants) (See page 76)

PROPAGATION OF DAHLIAS

The tubers should be started about April 1st in a warm, light room, merely placing them in a shallow box of sand or light soil. When the young shoots begin to show, they should be so cut that one or two eyes are allowed to remain on each piece; the eyes start from the collar between the old stem and tuber (See figs 20 and 43.)

PROPAGATION OF FANCY LEAF CALADIUMS

Small tubers started in February will be large by September, when they should be removed from the soil and stored in sand. When ready for propagation they should be cut into good size pieces and covered with powdered charcoal. They are then placed on a bench in sphagnum and sand where they can root nicely, before potting in a mixture of loam and leaf mold. This treatment applies to Gloxinias and Tuberous-rooted Begonias, but the latter two are not cut to pieces.

OFFSETS

Certain plants produce small plantlets, rosettes from the parent plant which, if allowed to strike the soil, will root readily. These are often designated as offsets. Familiar examples of offsets are those found with *Cotyledon*, the Hen-and-Chickens, *Anthericum* (see fig. 44), *Marica*, *Œnothera* and *Boltonia*.

SUCKERS

Suckers are unexpected shoots from the base of plants. The formation is frequently encouraged by injury to the roots of a plant. Familiar examples of trees which sucker are: *Sassafras*, *Asimina*, many of the fruits, *Ailanthus* and others. When the roots are not injured there is little trouble with suckers. Some propagators hold that plants grown from suckers are inclined to sucker later in the new plant.

The fruiting of the Pineapple, *Ananas*, is followed by the production of suckers which are removed and rooted in sand. The Banana is propagated almost entirely by suckers.

Plants which sucker are easily propagated by root cuttings (see page 63).

A number of conservatory plants, such as *Agave*, *Caladium*, *Billbergia*, *Tillandsia*, *Guzmania*, *Anthurium*, *Pandanus*, are readily propagated from suckers broken from the plants and potted in small pots plunged in a Wardian case (see p. 52).

LAYERS

Propagation by layers consists in rooting a portion of the plant without detaching it from the parent plant. Some plants may be propagated by this method when cuttings fail. Many propagate themselves naturally by this method, the branches coming in

contact with the earth, producing roots. Creeping Jenny, Boston Ferns, Grapes, Sedums, Tomatoes, and many other plants take root at the nodes, or eyes, very readily. In the case of many other plants roots easily form when a branch is bent down and covered with earth. This is *simple* layerage. It is advantageous to peg the branches in some manner and to cut the stem partially through (see fig. 45) at the point where roots are preferred. Black Raspberries root easily when the tips of their branches are buried (see fig. 46). This latter is known as *tip layering*. After the layers have rooted they are severed from the parent plants.

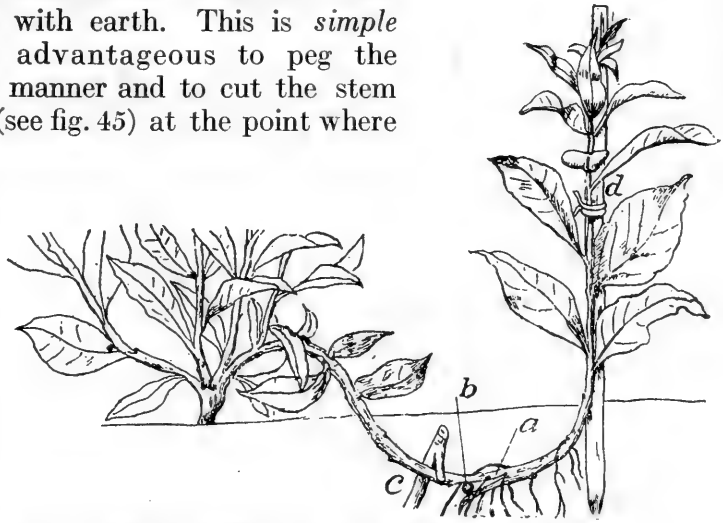


Fig. 45.—Simple layering. Note how the branch is bent down; a slit has been cut in the stem at *a* and held open by a pebble, *b*; a peg, *c*, holds the layered branch firmly in the soil; and the stake, *d*, keeps it upright. Note how the roots have formed

When the branch of a plant is covered with soil at a number of points, the term *serpentine*, or *compound* layering, is applied. It is used very advantageously with vines.

When nearly the whole branch is covered, the process is called

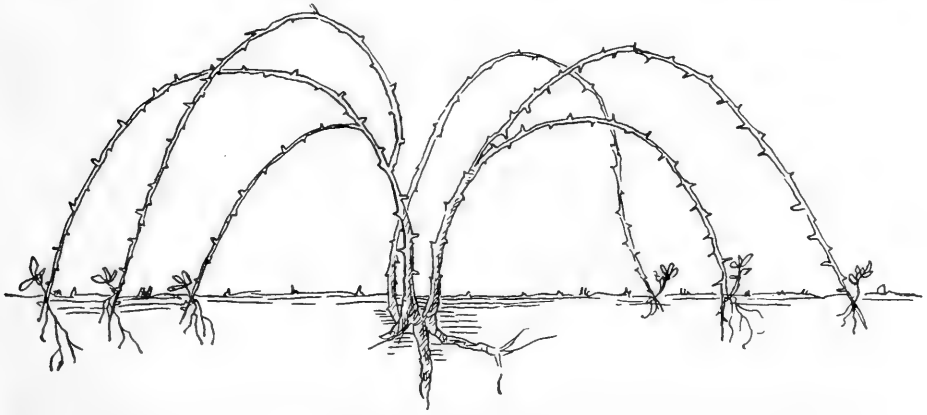


Fig. 46.—Tip Layering a Raspberry. The shoots have been bent down and covered with soil; each one has rooted and produced a young plantlet, which may be severed and grown separately

Fig. 47.—Air layers. A, A branch notched preparatory to air layerage. B, A Chinese layer, the notch has been covered with a ball of moist sphagnum moss. C, A pot layer; a pot filled with moss or sand has been used instead of just a ball of moss
(See page 78)

continuous layerage. This method is confined to a few shrubs and vines which grow readily from buds even though they are covered with earth.

With other plants whose branches cannot be bent down to the earth, some method of *air* or *pot layerage* is used. Ordinary flower pots are split in two pieces (see fig. 47, C) and placed around a branch. The pot is tied together, an incision is made in the bark and stem inside the pot and the pot filled with sphagnum moss or soil. This method is successfully used on Dracænas and Crotons when they become too tall and lose their lower leaves. The pot is not necessary; many plants are layered by merely tying a ball of sphagnum moss around the stem which as before, is injured. Such layers are called *Chinese layers* (see fig. 47, A and B). So soon as roots form, the top is removed and potted.

PREPARING PLANTS FOR LAYERING

Early Spring is the time to prepare for layering. Stock to be layered should be growing with ample room between the plants, to permit of the shoots being layered all around them, and still leaving room for cultivating between them. The soil should be con-

sidered: it should not be heavy, but rather of a light nature, making work easy for the operators; the layers, too, root more freely in light, sandy soil than in any other kind.

Having the plants at a proper distance apart, and the soil prepared the next thing is to prune the plants, to cause them to make some young, strong shoots for layering. These shoots should, preferably, always be of the same season's growth, though older ones will root. If not already pruned, do it before growth starts, cutting the plants down as near the ground as possible, having in mind that the shoots anticipated must be layered under the surface, so the nearer they are to the ground the better; layering should commence as soon as the shoots are of sufficient length to permit of it.

Fig. 48.—Rubus propagation. Shows method of increase.
Sketch by George W. Oliver

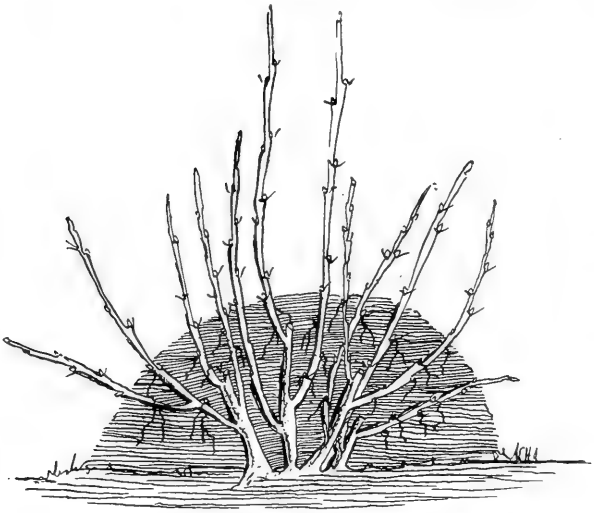


Fig. 49.—Mound layer of Gooseberry. Note that the shoots have been cut back close to the soil previous to mounding the soil about the plants; each shoot is rooting nicely

MOUND LAYERS

Plants with rather stiff branches which can hardly be bent down and covered with soil are *mound layered.* By this method the plants are cut back very severely and this will cause the production of a great number of branches. These are covered with soil which will cause each branch to root. (See fig. 49.) When the process is completed, the plants are divided. Gooseberries and Quinces are propagated by this method.

RUNNERS

Certain plants, such as the Strawberry (see fig 50), produce *runners*, or little plantlets, upon specialized branches. These are readily propagated by separation from the parent plant and potting into 2 inch or 2½ inch pots. In the Strawberry patch there is frequently a succession of these new plants started, but for the best results the first runners to be produced from the plants should be trained into pots sunk into the soil.

Fig. 50.—Strawberry runners

RHIZOMES

A rhizome, unlike a root, is an underground stem. In other words, rhizomes bear roots and have prominent leaf buds or eyes. (See figs. 51 and 52.)

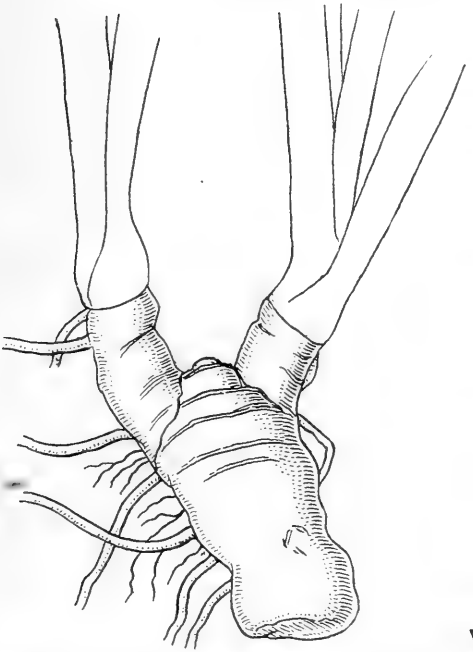


Fig. 51.—Portion of German Iris Rhizome. Between the leaf shoots is shown the scar left by the flowering stem. Each shoot might be separated as an independent plant

Divisions of a root stock or rhizome are safely planted vertically when it is known which is the upper end, otherwise, most divisions should be placed in the soil horizontally.

Many of our outdoor plants which bear rhizomes are best propagated by taking pieces which bear one or two eyes. For examples see under Bulbous Plants and Their Propagation, page 141.

CONSERVATORY PLANTS

Many conservatory plants are propagated by divisions of a rhizome. Some examples are :

ACANTHUS. Divide in Spring or early Autumn.

AGLAONEMA. The short rhizomes when divided are placed in sand to root.

ALOCASIA. Usually in March. Keep close, moist and warm. Use Wardian case.

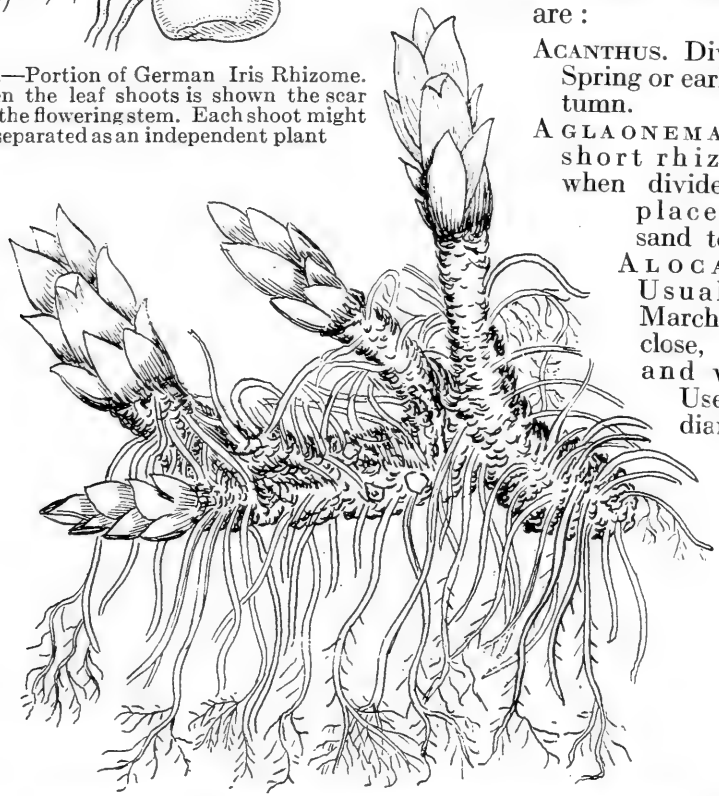


Fig. 52.—Primula Sieboldii. This sketch is of the Spring stage showing the rhizome

Fig. 53.—Maranta. Note the rhizomes at the root and the runners above the soil

ANTHURIUM. Place divisions in peat, sphagnum moss and sand, in small pots plunged in Wardian case, at temperature of 75° to 80° with bottom heat. Propagated in Midwinter.

ARUM. Division of rhizome in Spring.

ASPIDISTRA. Wash out old soil before growth starts and divide up rhizomes; place in propagating bench of sand to root, then pot.

CALATHEA. (See Aspidistra.)

CALLA. (Not Richardia.) (See Anthurium.)

CANNA. The rhizomes are rather tuberous. Divide and pot in March.

CONVALLARIA. (See Lily of the Valley.)
FATSIA PAPYRIFERA. Best in Spring.
FERNS. (See page P. 123.)
LILY OF THE VALLEY. (These rhizomes are called pips.) Divide. Grow in sand with good bottom heat and shade.
MARANTA. (See Aspidistra.) (See fig. 53.)
MONSTERA. Each piece should have several joints.
NELUMBIUM. Aquatic. Cut up rhizome and anchor to soil with a stone.
NYMPHÆA. Aquatic. (See Nelumbium.)
RICHARDIA. (Calla Lily) Dry off plants in summer. Pot in early Fall, removing offshoots which, when potted several together in a pot, often bloom the first or second year.

DIVISION OF PERENNIALS

One of the simplest methods of propagation is that of division. With a large knife or spade huge clumps are cut into convenient sizes for replanting. Certain very rampant growers get very much choked after growing in one place for any length of time. Examples of perennials which require almost annual propagation are: Michaelmas Daisy, *Achillea ptarmica* and *millifolium roseum*, *Helianthus*, *Sedum*, some Veronicas, Chrysanthemums, *Œnothera*, and all perennials which sucker badly should be moved and divided every year *Artemisia*, *Boltonia*, *Campanula*, *Geum*, *Funkia*, *Doronicum*, *Armeria and Thalictrum* are all propagated by division.

Certain perennials, such as Peonies and Fritillaria, should not be moved often; they must be thoroughly established in order to bloom properly Peonies should be moved every six or seven years, Phlox every four years and Iris every three years.

Boxwood can easily be separated by tearing to pieces old dwarf plants; the divisions are replanted to make a tiny hedge. A new plant, the Box-barberry may prove a good substitute for the Box, as it is a low growing form of *Berberis Thunbergii*.

CHAPTER IV

GRAFTAGE

Graftage Defined — Objects — Results — Limits — So-called Graft Hybrids — Characteristics of a Stock — Selection of Wood for Cions — Time to Graft — Important Points — Whip Grafting — Root — Cleft — Veneer — Side — Splice — Saddle Graft —Bridge — Crown — Terminal Bud — Budding — Time to Bud — Shield Budding — Patch — H Budding — Inarching — Seedling Inarch— Top Grafting — Double Working — Wax — Applying Wax — Cactus Grafting.

TERMS DEFINED

THE term *graftage* is now accepted to include both grafting and budding. The real difference between these two processes is slight. Budding is inserting a single bud into the growing wood of a plant; grafting, merely consists in using a twig of several buds instead of a single bud. Also included under graftage is the process of inarching, or grafting by approach.

The term *cion* (often spelled *scion*) is used to designate the portion of one plant which is inserted upon another plant, called the *stock*. The stock is usually rooted so that it may gather the nourishment from the soil and furnish it to the cion.

It must be remembered that even though the stock and cion are in intimate union, each retains its own individuality. The tissues of bark and wood of each never mix, they merely knit together.

Most dicotyledonous plants, as Apples, Legumes, Evergreens, Cacti, Composites, Crucifers and members of the Potato family, have been grafted. Monocotyledonous plants, as Lilies, Orchids, Grasses, Irises, and the Aroids, have never been grafted for commercial purposes, because their parts are not adapted for the essential close union.

OBJECTS OF GRAFTING

The reasons for grafting plants are well set forth by Baltet* as follows: "The object of grafting is—

1. To change the character of a plant, by modifying the wood, the foliage or the fruit which it was required to produce.

2. To excite the development of branches, flowers, or fruit on the parts of a tree where they are deficient.

3. To restore a defective or exhausted tree by transfusion of the fresh sap of a vigorous kind.

4 To bring together on the same stem the two sexes of monœcious† plants, in order to facilitate their reproduction.

5. To preserve and propagate a great number of woody or herbaceous plants for use or ornament, which could not be reproduced by any other means of multiplication."

THE RESULTS OF GRAFTING

After the cion grows it produces its leaf, flower, or "fruit after its kind." Shoots from below the point of union continue to produce their own characteristic leaves, flowers and fruits. But grafting hardly ever materially changes the qualities of the characteristic stock and cion.

Dr. L. H. Bailey‡ has summarized a few effects of grafting which are of interest.

Dwarfing. Grafting may alter the stature of a plant. It is a common method of dwarfing plants. The pear is dwarfed by grafting on Quince or on the Apple by working on the Paradise Apple stock.

Adapting varieties to adverse soil Grafting may be the means of adapting plants to adverse soils. Some varieties of Plums are worked on the Peach, which causes them to thrive in a sandy soil.

Roses when grafted on Manetti stock tolerate sandier soils.

Adapting plants to adverse climate. Grafting may be the means of adapting plants to adverse climate. The stock may mature sooner and cause a relatively earlier maturity of the cion, or the stock may actually impede the flow of sap and cause earlier maturity.

The Oldenburg and other Russian Apples are used as stocks, because the early maturing causes the ripening of the wood of

* Baltet, Chas. The Art of Grafting and Budding, p. 2.

† It would seem that Baltet might have included *diœcious* as well as *monœcious*. Monœcious plants have flowers bearing only one sex, but both kinds of flowers, on one plant; diœcious plants have the separate sexes on different plants.

‡From *Garden and Forest*, Feb. 26, 1890. The above excerpt from this paper is much changed, but the main facts are found in the article cited.

the cion, which consequently is less injured by adverse Winter conditions

Correcting poor habit. Grafting may correct a poor habit. Canada Red Apples, which are notably poorly shaped trees, are improved by top working upon some good grower.

Rapid method of testing seedlings. Grafting often hastens fruiting and flowering. Seedlings which require a long time to attain the age for flowering or fruiting are frequently budded or grafted upon a mature tree. (See Inarching, p. 102). This method saves years of waiting for, perhaps, an inferior fruit. With the Pear it often takes eight to ten years before the seedling will bear fruit; but when budded, Pears may be produced in two years. Even the bud from a seedling, therefore, becomes a part of the tree and the vigorous growth of its first year may be expected to produce, flower and fruit buds. Furthermore, it is known that cions from young trees bear fruit more readily when inserted in old trees, than when set in young ones. In France this system, by which a great number of excellent Pear varieties have been introduced, has been commonly practiced. There is keen pleasure in hybridizing fruits, raising the seedlings and awaiting the results of the labor.

Modifying season of ripening of fruit. Grafting will often alter the season of ripening of fruit, by causing a difference in time of maturity of wood in stock and cion. Pears of the variety Winter Nelis keep better when grafted on Bloodgood stock than when grown on Flemish Beauty. Twenty Ounce Apples ripen earlier than normally when grafted on Early Harvest.

Increasing fruitfulness. The increase in fruitfulness of some varieties may be due to better adaptation to climatic and soil conditions. Many instances of increase in fruitfulness, by grafting, can be given.

Delaying the running ou of varieties. Grafting, rather than growing plants from cuttings, seems to delay the degeneration of varieties of certain Camellias and Roses.

Increasing size of fruit. Certain Pears when grown on the Quince are much increased in size.

Modifying color. Grafting often causes a change in the color of flower, foliage and fruit. Many of the cases of apparent difference are due to environmental influences rather than grafting. *Prunus Pissardi* is deeper in the color of the foliage, when grafted on *P. americana*, than upon *P domestica.*

Influencing flavor of fruit. Grafting may appreciably influence flavor. Angoulême Pears are improved in flavor when worked upon the Quince.

LIMITS OF GRAFTING

The solution of the problem as to just which plants may be grafted upon each other has hardly been explored. Certain species graft with perfect ease, certain other species in the same genus are united with difficulty. Peaches do not bud readily on the Apricot, but both the Peach and the Apricot may be budded on the Plum Apparent similarities are confusing. The Horsechestnut cannot be budded on the Oak, but the edible Chestnut may be so united. Botanically, the Chestnut and the Oak are of one family. Plants belonging to different families cannot be grafted. It is, however, possible to have the Mountain Ash, the European Quince, the Japanese Quince, the June Berry, the Crab Apple, the Pear, the Medlar and the Cotoneaster all in bloom on one Thorn Apple or Cratægus tree. All of these plants belong to the Rose family.

Absurd statements concerning graftage have continually been made by those persons who have allowed their imaginations to rule their writings. Even Virgil speaks of Apples growing on Plum trees; a core fruit on a stone fruit. We believe such things impossible. Martial speaks of the Cherry on the Poplar. Madame de Genlis claims to have grafted the Rose on the Black Currant, to obtain black Roses. Only last year a prominent New York newspaper published with seeming sincerity the account of a *table d'hote* tree which, by grafting, grew Tomatoes, Cucumbers, Potatoes, Apples, and a dozen other crops on one specimen. It was advised for planting in the small backyard.

SO-CALLED GRAFT HYBRIDS

In 1826, at Vitry, France, M. Adami grafted *Cytisus purpureus* upon *Laburnum vulgare*, and there came from the point of union a branch which was hybrid in nature. It bore pink, yellow and purple flowers. Yellow flowers are characteristic of *Laburnum vulgare*, and purple flowers are borne by *C. purpureus*, but the pink is truly hybrid. The wood and foliage accompanying each type of flower followed the characteristics of the parent from which the flower came. This graft was propagated and is known as *Cytisus Adami*. Biologists are not willing to call this a graft hybrid, however, for they point out that the tissues are not hybrid. The outer tissues of *C. Adami* are distinctly *A. purpureus* and the inner *Laburnum vulgare*.

Many other examples of so-called graft hybrids have been found. In 1914, D. Bois in *Revue Horticole*, reported the case of a Pear grafted on a Quince, which sent out *below* the graft two opposite branches; one being of the Quince growth, the other differed widely

from both the Pear and Quince. It was called *Pyrocydonia Winckleri.** It is reported that this variation is propagated true to type.

The settlement of the question whether such growths are truly hybrid is important, for if they are, sexual and asexual reproduction are identical. Hybrids are supposed to occur only upon the union of the sex cells, not the structural cells, of a plant.

CHARACTERISTICS OF AN IDEAL STOCK

A good stock for budding or grafting should be:

1. Hardy, if possible, so that the plants may live through the Winter.

2. Easily multiplied; simply and rapidly.

3. Cheap to obtain; many stocks are grown from seeds gathered from the wild.

4. Free from susceptibility to pests and diseases. Certain plants being very susceptible to pests are grafted for this reason. The European Grape being readily attacked by the phylloxera, a root louse, it is grafted upon the American Grape stock which is not attacked. Diseases are readily communicated from stock to cion or *vice versa.*

5. Easy to work; looseness of bark for budding is a prominent asset.

6 Capable of making good strong unions and unite quickly; the cion should not outgrow the stock.

7. Able to produce a good, well-balanced root system. In the case of many commercial plants, a small but very fibrous root system is preferred, because of the advantage of easy transplanting and later the ability to fertilize the limited area about the plants. The long wiry roots are often the only ones produced when the seedling stocks are raised in a heavy soil. A loose, fibrous soil containing leaf mold will cause such trees as Hickories, Oaks, English Walnut, and Chestnut to make fibrous roots. To get a desirable root system Fuller† advises sowing nuts "in shallow pots or boxes, and in nearly pure sand, applying liquid manure as needed, to insure a vigorous growth."

8 Non-suckering Suckers are always a nuisance because they must be removed, else they will often outgrow the cion.

9. Adapted to a wide range of soils. The adaptation of a stock to both sand and clay will go toward making the success of a variety from the commercial standpoint.

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* Bois, D. Pyrocydonia Winckleri. Revue Horticole, Jan. 16, 1914, pp. 27-29.
† Fuller, A. S. The Propagation of Plants, p. 233.

10. Straight stocks for weepers and standards. For grafting this class of plants, a crooked stock is objectionable. During the Winter or early Spring cut down the plants and encourage one shoot only to grow. Cut out the weaker ones. In growing stocks for weepers the growth of a leader is not stopped, for side shoots are not wanted. Stocks for standards can often be stopped in growth after reaching the proper height or they can be pruned in order to form a head the same season.

SELECTION OF WOOD FOR CIONS

The material for making cions should be collected, preferably in the Midwinter, and is best stored in moist sand or sawdust and kept cool. The wood may, however, be gathered any time before the buds start in the Spring. For making cions the strong, vigorous wood of the previous season's growth should be chosen which have pulp matured buds on each branch.

TIME TO GRAFT

Grafting is usually done when the buds of the stock are beginning to swell, which indicates that the sap is now active. As the different trees and shrubs vegetate at various times in the nursery there is a well-planned succession of grafting for the various species of plants.

THE IMPORTANT POINTS IN ALL GRAFTING

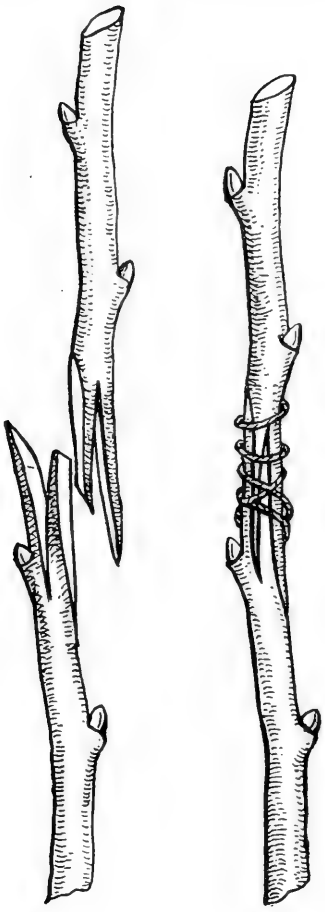
Plants which can be grafted have a layer of bark which covers the wood. Usually this bark, at least on the young branches, will peel from the wood. It is absolutely essential that the tissue between the bark and the wood of both stock and cion be in contact. This layer is known as the *cambium layer*. It has the ability to grow wood tissue from its inner side and bark from the outer; by such knitting together the tissues heal nicely.

After the graft is made, especially in outdoor work, the whole area of cut surface in stock and cion must be waxed over to check evaporation from the tissues.

Grafts may be made: (1) upon seedlings, a method especially used in propagating horticultural varieties of ornamental trees and shrubs. (2) upon young trees as with Apples, and other fruits; (3) upon the trunk and branches of older trees; (4) upon roots; or (5) upon the crown of the plant

WHIP OR TONGUE GRAFTING

Whip grafting is largely used when grafting small stocks. Both the stock and cion are cut diagonally; this cut should be long and



A B

Fig. 54.—Whip or tongue grafting. A, Stock and cion properly cut. B, The parts fitted together and wrapped with waxed string

straight. A vertical cut is then made in both. Practice will show that the cut must be made a trifle to one side of the diagonal cut. The two parts are fitted together as shown in the cut (fig. 54). Care must be taken to have the cambium layers in contact. If the stock is larger in diameter than the cion, the cion must be placed at one side. The union is then wrapped with waxed string or raffia. The waxed string used is No. 18 knitting cotton. The balls are soaked in melted grafting wax and laid away to dry. This string is just weak enough to be broken by the hands. In whip-grafting Pears, it seems best to wax the grafts rather than use the string. In order to harden the wax quickly the grafts are dropped in a pail of water.

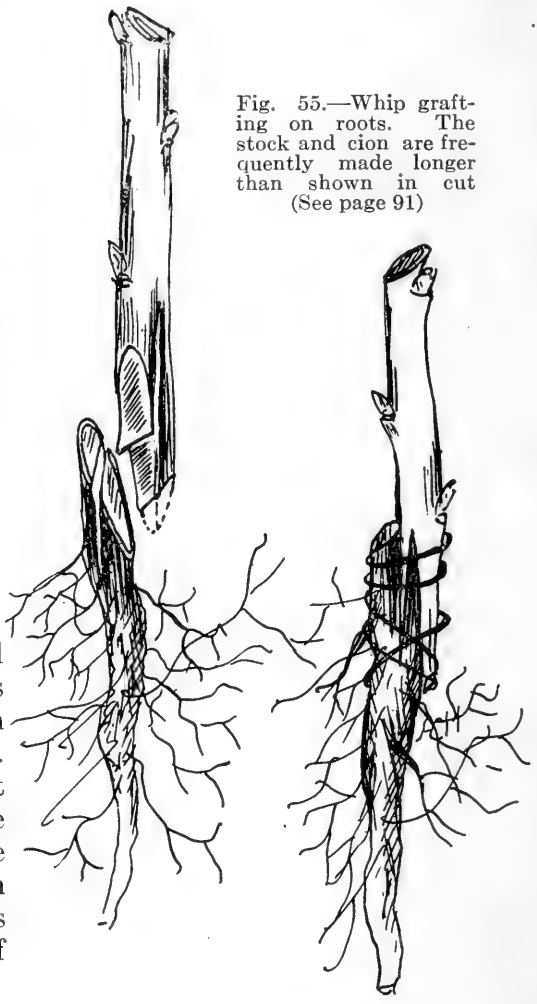


Fig. 55.—Whip grafting on roots. The stock and cion are frequently made longer than shown in cut

(See page 91)

Fig. 56.—Cions for cleft grafting
(See page 92)

ROOT GRAFTING

The whip or tongue is the most common method of root grafting Apples. The stocks are dug and stored in the Autumn and grafted in January or February. Whole roots may be used, grafting at the crown Sometimes each root is cut into two or three pieces, in which case two or three grafts may be made (see fig. 55). The grafts are packed in moist sand or sawdust and stored in a cool cellar, where during the Winter the grafts will callus. Care is taken to label the grafts which are tied together in bundles of 100. As soon as the soil can be worked in the Spring the grafts are dibbled out in rows, so that the top bud is just above the surface of the soil. For extensive plantings, furrows seven or eight inches deep are frequently turned, the grafts are set in the row and the soil thrown back and firmed, either by hand, with tamps or by a machine with oblique wheels which presses the soil about the grafts.

CLEFT GRAFTING

Cleft grafting consists in splitting a stock after it has been cut off perfectly even and inserting one or two cions. The cions should be wedge-shaped (see fig. 56) and of equal size. In cutting the wedge great care is necessary in order to have both sides straight, not lopsided nor scooped out. The lowest bud on the cion is best placed when it is just above the cut sides of the wedge. A special tool may be used to make the cleft and hold it open

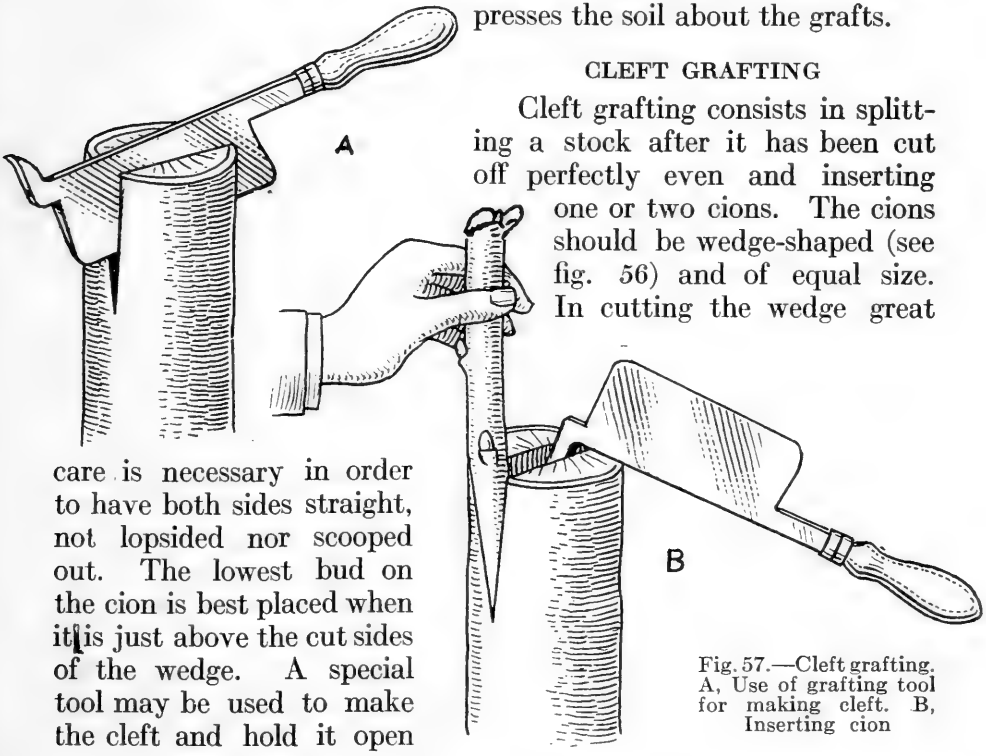
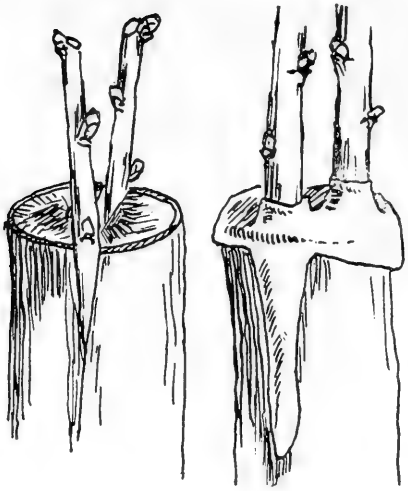


Fig. 57.—Cleft grafting. A, Use of grafting tool for making cleft. B, Inserting cion



A B
Fig. 58.—Cleft grafting. A, The completed graft. B, Properly waxed

while the cions are being inserted (see fig. 57).

Cleft grafting is used principally when the stocks are over one inch in diameter, making it possible to insert two cions. Should both grow, the weaker is cut out at the end of the first year. As in all grafting, the cambiums of both should be in contact. To insure this the cions should be inserted a trifle diagonally (see fig. 58-A).

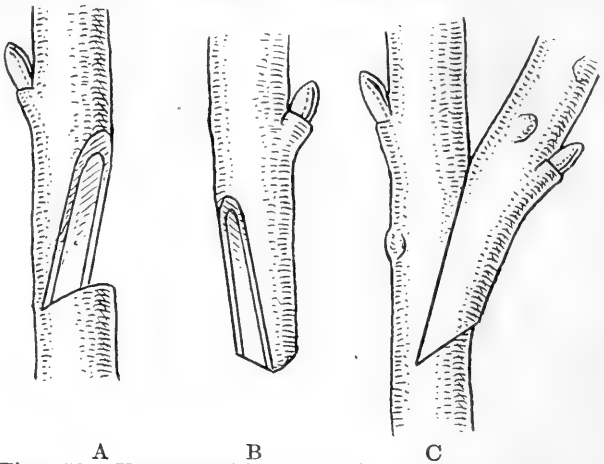
As soon as the graft is made, all cut surfaces must be covered with wax (see fig. 58-B); even place a slight dab at the ends of the cions.

The Cacti are easily cleft grafted. *Pereskia* (see fig. 80) and *Cereus* are the common stocks for such Cacti as *Epiphyllum*, which is very drooping (see pp. 109-110).

Peony roots may be cleft grafted, especially Paeonia Moutan, which is grafted either on the herbaceous or the shrubby stock. Bind the graft with copper wire; raffia decays before the union takes place.

VENEER GRAFTING

Veneer grafting (see fig. 59) is practiced mostly in the greenhouse upon ornamentals. The graft is very simply made, consisting merely of cutting a chip from the stock and fitting a cion to it. In the greenhouse a ball of moss around the union is sufficient. When used out of doors the cut edges must be thoroughly waxed. The stock need not be headed back until the cion is growing nicely. Certain of the plants which are more difficult to graft will best be placed in a Wardian case, or grafting frame, where the at-



A B C
Fig. 59.—Veneer grafting. A, The stock notched. B, The cion cut to fit the stock. C, Stock and cion together

mosphere can be confined. Many of the evergreens and Rhododendrons are propagated by this method.

SIDE GRAFTING

Very closely resembling the veneer graft is the side graft. A diagonal cut is made in the stock, which should be long. Note the sketch (fig. 60), which shows how the cion is made and inserted into this cut. Plants by this method may be propagated either when in full growth or when dormant. Waxing is necessary out of doors; tying with waxed string indoors holds the cion in place. If the stock is headed back slightly, the growth will be encouraged.

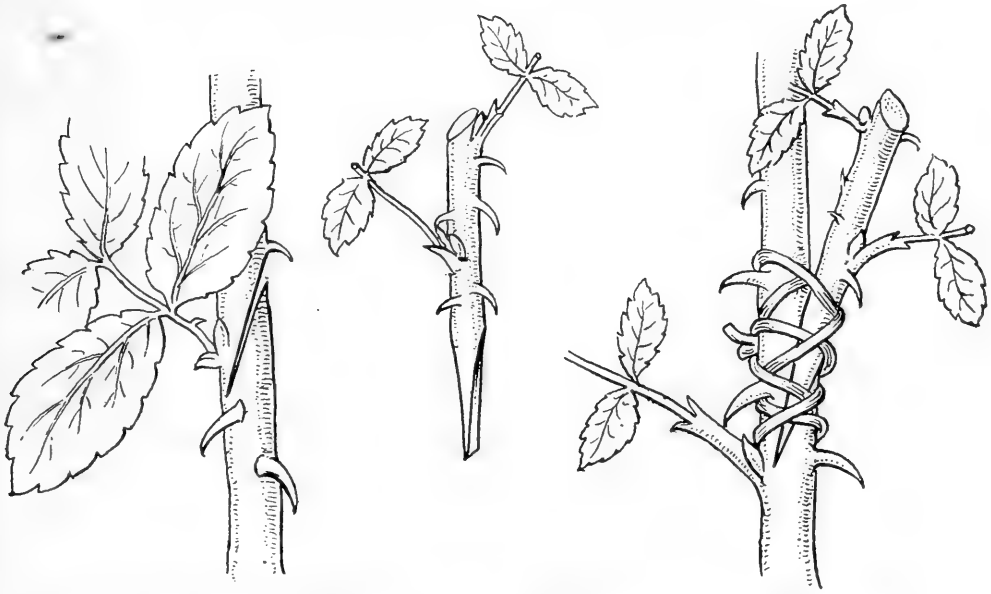


Fig. 60.—Side grafting the Rose. The cut in the stock should not be so nearly through the stem and is best made longer and more acutely than shown in the sketch

SPLICE GRAFTING

An exceedingly simple form of grafting is the splice graft. Stock and cion are cut with a long diagonal cut as for the whip graft. The two parts are tied together without further fitting, although the stock and cion should be approximately the same size. This method is used on Roses (see page 136) and Cacti (see fig. 61), and is only successful in the greenhouse.

SADDLE GRAFT

In making the saddle graft the stock is cut in the form of a wedge. The cion may either have a section removed to fit over the wedge or it may be merely split upward (see fig. 62). This method is successfully employed in grafting Rhododendrons.

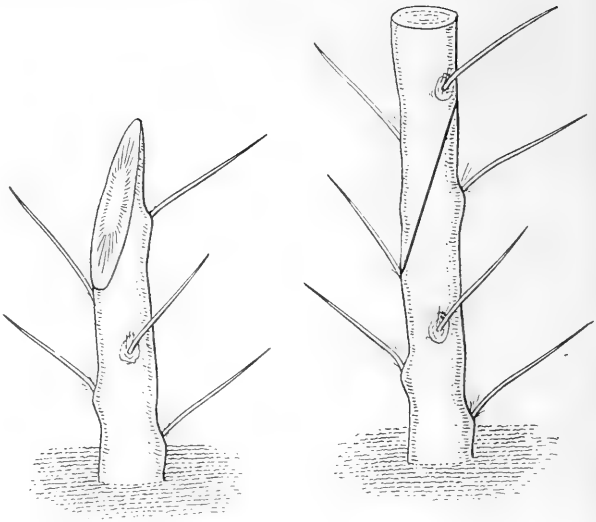


Fig. 61.—Splice grafting Pereskia Cactus
(See page 93)

BRIDGE GRAFTING

When trees are girdled, or nearly so, the wound may be encouraged to heal and the sap caused to flow, by bridging the injury by cions made in the form of a wedge at each end and fitted into V-shaped cuts in the bark. A tack holds the cion in place, but the exposed cut areas must be waxed. (See fig. 63.)

This method has been widely used by the French in restoring mutilated fruit trees in France.

"Throughout the entire district devastated by the Germans there were thousands of trees that the close pursuit of the French kept the Germans from having time completely to cut down. Instead, the 'kultured' tree-killers cut off a circle of bark around the trunk of the tree, which with a few days' exposure to the sun would be sufficient to kill Peach, Plum, Apple, Apricot, and Cherry trees that had been half a century attaining their actual productiveness.

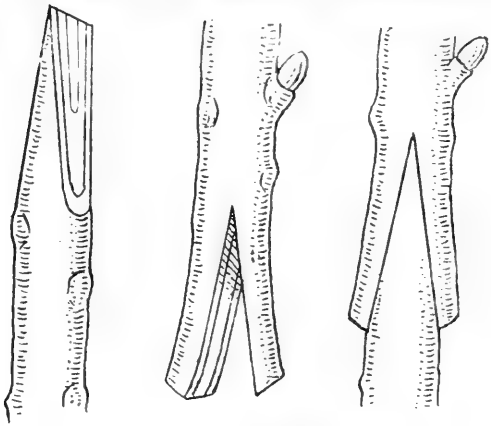


Fig. 62.—Saddle grafting

"So great was the number of trees that had to be dressed in this way that the entire available supply of grafting preparation was quickly exhausted. Tar was then used as a substitute, and, finally

loamy clay. Substitutes for surgical bandages also had to be found, and in the end it was discovered that moss twisted and tied about the dressed wound was as effective as anything else."*

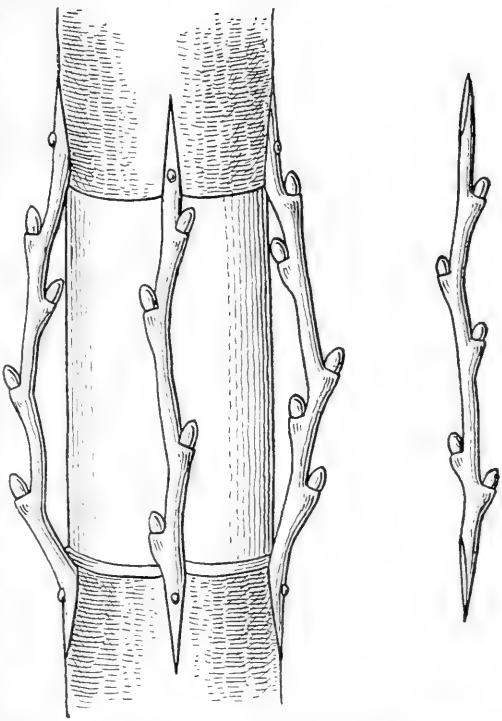


Fig. 63.—Bridge grafting. Note how the cions are cut to fit into v-shaped incisions in the bark (See page 94)

CROWN GRAFTING

The crown graft is a slight modification of the cleft graft. In this case the stock is not split, but the cions are cut various shapes and fitted into the cuts in the stock. The cions may be tapered as in the cleft graft or they may be cut off straight at the base as in fig. 64. Another kind of crown graft is made by removing triangular chips from the stock and using a cion to fit. A special inlaying tool is used for the purpose. (See fig. 65.)

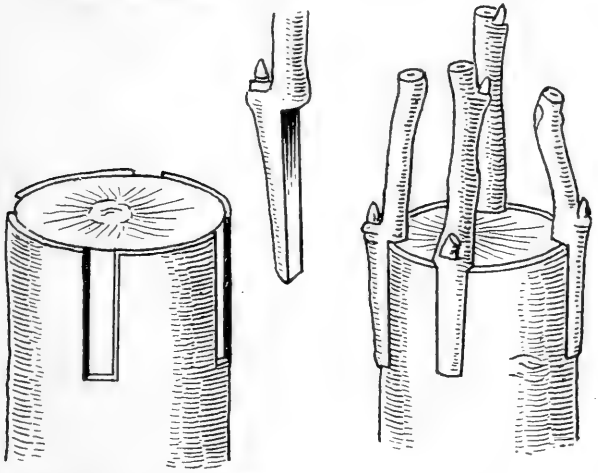


Fig. 64.—Veneer crown grafting. This is a modification of the crown graft (After Baltet)

Crown grafting is used extensively upon very large trees which have been cut down. Many cions may be inserted. They must be tied and waxed in place. To prevent transpiration it will be best to cover the whole stump with wax paper. The unions will not be very strong and some stake should be provided at the start, for,

* Wood, Henry. From an article reported in the *Literary Digest* from the *Westminster Gazette* (London).

when the cion grows, little surface should be exposed to the wind.

In the areas devastated by the Germans in the war where trees have been cut down, the French are crown grafting the trees. Regarding this work we find reported in the *Literary Digest* the following comment from *L'Illustration* (Paris, April 28, 1917):

"The work of reparation was taken up in time, and Nature was given a chance to act. When the bark of the oldest trees was too deeply grooved to admit the passage of young sap, the old trees were eliminated, and trunks not exceeding 25 centimeters in diameter were left to send up shoots. Four or five of the most vigorous of the shoots will be used for grafting-slips next year.

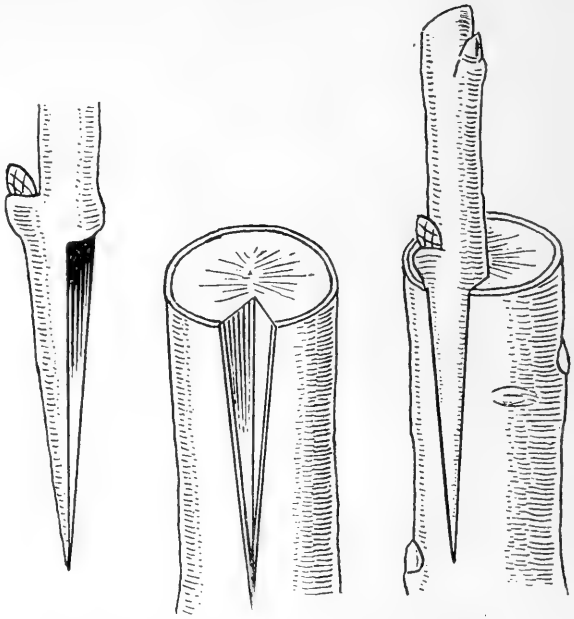


Fig. 65.—Inlayed crown grafting. It is well to have a special inlaying knife for cutting this sort of a crown graft but it can be made without one. The cion is cut with a triangular face with a notch which will act as a support upon the stock. By placing the cion upon the stock the section of wood can be marked with a knife and easily removed (After Baltet) (See page 95)

Some of the trunks saved have been grafted even with the ground when planted, so the new growths, springing from the trunks at a height of 80 centimeters, will bear, above the graft, exactly the same kind of fruit that the tree bore at first. Other trees not the issue of grafts, but seedlings, whose bark has not been roughened by age, are expected to recuperate very rapidly.

When the mutilated tree did not measure more than 20 centimeters in diameter the 'crowning' method has been used. This means that the trunk has been sawed in a slightly oblique direction to facilitate the course of the rain (fig. 66, a), and then from three to six grafting-slips have been inserted all around the trunk, between the bark and the wood. For use by the 'crowning' method, the grafting-slips are prepared as shown in figs. 66, b and c, and set in 8 or 10 centimeters apart, the space varying according to the diameter of the trunk (fig. 66, d). When set in place, the graft-slips are ligatured, and the whole—wound, bark, and ligature--

carefully covered with grafting wax. The slips (which must be in a state of complete rest) will be found in France growing in a crown around the top of the mutilated trunk. . . ."

TERMINAL BUD GRAFTING

With certain plants the tip of the twig of a seedling is split lengthwise through the terminal bud and the cion is inserted as in the ordinary cleft graft. This method is performed upon the Walnut and the Pine according to Baltet. This method is known as terminal bud grafting. (See fig. 67). It is best practiced indoors and is here presented in the hope that it may be a method by which some other difficult plants may be grafted.

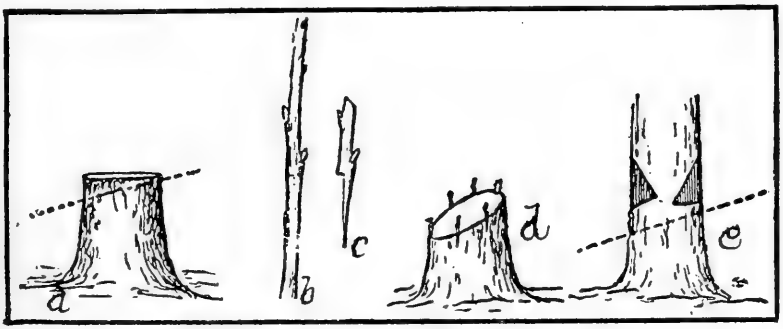


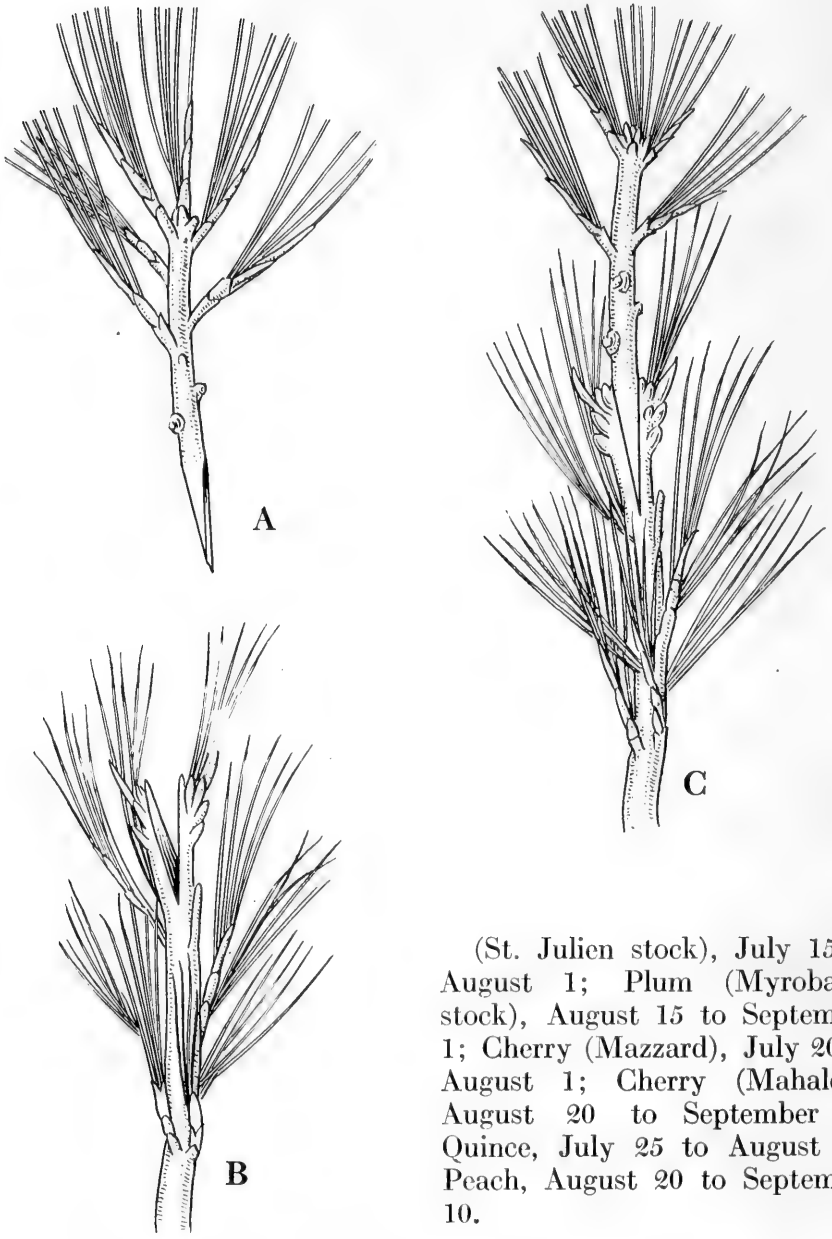
Fig. 66.—Crown grafting in war zone. (From *L'Illustration*, Paris)
(See page 96)

BUDDING

When the cion is merely a bud, the process is known under the specific name of *budding*, a term less accurate than the French term *bud-grafting*. The bud is usually accompanied by a small piece of bark, and generally in cutting most buds there will also be a small piece of wood. If done carefully the wood is best removed, but the buds grow fully as well without going to this trouble. The stock for budding should be in a growing condition.

When to bud. The bark of the stock must peel readily. The buds must be large and plump in the axils of the leaves, because immature buds do not grow. The bud wood or bud stick should be kept in moist paper or sphagnum moss as soon as cut.

Prof. U. P. Hedrick, the expert horticulturist of the Geneva Experiment Station, gives the following dates for budding: Rose, July 1 to 10; Pear, July 10 to 15; Apple, July 15 to August 1; Plum



(St. Julien stock), July 15 to August 1; Plum (Myrobalan stock), August 15 to September 1; Cherry (Mazzard), July 20 to August 1; Cherry (Mahaleb), August 20 to September 1; Quince, July 25 to August 15; Peach, August 20 to September 10.

Fig. 67.—Terminal bud grafting. Pine. The tip of the stock (B) is split and cion (A) is inserted (C) (See page 97)

SHIELD BUDDING

The simplest method of budding is known as shield budding. The buds are cut from the bud stick, holding the branch as shown in the cut (fig. 68), with the top end toward the budder. The cut is made downward and as smooth as possible. Professional budders prepare the bud stick by cutting the buds almost entirely through, allowing them to hang so that they may be removed just before inserting on the stock.

The stock is best gone over several days before budding so that the weeds are removed from the base of the plants. Interfering leaves and branches are also cut out. In most nursery budding, except for weeping varieties and standards, the buds are inserted an inch and a half above the soil. With a knife a T is cut in the stock (see fig. 69); this may be right-side up or inverted. Much is being said of late of the advantage of the inverted T; the buds may be inserted more easily and shed the water better. The edges are peeled back and the bud is inserted so that it fits flatly. Should a piece of bark protrude above the bud it may be removed. The bud is now tied firmly with raffia to keep out water; the whole cut surface, except the bud, being covered.

About ten days after budding, the buds will have united to the stock and the raffia should be cut, else the young bud will be strangled. Plants budded early will often start to push a shoot, then the top may be cut off entirely or it may be sawed partially through and the top bent over. Eventually, however, the top should be removed. With plants budded later the bud will remain dormant through the Winter and start in the Spring. The main shoot should not be cut until after the bud has grown in the Spring (see fig. 70).

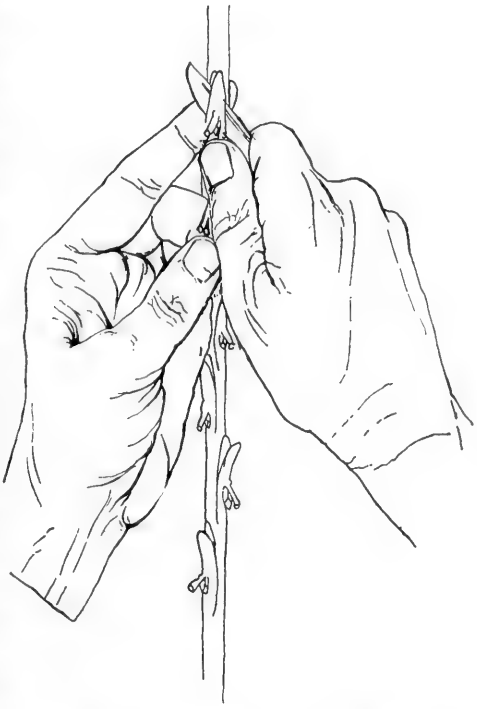


Fig. 68.—Cuttings buds. The sketch shows the proper position of bud stick and the hands. The bud is only partially removed from the twig until ready for insertion; then the bud may be easily cut straight across

The Peach may be budded either in June or September. Regarding June budding, Joseph Meehan writes: "Whoever possesses strong Peach stocks can secure by Fall, Peach trees large enough to sell, if budded in June or early July. These would be what are called June budded Peaches in the trade. Budding is done now instead of in September, and the stocks are then treated in a way to cause the buds to grow at once instead of remaining dormant until Spring, as is the case with the buds set in September.

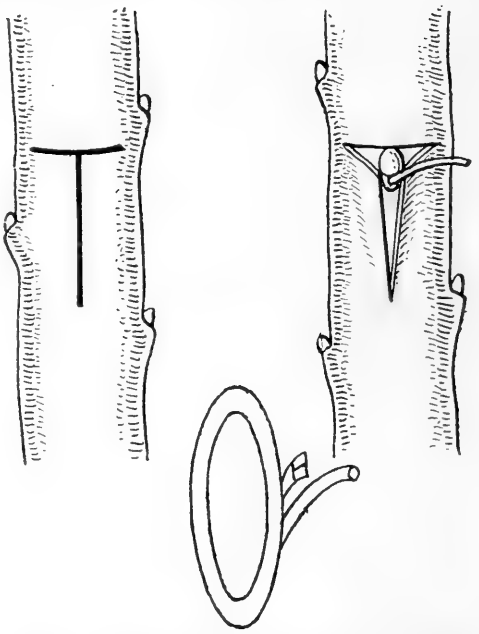


Fig. 69.—Shield budding. Showing T-shaped cut in stock; the bud and the budded tree (See page 99)

The September budding is performed by inserting the bud near the ground, but in the June work it can be placed higher up, so as to increase the height of the tree when offered for sale. Below the height branches are wanted on a Peach tree, it is immaterial whether the part below be seedling or what, so the bud can be placed up a foot or more, if the vigor of the stock will permit of it. The stock should be headed back to about six inches above the bud. As soon as the union of the bud is assured, strip off the foliage from the part above the bud; but do not cut the stem away until later in the season, as it well serves the purpose of a stake to which to tie the growing bud, and it is better to leave the foliage below the bud as well for awhile, cutting it away gradually as the bud advances. To strip it all off as soon as the bud starts has a weakening effect, which is soon perceived."

Fig. 70.—A budded seedling tree. Note that the bud at the base has started to grow. The top can now be removed

PATCH BUDDING OR FLUTE BUDDING

It is much more difficult to make a successful *patch bud* than a shield bud. The bud is cut from the branch with a square of bark and a square the

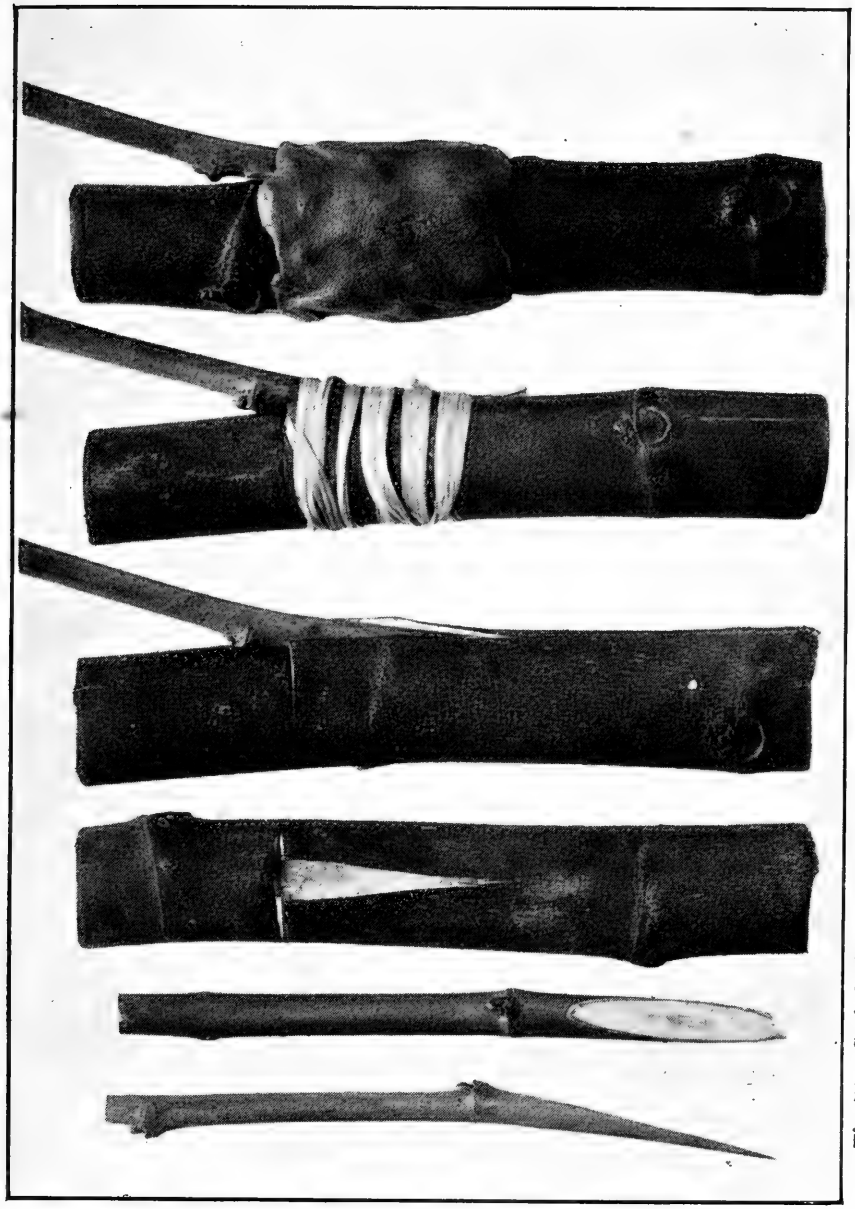


Fig. 71.—Sprig budding, showing the successive operations; instead of a single bud a whole branch is used

same size is cut from the stock (see figs. 72 and 73). The bud must fit nicely into the stock, otherwise the union is difficult. This method is used mainly with very thick barked plants and is done in late Spring.

When the whole ring of bark is removed with the bud, the process is called *ring* or *annular budding* (see p. 153, fig. 95). It is merely a modification of the patch bud and is sometimes used on the Grape.

The patch budded plants are treated just as are the shield budded ones.

H-BUDDING

The nature of the H-budding method can be readily seen from the sketch (fig. 74). An H is cut in the bark, the bud is inserted beneath the double flaps and bound with raffia.

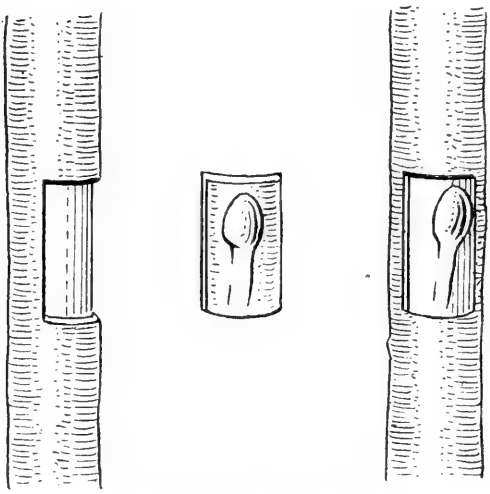


Fig. 72.—Patch budding

INARCHING

Inarching is a method of approach grafting. It is a simple method of cutting a portion of bark from the stems of two plants (see fig. 75-A) and tying them securely together so that the cut surfaces of each may knit. The plants are growing in both cases. There are many modifications of this simple method.

When the plants have united one of them is cut from its root and is allowed to grow on the roots of the other. At the same time the head of the undesirable sort is removed. The parts of the plant are frequently joined by a tongue graft (see fig. 76).

Beech, Birch, Maple, Larch and various evergreens are often increased in this way, whenever desirable varieties of them cannot easily be increased in any other way. When stocks are to be used in this way, it is better that they be well established in pots by potting them in March. It is still better to have them potted a year in advance.

Dr. David Fairchild, in the introduction to the bulletin on the seedling inarch of G. W. Oliver (1911),* remarks that one of the greatest drawbacks of horticulture is the time required to test a new variety originated from seed, and any method which shortens the time required to make such tests must appeal to everyone, whether an originator of new varieties or a tester of them, as of the greatest value.

Mr. Oliver writes: "It was discovered by the writer that a large number of hard-wooded shrubs and trees are capable of very rapid increase when propagated by processes which may be termed the seedling-inarch and nurse-plant methods.

These methods are inexpensive and, owing to their simplicity, may be used by persons without previous experience in the propagation of plants. By these methods the ever-increasing number of plant breeders will be able to save much time in determining the value

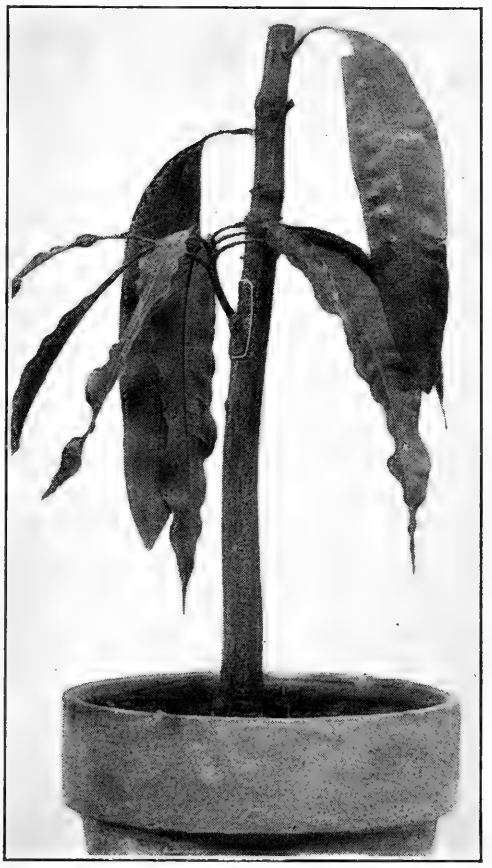


Fig. 73.—Patch bud of Mango. The patch bud is well adapted for budding thick barked trees

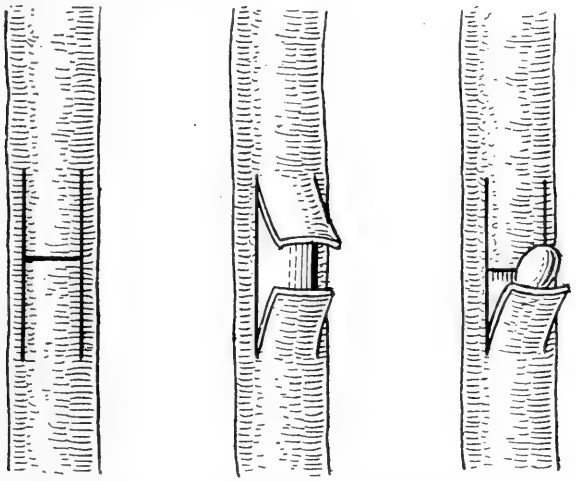


Fig. 74.—H-budding (See page 102)

* The Seedling-inarch and Nurse Plant Methods of Plant Propagation, U. S. Dept. of Agri., Bur. of Pl. Industry, Bull. 202

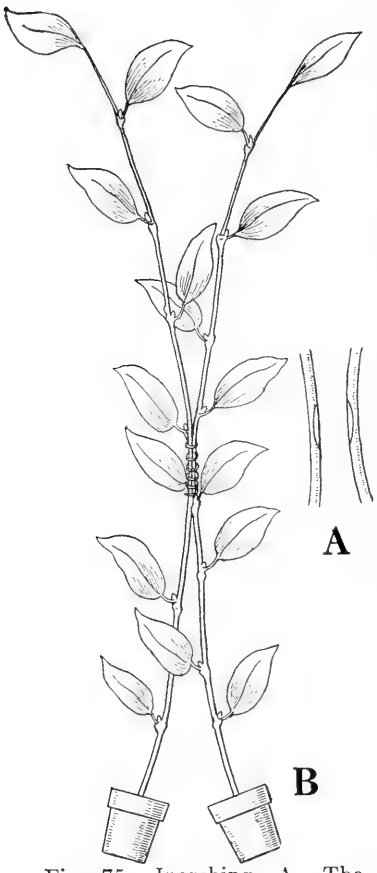


Fig. 75.—Inarching. A,—The method of cutting off a slight amount of bark of both plants to be inarched. B,—The two plants tied together.
(See page 102)

of hard-wooded plants raised by means of hybridization. They can be used in manipulating seedlings of rare trees and shrubs intended for crossing, so that each plant will bloom in a much shorter time than if left to grow on its own roots. Seedlings of all hard-wooded plants, resulting from collections made by travelers in foreign countries, may thus be brought to the flowering stage and their value determined quickly.

The most remarkable feature of the new methods lies not only in their simplicity, but also in the certainty of the unions which result. The writer has had very few unsuccessful unions and none among those classes of plants where the most suitable stocks are known and in common use. Not only is it possible to inarch a seedling a few weeks old to a large stock, but a moderate sized seedling stock can be inarched to a shoot of a rare shrub or tree having the same diameter as the stem of the seedling. A satisfactory union may thus be induced where other methods of a sexual propagation have invariably failed.

Rose seedlings resulting from crossing varieties have been inarched on Manetti stocks when the seedlings were from three to four weeks old, and they produced maximum sized flowers long in advance of those on seedling plants growing on their own roots. The rare Finger Lime, *Citrus australasica*, sometimes seen in a dwarf, sickly condition in greenhouse collections, has borne fruit two years after inarching on one of its congeners; and within nine months after flowering, hybrid seedlings between this Citrus and a cultivated Orange were in their turn inarched on 2-year old Lemon seedlings.

Very young seedlings of hundreds of other rare hard-wooded plants may be worked on the same or allied species or genera, and their value determined much in advance of the time when they would flower on their own roots, or on plants obtained by

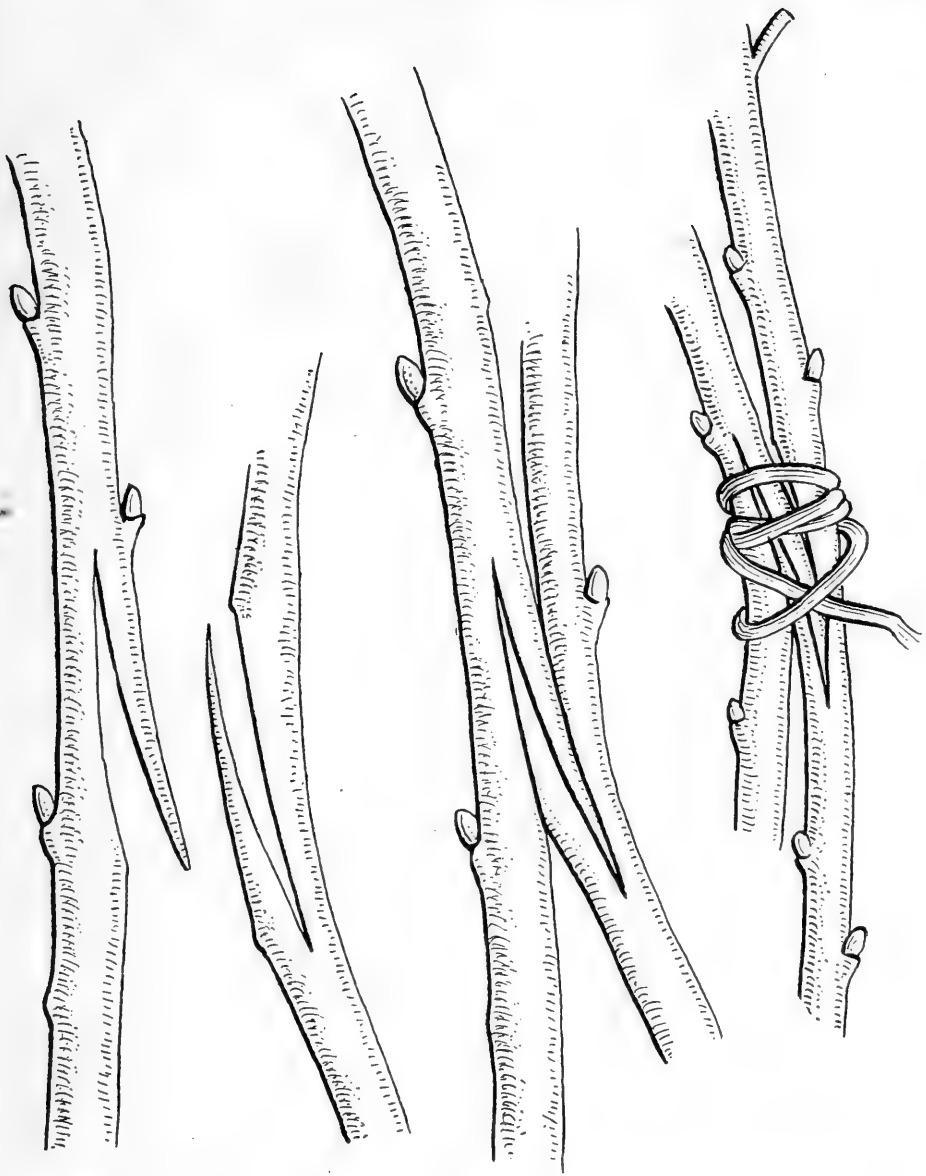


Fig. 76.—Modification of inarch. Instead of simple inarching; the two plants to be inarched may be cut with tongues which will fit together (See page 102)

grafting or budding from the mature shoots of the seedlings.

Hard-wooded seedlings which need to be flowered in the shortest possible space of time, in order to determine their value, are used for inarching as soon as the first leaves attain a fairly firm texture, as, for example, in the case of the Mangosteen. But when seedlings

Fig. 77.—Seedling Roses. Note that the seedlings are potted at the side of the pot in two-inch pots

are used as stocks for the vegetative propagation of established varieties by uniting the stocks to small branches, then larger seedlings are used, as for example, in the case of the Mango."

INARCHING ROSE SEEDLINGS

"Seedlings of some of the Rose groups, resulting from crossing distinct varieties or otherwise, take more than one season to produce flowers of maximum size to enable the breeder to judge of their merits. They take much longer to develop when budded on Manetti or other stocks, because in that case a considerable time has to elapse before the growth of the seedling is strong enough to give buds and wood fit for propagation by budding or by grafting. Rose seedlings three to four weeks old, or after the first few character leaves are developed, lend themselves very readily to the seedling-inarch method of propagation. Tea and Hybrid Tea seedling Roses will give flowers of maximum size very quickly after the tiny seedlings are inarched to strong-growing Manetti or other stocks, thereby saving much time in preliminary tests.

The operation of inarching is simplified if each seedling is pricked off into a 2-inch pot (fig. 77) shortly after the cotyledons are developed. The seedling should be placed as near the rim as possible. In two or three weeks the seedling makes sufficient growth to be removed from the pot, when a little fresh soil is held in place around the root by a piece of cloth about 5 inches square (fig. 78). The ball containing the roots of the seedling is secured to the stock, the stem of the seedling being placed close to it, so that the inarch may be easily accomplished (fig. 79). The union is a rapid one and becomes perfect some time before the cotyledons decay.*

* Author's Note.—As above described, a small piece of bark is removed from both stock and cion before tying the seedling to the stock.

It is well known that many seedling Roses on their own roots produce flowers before the cotyledons decay, but the flowers are necessarily small and have little to indicate their eventual value. The seedling-inarch system shortens very considerably the period between germination and the production of flowers of maximum size—a material aid to the breeder in determining the value of the seedling within a few months after germination.

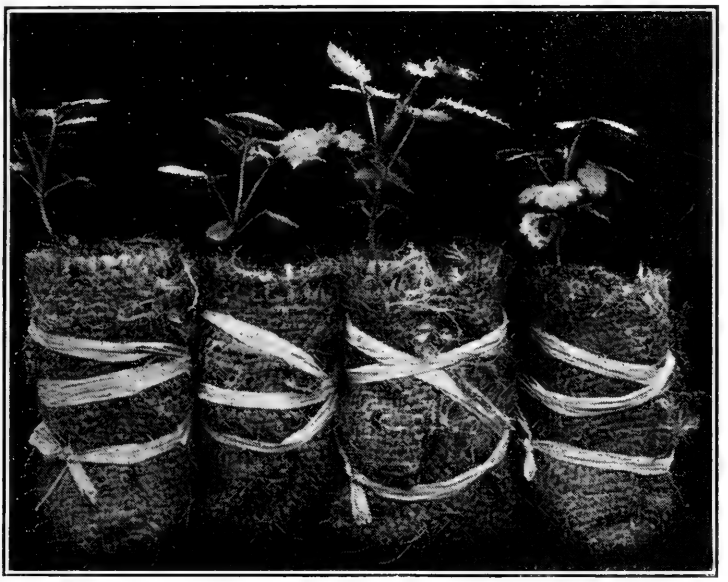


Fig. 78.—Seedling Roses. The plants have been removed from the pots and wrapped in burlap (See page 106)

Seedlings raised from seeds of new and rare trees, shrubs, and vines may be induced to grow very quickly if used as cions when a few weeks old, by inarching to strong-growing plants of other species of the same genus, or in some cases on species of other genera of the same family. This has been done recently with such plants as Chestnuts, Walnuts, Hawthorns, Oaks, and many others. It is not necessarily done for the purpose of hastening the flowering or the fruiting of new plants, but to give quickly an abundance of material for propagation by budding or grafting when the new material is assumed to be valuable.

If a hardwood seedling of hybrid origin is tied to a large stock and they fail to unite, there is little or no danger of losing the seedling, provided its roots are kept damp during the period of making the attempt. If the inarch is not successful, the seedling can be repotted and grown in the usual way."

TOP GRAFTING AND DOUBLE WORKING

Trees which are not of the desired variety, even when old, can be grafted at various points in the top. It should take three or four years to work over a whole tree, certain branches being chosen each year. The younger the tree, the easier and more quickly it can be worked.

Fig. 79.—Inarched seedling Roses. Just as in figure 75A the bark is cut on both stock and cion and tied together. The seedling Rose is tied to the rose stock
(See pages 106, 107)

Cleft grafting is mainly used in carrying on this work. It must always be remembered that the cions will grow straight up; the clefts must, therefore, be made horizontal rather than vertical.

In some cases varieties which make poor growth or are susceptible to decay at the soil line are double worked; in other words, some strong variety is root grafted on a stock, then later the second variety is cleft grafted on the strong stock.

Bosc, Dix, Dunmore, Josephine de Malines, Marie Louise, Paradise, Shelden, Washington, Winter Nelis and some other Pears do not graft readily on the Quince. A strong growing sort, such as Duchesse d'Angoulême, Vicar of Wakefield or Diel, is used upon the Quince; then the other varieties are budded a few inches above the graft.

The Tompkins King, Grimes Golden and some other Apple varieties are best top worked upon the Spy.

GRAFTING WAX

A wax composed of resin and beeswax is most successful in this hot country. In certain European work, waxes containing some alcohol are used, but they are apt to melt. A good wax is made of four parts (by weight) of resin, two parts of beeswax and one part of beef tallow. The beeswax and resin are broken up and the whole mixture melted. When thoroughly melted, the mixture is poured in a pail of cold water. When hard enough to handle it should be worked like molasses candy, pulled until it has a grain and becomes a creamy light brown. When applied the hands should be well greased. The resin makes the wax hard, the beeswax gives it oiliness and the tallow keeps it soft.

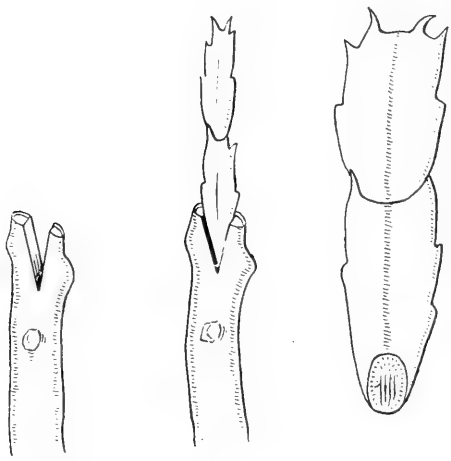
Applying the wax. The wax should be applied by working it in the hands in the form of a flat ribbon. Start in one place and go as far as possible with one piece; a quarter of an inch or less is thick enough, but let all joints between different pieces of wax be thoroughly worked together so that no air nor water may enter. Cover all cut surfaces. Some workers even wax the upper ends of the cions.

Waxed string is prepared by soaking for a few minutes a ball of No. 18 knitting cotton in the kettle of melted wax. Waxed bandages are prepared the same way; the cloth should be torn into widths of a half inch and rolled before dipping into the wax.

CACTUS GRAFTING

Some Cacti are grafted to cause earlier flowering. With others to increase the decorative appearance of the trailing sorts such as the *Epiphyllum* or Christmas Cactus, they are placed upon upright growing sorts such as *Pereskia* and *Cereus*. Furthermore, when plants become so decayed at their roots that cuttings are difficult to obtain, the small tip may be grafted upon a vigorous stock.

Cleft (see fig. 80), saddle and splice (see fig. 61) grafts are the most used. Both methods give a good area for the union of the parts. In preparing the stock for the cleft graft, the clefts are cut V-shaped, rather than split. The cions should be trimmed wedge-shaped to fit the cleft. As the sticky sap of the Cactus allows the cion to slip from the stock readily, a spine



A B C

Fig. 80.—Cleft grafting Cacti. A, The stock, a Pereskia, is prepared by cutting out a wedge-shaped piece. C, The cion, an Epiphyllum, is a short branch; a little of the outside is removed from each side of the base. B, the stock and cion fitted together

from an Opuntia or a Pereskia is frequently used which will pin the cion to the stock. Wm. G. Becker, of the New York Botanical Garden, believes that grafts made indoors are benefited by waxing with ordinary candle wax dropped on the cut surfaces.

In grafting *Mammillaria*, the *Echinocactus*, the *Echinocereus* and other globose or thick sorts, a stock is selected which is about the same diameter as the cion. The top of the stock is cut off perfectly level; the cion is cut in the same way; the cut surfaces are fitted together and tied with a cloth or soft cord.

CHAPTER V

FRUIT STOCKS

Apples — Collecting Seeds — Sowing Seeds — Dwarf Apples — Apricots — Cherries — Peaches — Pears — Plums — Pedigreed Stock.

APPLES

THE common stock for the Apple is that grown from the seed of the French Crab Apple, which is found wild in Europe. The Apples are used for cider, the seeds being kept and sown. The seedlings are quite uniform in their growth and are supplied to the American nurserymen so cheaply that much stock is imported rather than being grown from seed.

There is, however, an extensive acreage of Apple stock growing in the neighborhood of Kansas and the Central West. Formerly quantities of seeds were collected in Vermont, but as this seed was obtained from the grafted varieties, rather than from seedlings, in many cases, it proved to be inferior and is gradually losing favor.

COLLECTING SEEDS

Should the orchardist or nurseryman wish to save his own seed, he may collect the pomace at the cider mill and place it in a barrel of water to soak. The pulp will gradually come to the top and can be skimmed off; the seeds will settle to the bottom. By screening through two sieves the seeds are cleaned sufficiently. The first screen should be just coarse enough to let the seeds pass through and the second sieve should be finer, so that the fine pulp may be removed, leaving the seeds. The seeds are spread out in thin layers to dry, after which they are stored in a cool, moist place until Autumn, when they are sown.

SOWING SEEDS

Apple seeds are usually sown during November in special seed beds which are prepared with a light sandy loam. Four feet will be a convenient width for working the beds. Lath screens should

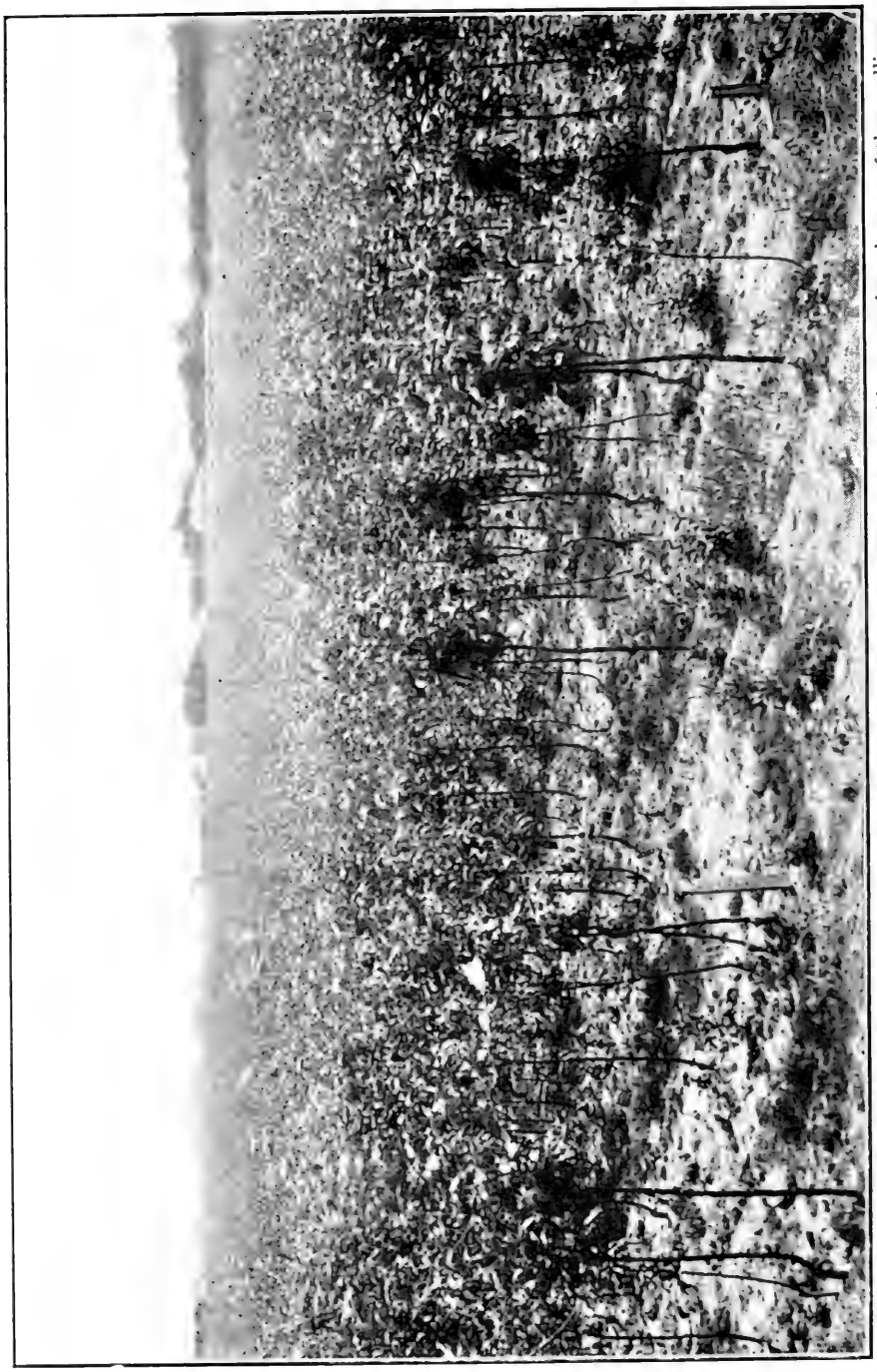


Fig. 81.—Budded Apples. Note the crook in the stem just above the soil. This is caused by removing the top of the seedlings which have been budded; the growth shown is that growing in one year from the bud

be provided. In the Spring, when germination has taken place, the seeds are taken from the beds and sown in the nursery row.

Had the seeds been sown directly in the nursery there might possibly have been greater chance for vacant spots due to poor germination, and at the same time the weeds would have come up earlier than the Apple seedlings. Most Apple seedlings are root-grafted (see page 91) but this is often accompained by crown gall.

DWARF APPLES

The stocks used for dwarfing the Apple are known as the Doucin and the Paradise. The Paradise is the more dwarf. Incidentally, it may be stated that dwarf trees are hardly as popular in the United States as in Europe for the trees are less hardy, the tree roots are at the surface of the soil and are frequently injured by cultivation. When any of the dwarf trees are planted, care must be taken that the union of the stock and cion is not placed beneath the surface of the soil, or else the cion will root, and being on its own roots, will lose its dwarfness.

APRICOTS

Apricots are usually budded upon seedling stocks or upon the Peach. The stones are treated as for Peaches. They are budded about the first of September.

Some propagators hold that the Peach being better adapted to a range of soils than the Apricot is, therefore, a more successful stock. Prof. Budd, however, advises the native Plums as the best stock, holding that they are superior to the Myrobalan or St. Julien stocks. For wet locations the Plum is especially useful.

CHERRIES

Fruit growers and nurserymen are, at present, having a controversy as to just which stock is the best for commercial Cherry culture. The Mahaleb and the Mazzard are the two sorts most used. According to Hedrick,* the fruit growers hold that the Mazzard is the best stock for all orchard varieties; the nurserymen believe the Mahaleb better for the Sour Cherries and really good for the Sweet sorts as well. The Mazzard stock is more expensive.

The Mazzard Cherry, *P. avium*, is the type from which has come the varieties of Sweet Cherries. It is tall growing. The tree is not

*Hedrick, U. P. Cherries of New York.

of the hardiest type but is a vigorous grower and is healthy, except for its susceptibility to attacks of the Shot-hole Fungus which makes it difficult to grow in the nursery. This stock is readily grown from seed.

The Mahaleb Cherry, *P. Mahaleb*, is a bush-like Cherry, with fine branches; the leaves are small. The fruits are green, turning yellow, and when ripe become black; but they are hard, bitter and astringent. Mahaleb, therefore, differs widely from the sweet and the sour Cherry. It is propagated mostly by seed, but may be increased by cuttings and suckers. It is much easier to get a good looking tree when Mahaleb is used because it is adapted to a great range of soils; is hardier to heat and cold; less particular about cultivation; will stand more cutting in nursery when pruning is necessary; is less susceptible to aphis; is usually not so susceptible to the Shot-hole fungus and is more easily budded. Cherries on Mahaleb ripen their wood earlier and may be dug earlier; for the fruit grower Cherries budded on Mahaleb are hardier for the same reason. Sweet Cherries should be on Mazzard stock; the Mahaleb budded sorts are dwarf growing and varieties come into bearing earlier, although the size of Cherries is the same. Better unions are made on the Mazzard. The Mahaleb thrives on a greater variety of soils. The varieties on Mazzard are more productive and profitable than on Mahaleb.

Cherries are usually budded, but they are successfully grafted, upon seedling roots. When planted deep enough the cion takes root; the variety is then upon its own roots.

PEACHES

Much of our Peach stock is home grown. The stones are gathered from the wild Peaches in the mountains of Tennessee and the Carolinas. The seeds collected at canneries are thought to produce short lived trees. Peach seed may be sown in flats of a sandy soil and exposed to the Winter frosts or they may be placed in pits, mere holes dug in the soil, in which the stones may be kept moist and to which the frost may enter. Peaches are usually budded, although some growers report having been successful in grafting them.

In the South, Peaches are June budded but in the North budding is practiced in August or September. See page 100.

Care must be exercised in selecting bud-wood that mature buds are used; there are usually two or three immature buds at the ends of the branches. The current year's growth also has two

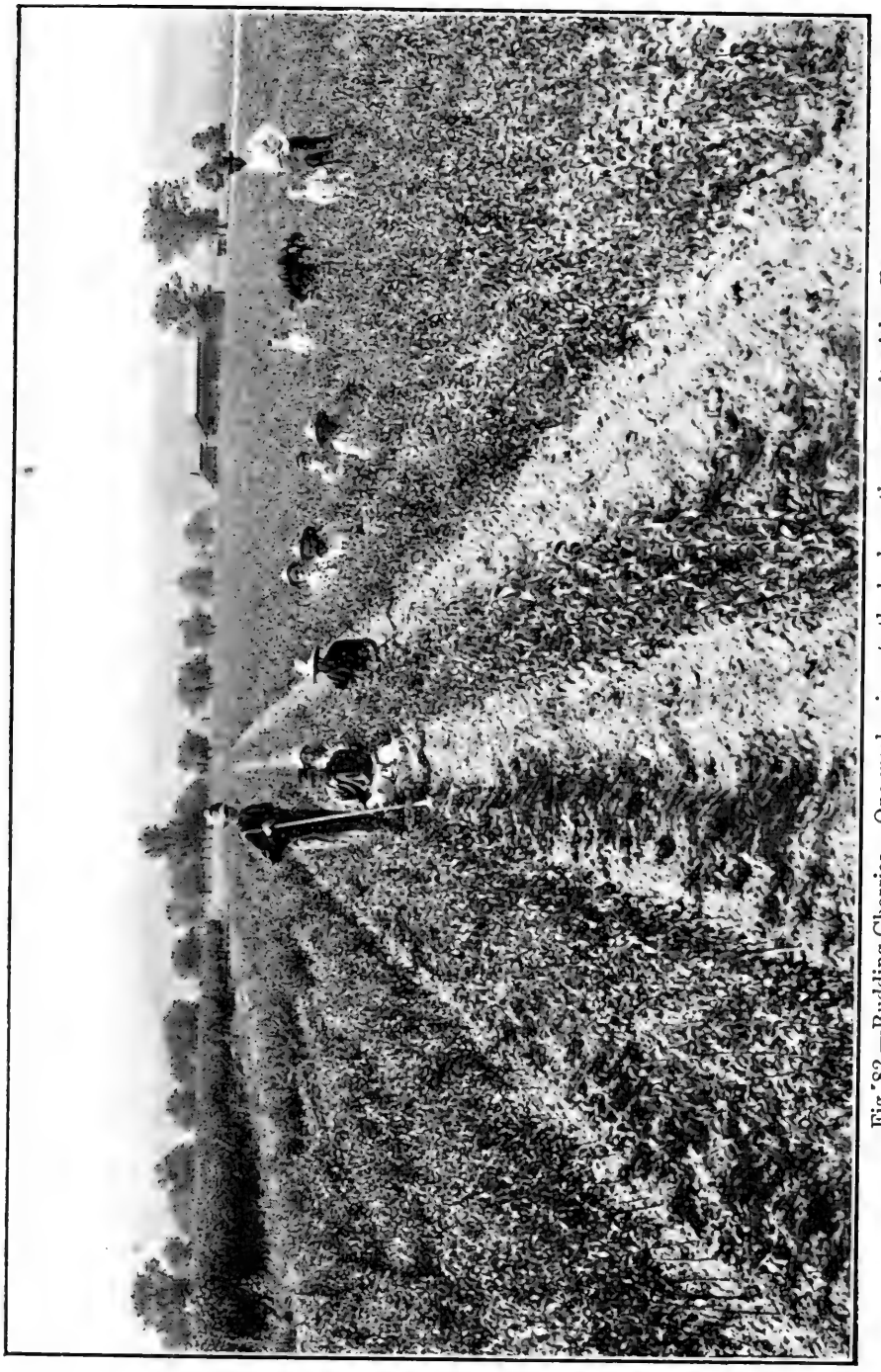


Fig. 82.—Budding Cherries. One worker inserts the bud, another wraps it with raffia

sorts of buds, *branch buds and fruit buds; branch buds must be used as the fruit buds merely flower and are gone, while branch buds grow to make the top of the tree. The fruit buds are frequently found on each side of the branch bud; they may be broken off, as they are of no use. When only one bud is found in the axil of the leaf it is generally a branch bud.

PEARS

The stock used for the Pear is mostly raised from seed gathered from the cider mills of France. This Pear is known as the Perry Pear. Often seedlings of the Kieffer are used for stocks, for these prove very blight resistant. Some stock is obtained from Japan in which case the stocks are seedlings of the Chinese or Japanese Sand Pear. Regarding the use of the latter Pear, Joseph Meehan writes:

"The Sand Pear and its offspring, the Le Conte, are found unsuitable for using as stocks for ordinary Pears, much as they may be desirable for the Kieffer, Garber and other kindred bloods. When the ordinary Pears are worked on them they grow nicely for a year or two, then almost cease growing and dwindle away. Whether this is true, too, in respect to the Kieffer itself, when its seeds are grown, is not so well attested. As it is a hybrid between the common Sand Pear and a common one, supposedly the Bartlett, its seedlings may be better suited for stocks than pure Sand Pear seedlings would be; still, those who have tried it do not appear to consider it as good for their purpose as the common French Pear stocks. Australian papers speak of the Kieffer seeds being used by the nurserymen of that country at the present time. What attracts those who use the seeds of the Sand Pear tribe, is, that the seedlings are just the thing for stocks for the Kieffer, this latter being popular everywhere as a profitable market Pear; and then the vigorous growth of these seedlings would fit them for stocks for all sorts of Pears could they be got to thrive on them."

Dwarf Pears. Dwarf Pears are obtained by budding or grafting on the Quince, the former method being preferred. Most Quince stock is obtained from Angers, France. The Pear seems to produce larger fruits when grafted on the Quince than it does on the Pear. Peculiarly enough, the Quince is not successfully grafted upon the Pear.

The Kieffer Pear should not be dwarfed; it usually outgrows the stock and results in a top-heavy tree.

*Branch buds are frequently called leaf buds but this is an incorrect term because each bud of this sort produces branches.

PLUMS

Most growers prefer the Myrobalan Plum stock for general purposes. The native Plums are also used for American varieties and some nurserymen prefer the Peach for the Japanese sorts, when they are to be grown on sandy soils. The St. Julien is a variety which is propagated by the French nurserymen and frequently used as a stock for Domestica and Insititia when it can be obtained cheaply.

The Myrobalan is obtained from France and is raised from seed. Prof. Hedrick* mentions that its roots are apt to Winter-kill in the colder regions and in the warm sections of this country the plants sucker badly.

The St. Julien stocks make trees longer lived, hardier, deeper feeding, less suckering and well adapted to changed soils. It is, however, difficult to bud; the young trees do not make the good growth that is made on the Myrobalan. Besides the poor growth the young trees are rather susceptible to fungus attacks in the nursery rows.

The Peach as a stock proves successful on sandy or gravelly soil. The trees make a rapid growth, and bear when young. There is little tendency toward sprouting at the roots. The budding is easy and the nursery plants have a good appearance, besides being produced cheaply. Especially successful on the Peach are the Japanese or Triflora Plums. Prof. Hedrick says that the Lombard, the Damsons, the Yellow Egg, the Washington, the Domestica and the Insititia varieties do not unite readily with the Peach.

Mariana stocks root readily from cuttings and give a good nursery appearance, but they are inclined to sucker.

The Americana stock is the only safe one for the coldest parts of this country. They sucker badly but produce good root systems. Americana stocks are not extensively employed by nurserymen because of their price and their unknown value.

Munsoniana seedlings are adapted for stocks when the orchard is planted in low wet lands.

In top working Plums let the work be done early in the life of the tree. Later working will make slow and crooked growth. The Lombard has proved a successful stock for top working the Domestica varieties.

PEDIGREED STOCKS

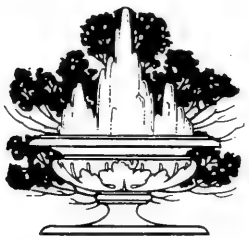
Incidentally, it is interesting to add a statement made by Hedrick, who opposes the idea that pedigree stock is superior to ordinary

*Hedrick, U. P. The Plums of New York.

stock. Regarding Plums he writes: "Buds in propagating are usually taken from nursery stock, a practice of decades, and there is no wearing out of varieties. Old varieties have lost none of the characters accredited to them a century, or several centuries, ago by pomological writers. Nor does it seem to matter, in respect to trueness to type, whether the buds be taken from a vigorous, young stripling, a mature tree in the hey-day of life, or some struggling, lichen-covered ancient—all alike reproduce the variety. The hypothesis that fruit trees degenerate or, on the other hand, that they may be improved by bud-selection, finds no substantiation in this fruit."

Certain other authorities and, especially, nurserymen, like to believe that a good tree bearing good fruit yields buds and cions superior to those taken from an ordinary specimen tree. The reader must not take this statement to mean that cions of Bartlett Pears would not be superior to cions from a seedling or inferior variety. But Hedrick feels that cions from one especially superior tree would not give better results than from a less attractive appearing tree, or from young plants in the nursery row. Hedrick has an orchard of Rome Beauty Apples all propagated from cions from the same one tree. There is as much variation in this orchard as one would find in any orchard of one variety of fruit. Environment governs the yield, in this case, not the heredity.

It might be added that the expression "pedigreed stock" means to some nurserymen that they guarantee their stock true to name, and that it has been propagated from bearing trees and does not carry with it the idea of propagation from exceptional trees.



CHAPTER VI

A FEW COMMERCIAL FLORISTS' PLANTS

Carnations — Chrysanthemums — Ferns — Life History — Collecting Spores — Soil for Sowing — Sowing — Getting New Varieties — Division — Runners — Bulblets — Tip Layers — Tubers — Top Layers — Orchids — Division and Cuttings — Seed — Poinsettia — Roses — Seed — Hardwood Cuttings — Softwood Cuttings of Outdoor Sorts — Indoor Cuttings of Commercial Roses — Summer Cuttings — Grafting and Budding — Rose Stocks — Manetti — Canina — Carolina — Multiflora — Setigera — Budding Roses — Grafting to Increase Yield — Grafting Case — Preparation for Grafting — Grafting Operations — Rapid Method of Increasing New Varieties — Trenching Method — Root Cuttings — Layers — Violet — Improving Violet Crop.

CARNATION CUTTINGS

LARGE Carnation growers reserve a certain number of plants, which are not allowed to produce blooms, for it is from such plants as this that the best cuttings are obtained. The cuttings should be three to four inches long and are best removed from the plants by giving them a downward pull. Such a cutting will have several "hairs," or fibro-vascular bundles, at its base. Except for removing these hairs the cuttings are untrimmed, unless too long, for, according to the best modern practice, the cutting should have as little cut surface as possible. Cuttings if taken from high up on the flowering stems are thought to give weak-stemmed plants, and if taken from the shaded bases of the plants the resulting plants are apt to be narrow-leaved and weak.

They should be rooted in a temperature of from 50 degrees to 55 degrees overhead, and 60 degrees to 65 degrees in the sand. Too high a temperature weakens the cuttings, and when rooted at 40 degrees it takes a week longer to root. It usually requires 10 days to callus and from 18 to 21 days to root. The cuttings should be inserted very shallow in the sand for best rooting. When rooted, pot in 2-inch pots and keep them close for several days, shading them and syringing carefully.

CHRYSANTHEMUM PROPAGATION

Chrysanthemum cuttings (see figs. 17A and 17B) may be rooted at a temperature of 40 degrees or up to 80 degrees, but 55 degrees is the proper one. If a bottom heat of from 5 degrees to 10 degrees can be supplied they will root a little more quickly. The cuttings are taken any time between February and July, though April is the ideal month. The earlier they are taken the more shifts the plants will require in order that they shall not become woody. Late propagation gives dwarf plants. The cuttings are treated as softwood cuttings and should be potted as soon as roots start. The plants may be set deeply in the pots in order that they may not appear spindling. Use little or no manure at this time.

CHRYSANTHEMUM STOCK PLANTS

After flowering, the blooming stems are cut down and the plants are shifted to an out-of-the-way bench, planted closer together where they may be kept cool (40 degrees), but in good condition until cuttings are required. At the beginning of March more heat and moisture should be supplied.

FERN PROPAGATION

Life history. Ferns bear spores; the flowering plants produce seeds. Fern spores are not embryo plants but are single cells. When they are placed in a favorable soil for growth, they produce small, heart-shaped plants, usually about the size of the end of a lead pencil. This young Fern stage is known as the *prothallus* (see fig. 83[3]). Male and female organs are produced on this prothallus.

When the male elements are ripe, they lash themselves about, for they possess tiny tails, and enter the female portions of the plant. As soon as the union has taken place, a tiny frond is produced which gradually develops roots and other fronds until it matures.

Upon maturing, a definite portion of the frond develops spore-bearing apparatus. These are known as *spore cases* or *sporangia* (see figs. 84[1] and 84[2]). They become miniature sling-shots when ripe, and bursting, scatter the spores a great distance. Most Ferns have these sporangia associated together in small clumps, called *sori*, and appear as brown spots on the fronds (see figs. 83[1], 83[2], 84[3], 84[4], 84[5] and 84[6]). Certain fronds only, in the Staghorn Fern, bear these sori in huge patches. These fronds differ in form from the sterile fronds.

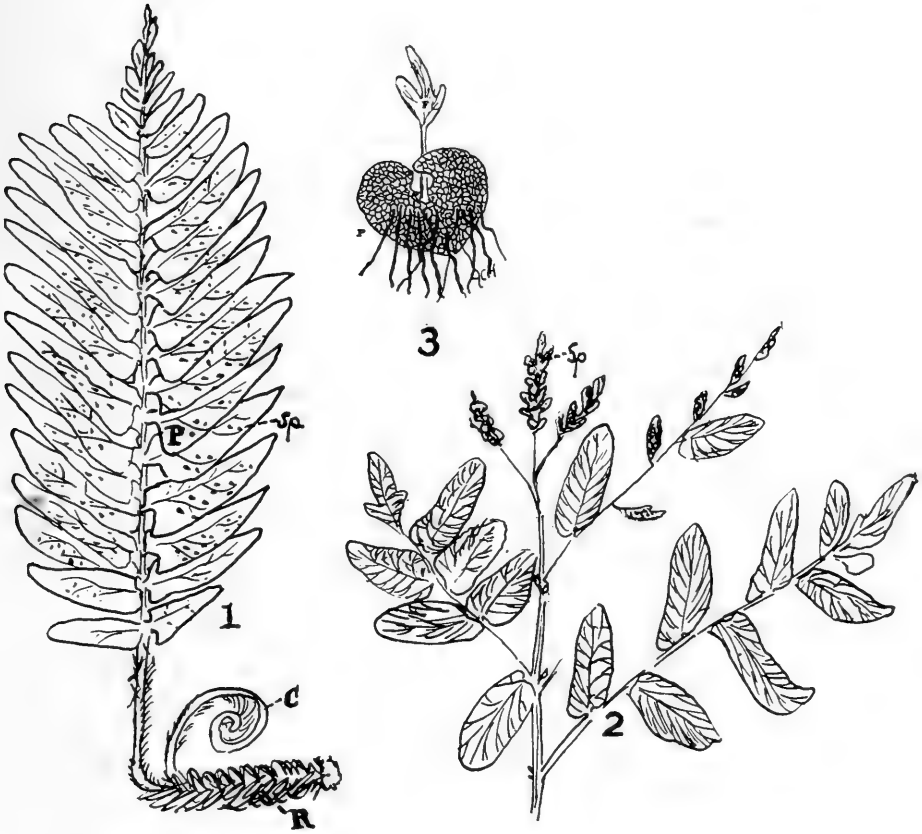


Fig. 83. Ferns. 1, A Fern plant bearing a mature and an unfolding frond (c). Each division of the frond (or leaf) is known as a pinna (plural, pinnæ) (P). The pinnæ are covered with dot-like masses, or spore cases (sp). The underground stem of a Fern is known as a rhizome or root-stock (R). 2, A portion of a frond of *Osmunda regalis*, the Royal Fern; in this case certain pinnæ are much reduced in size (sp.) and are the only ones which bear the spores. 3, A Fern prothallus. This is the sexual stage and produces the male and female organs which in uniting give rise to the growth of the mature forms. This prothallus has started to produce a frond (See pages 120-123)

In the *Osmunda regalis*, or Royal Fern, the tips of the frond are so changed as to be devoted alone to spore bearing (see fig. 83[2]). Certain of the Adiantums, or Maidenhair Ferns, and many of the Boston Fern sports have transformed their fronds to such an extent that no spore areas are found.

FERN PROPAGATION BY SPORES

Collecting. As soon as the Fern fronds are seen to be maturing their spores, the whole frond should be picked and placed in a paper bag to catch the powdery spores. The ripening can best be

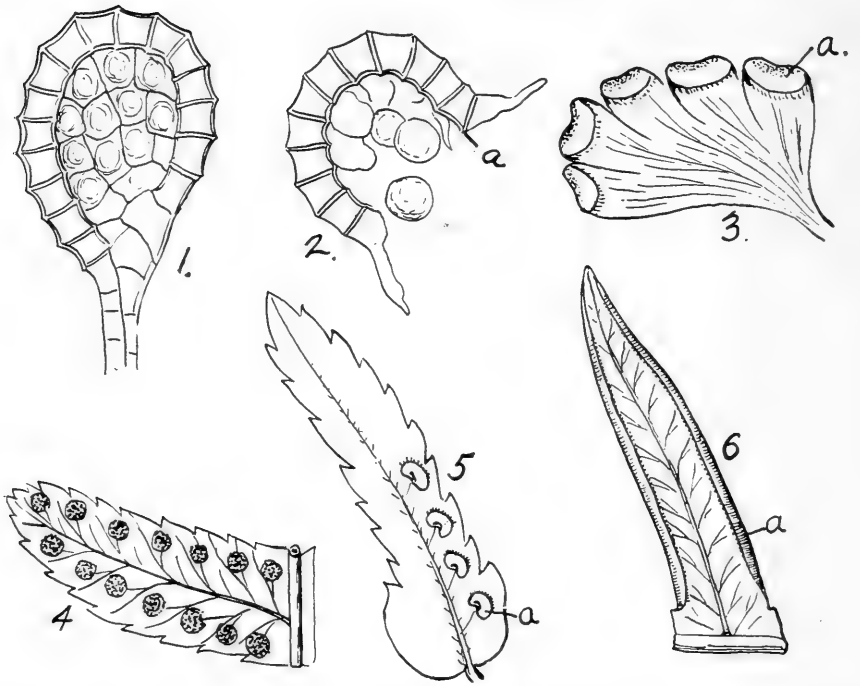


Fig. 84. Ferns. 1, A microscopic view of a spore case before it has burst. 2, The spore case has ripened and is scattering its spores. 3, The spore areas of *Adiantum*. Note that the tips of the pinnæ are folded back and it is under the margins that the spore cases are produced. 4, The spore cases form huge clusters in *Polypodium*. 5, In *Dryopteris* the spore cases are kidney shaped. 6, Each pinnæ at the tips of certain fronds of *Pteris* has the edged rolled back; under these the spore cases are borne
(See page 120)

ascertained by the use of a hand-lens. They should remain in the bag for several weeks before sowing.

SOIL FOR SOWING FERN SPORES

The proper soil for sowing spores is one composed of leaf mold, sand and well decayed sod loam. The sand will furnish good drainage. The soil must be carefully sifted through a fine sieve, and should be sterilized by pouring boiling water through it, or by baking it.

SOWING FERN SPORES

The pots used should be thoroughly sterilized by burning. When large quantities of Ferns are grown the spores are sown in flats or shallow boxes, although usually seed pans will be large enough. Plenty of drainage of broken flower pots, is always placed

in the bottom of the flats. The soil is now carefully placed in the flat and slightly pressed to a perfect level. When the surface is not absolutely level the lower portions of the flat will become damp and sour. Water the soil now, by a fine rose spray, or submerge the flat in water so that there will be sub-irrigation. Scatter the spores evenly over the surface after the soil has lost its first appearance of wetness, and cover with a pane of glass and a newspaper. When the spores have germinated the glass should be raised to give ventilation. Gradually more air should be given until finally the glass may be removed.

When the Ferns have grown several leaves they should be transplanted on the point of a knife into flats, using a soil consisting of a mixture of leaf mold and sand.

GETTING NEW VARIETIES OF FERNS

It is when the Ferns have grown to resemble a small round leaf that they have reached the prothallus stage, or the sexual period (see fig. 83[3]). They will now hybridize. If hybrids are not wanted, keep the various flats away from each other, otherwise a mixed lot of stock is the result. Ferns do not mix when in the large, frond-bearing stage. It is not the spores of the fronds which do the crossing.

When hybridization is preferred sow the various sorts of spores together, so that when they grow into the sexual stage they may cross one with another.

FERN PROPAGATION BY DIVISION

Many of the Ferns produce prominent rhizomes which may be cut into small pieces and placed in the propagating bench, with a little bottom heat, to root. When rooted they should be potted into small pots, using a loose soil. A decayed sod loam and leaf mold will be best. A few of the Ferns so propagated are: *Davallia*, the Rabbit's Foot Fern; *Dicksonia*; *Lygodium*, the Climbing Fern; *Nephrolepis*, the Boston Fern allies; *Osmunda*; *Phlebodium*; *Polypodium*, and *Niphobolus*, also called *Cyclophorus*.

Adiantums, especially *Farleyense* and *Croweanum*, which produce no spores, are frequently propagated by division; the plants are removed from the pots and the mass of rhizomes is broken apart even down to one or two eyes. The small pieces are placed in sphagnum moss at a temperature of 65 degrees in a confined atmosphere to produce roots. Later they are potted into thumb

pots. The large plants may merely be cut in two or three clumps, but the method mentioned will give a great increase of stock which will soon attain good size.

FERN PROPAGATION BY RUNNERS

One of the commonest methods of propagating the Boston Fern allies is by runners. Long string-like growths take place on all sides of the main crown. Boston Ferns intended for sale may be placed in the empty greenhouse benches early in Summer. With a little care the Ferns will be surrounded by young plants which grow quickly. In August many of these plants may be potted for Autumn sales.

In the propagating of the numerous sports of the Boston Fern, should a new one appear, watch the rhizome carefully at the spot

Fig. 85. Asplenium. Certain of the fronds may be noted in the cut which show the development of small plantlets on the fronds (See page 125)

where the sport shows, and if a runner starts it will often carry the characteristics of the frond above it, otherwise the rhizome may be divided.

PROPAGATION BY BULBLETS OR PLANTLETS ON FERN FRONDS

It is interesting to note how some Ferns produce, upon their fronds, small bulblets which even start to grow while attached to the parent leaf (see fig. 85). The fronds of such Ferns should be placed flat on the sand, or in a flat of leaf mold, so that the growth from the bulblets may be encouraged.

Asplenium bulbiferum, *Gymnogramma*, *Cystopteris bulbiferum* and *Polystichum angulare var. prolifera* produce bulblets. *Pteris* (*Doryopteris*) *palmata* produces little plantlets at the base of the frond.

FERN PROPAGATION BY TIP LAYERS

In propagating *Camptosorus rhizophyllus*, the Walking Fern; *Asplenium ebonoides* and *pinnatifidum*; *Adiantum caudatum* and *Edgworthi*, the tips of the fronds should be pegged down to the soil, where they take root readily.

FERN PROPAGATION BY TUBERS

Nephrolepis exaltata var. tuberosa produces tubers beneath the soil which may be used to increase the plants.

FERN PROPAGATION BY TOP LAYERS

The tree Ferns, such as *Alsophila* and *Cyathea*, may be propagated by Chinese layers as described on page 78 (see fig. 47).

ORCHIDS

Although most Orchids are not propagated, but are collected from the wild, they may be increased by division, cuttings and seeds. All Orchids are propagated at the beginning of their growing seasons.

ORCHIDS FROM DIVISION AND CUTTINGS

The rarer sorts bearing pseudo-bulbs, such as *Cattleya*, *Odontoglossum*, *Cœlogyne*, may be propagated by division; the rhizome is cut partially through. Two or three pseudo-bulbs are best left beyond the growing point. The cut will cause the forcing of an adventitious bud upon the older wood. The old portion is then removed and potted separately. With *Calanthe Veitchii* the old bulbs may be removed when potting in Spring, and placed in pans of sphagnum moss until they start to grow, when they may be potted.

Dendrobium canes may be cut into four to five-inch lengths or the whole cane may be laid on wet sphagnum. New growths will often start from the eyes. *Aerides* and *Vanda* are propagated by cuttings of the upper portion of the stem, which is about a foot long and supplied with roots. The old stems will usually produce shoots readily. *Cypripedium* plants are best divided between old growths and potted separately, leaving an older growth with each lead. Allow abundant moisture in starting. *Masdevallia* and allied genera are propagated like *Cypripedium*.

ORCHIDS FROM SEED

The seeds of Orchids are very fine and dust-like. Some pods contain over 500,000 seeds. Great care is necessary for growing them successfully Several years ago it was discovered that the tiny seedlings only grow when a certain fungus is present. This fungus is found in the pots or baskets of most Orchids, so that it is not difficult to obtain, and if a plant is kept in the seedling frame, the fungus usually spreads to the seedlings.* It takes patience to grow Orchids from seed because few of them bloom in less than five years; it may even require ten years. John E. Lager†, a successful Orchid specialist, describes the sowing of Cattleya seeds as follows:

"Cattleyas, like most other Orchids, are unable to fertilize themselves, and hence the fertilization must be accomplished by insects. The seed pods should be left on the plants until well ripened and when the pods show signs of splitting open, a string or piece of raffia should be tied around them to prevent water from getting inside. Leave the pods on the plants until they begin to crack open, when they should be removed from the plant, placed in a paper bag and stored in a dry place to prevent loss of seed until ready for sowing.

* Refer to Stand. Cyclop. of Hort. under Orchids for full account of seedlings.
† Lager, John E. The Seeding of Cattleyas. *Florists' Exchange*, Nov. 25, 1916, p. 1226.

Fig. 86. Rhizome of Cattleya. Each year the *Cattelya* sends up a food-storage stem, or pseudo-bulb, the growth arising from the scales at the base of the parent stem. The leaves have fallen from the stem at the right; the center stem may bloom, and the stem at the left is ready to produce leaf growth

One way of sowing the seed is to sow on the surface of the compost of the plants. Personally, from observations taken at several places where Orchids are raised from seed successfully, I believe it is better to use muslin or calico; that is, take a piece of this material and place in it a ball of sphagnum and press the whole into, say a 3½ inch or 4 inch pot, in such a way that the highest part is in the center of the pot, sloping gradually toward the edges, and pressed in firmly. After this is done water thoroughly and allow to dry, after which the seed may be distributed over the surface of the goods.

If a propagating case is available it may be used if the temperature does not exceed 75 degrees; otherwise place a piece of glass over the pot, put the pot on an inverted pot, the latter in a saucer of water to prevent insects from attacking the seed. Watering should at first be done only by immersing the pot up to within an inch of the rim, as any overhead watering would wash away the seed. Later on spraying with a very fine sprayer will be all right. Air must also be admitted carefully. After germination the little seedlings should not be allowed to get dry. When germination has taken place it may be noted by the seed's taking on a green appearance, after which they develop into green bodies showing a growing point; then roots appear.

The tiny plants are now ready to be pricked off into pots, several in a pot. These should be prepared carefully, with ample drainage of broken pots and charcoal, over which good Osmunda fibre should be placed, the top finished off with the same material mixed with a sprinkling of live sphagnum and cut up finely. Insert the little plants in holes a quarter of an inch apart and spray the whole with a fine sprayer to settle the plants in position. Great care should now be exercised to prevent the plants from damping-off, through excessive moisture or too close an atmosphere. A constant, genial moisture and the admittance of air in moderation; in short, a constant attention is what is now required. Later on, when the little plants begin to send forth their leaves, they may be transferred to small one inch pots, a plant in each."

POINSETTIAS

The Poinsettia produces an abundance of milky juice; such plants are more difficult to root than some others. Two sorts of cuttings may be made of Poinsettias, hardwood and softwood.

In making the dormant wood cuttings the plants, after flowering, are placed under the bench of a warm house and gradually

allowed to ripen by withholding water. During March the canes are cut in to four inch lengths, and after the milk has stopped flowing, the cuttings are washed in warm water and dipped in powdered charcoal. Place in a moderately dry propagating bench at a temperature of 65 degrees. As soon as roots have started the cuttings should be potted in thumb pots.

For making softwood cuttings, the plants are started in April. Shake the soil from the roots of the old plants and pot in smaller pots. The storage roots will soon cause the growth of good cuttings. When several inches long, the cuttings are taken with a heel. They may be rooted in the sand bench or potted immediately and placed in a close propagating case. Cuttings may be taken all Spring and Summer; the earlier cuttings will give the taller plants.

ROSES

Seed. The various botanical species of Roses may be propagated by seed because they breed true. Horticultural varieties must be propagated by some other method.

Collect the seeds when ripe and pound them from the fruits, allowing the fruits to ferment; then the mass is washed and the seeds separated. They are sown immediately or else stratified. Cover the seed with sand instead of soil. *Rosa blanda*, *R. canina*, *R. carolina*, *R. cinnamomea*, *R. hispida*, *R. Hugonis*, *R. humilis*, *R. lutea*, *R. multiflora*, *R. nitida*, *R. pisocarpa*, *R. rubiginosa*, *R. rubrifolia*, *R. rugosa*, *R. setigera*, *R. spinosissima* and *R. Wichuraiana* are especially grown from seed.

Hardwood cuttings,. Most Briars, Climbers and Polyanthus may be propagated by hardwood cuttings. The canes should be cut into 5 inch to 6 inch lengths and buried in sand during Winter and set out in Spring. (See p. 52.)

Softwood cuttings of outdoor Roses. Pot up such Roses as are needed for propagation, using one- or two-year-old plants. Store away in coldframes. About the holidays the plants should be brought into the houses. When the growth is about to bloom, just when the buds show color, the flowering stems may be cut into one- or two-eye cuttings. These cuttings should then be placed in sand to root. Pot in two inch pots as soon as roots are a half inch long. The large potted plants will furnish cutting material for the whole Winter and Spring.

This method is used especially in propagating Teas, Hybrid Teas, Hybrid Perpetuals, Climbers, Polyanthus, and others not coming true to seed.

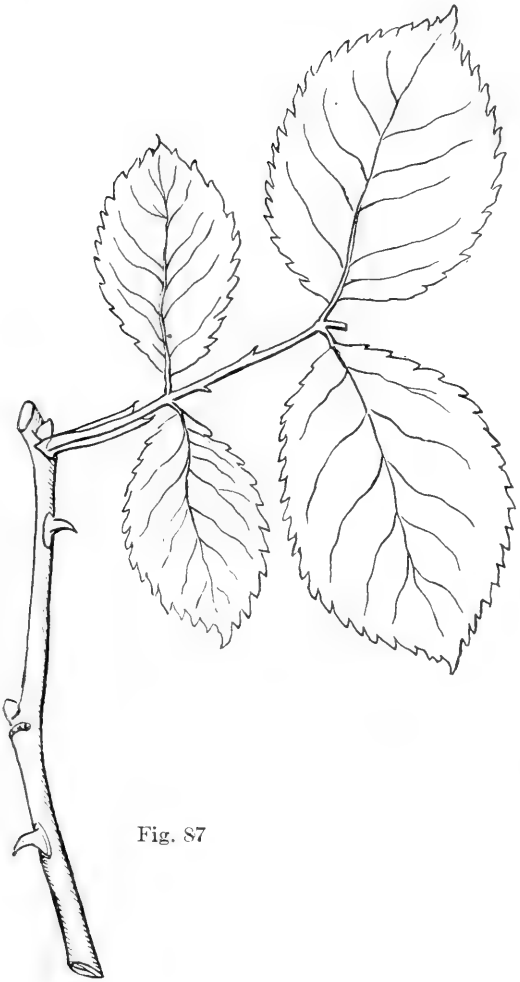


Fig. 87

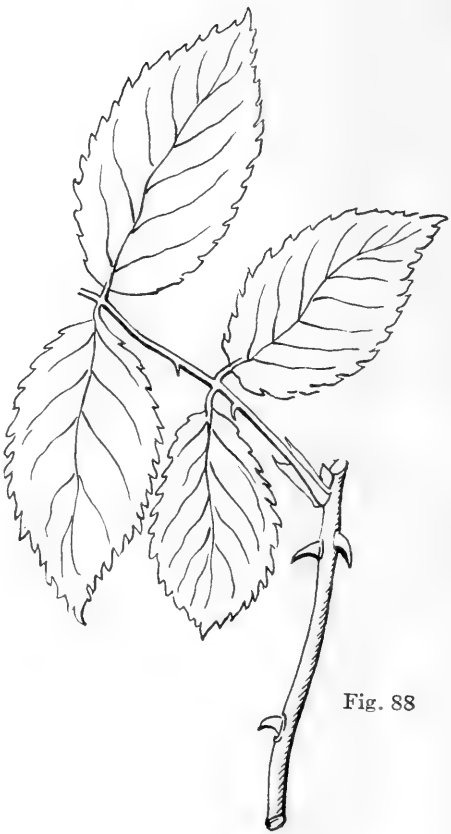


Fig. 88

Fig. 87. A two-eye Rose cutting. The cut at the base has been made through an eye. One eye is placed in the sand

Fig. 88. A one-eye Rose cutting. The leaf area has been reduced and the cut at the base is through an eye

INDOOR CUTTINGS OF COMMERCIAL ROSES

Cuttings of greenhouse Roses are taken from the middle to the end of January. Most growers prefer to use cuttings which have been so made that the cut at the base is through an eye, two other eyes being left on the cutting (see fig. 87). It is, however, admissible to make cuttings with only one eye when stock is scarce, but the plants do not develop so rapidly (see fig. 88). Many growers

in cutting the crop for sale allow longer stubs than necessary; these stubs are later removed for propagating wood.

Blind wood, or non-flowering wood, is produced on many plants which seems to be just as good for use in propagation as the flowering wood.

The best temperature for rooting Roses is 55 degrees for the overhead and 60 degrees for the sand. Care should be taken in watering so that too cold water is not used because black spot is apt to result.

Roses root in about 30 days, depending upon the variety and the temperatures. When the roots are about a half inch long the cuttings are potted. The deeper 2½-inch Rose pot is preferred to the standard pot. A little manure may be used for the first potting soil.

Summer Cuttings. Cuttings may be taken from plants grown indoors and are made during late Spring, Summer or early Autumn and placed in warm beds until rooted, when they are potted and grown to proper size under glass. They are hardened off and go through the Winter in dormant or semi-dormant condition. The Teas and Hybrid Teas should not be allowed to freeze or become perfectly dried out. "The claim made for it is that all unnaturalness of forcing out of growing season is eliminated, both in production of wood and growth of plant".* Many varieties as for example, Frau Karl Druschki, are easy to root by this method, although difficult when cuttings are taken in Winter.

GRAFTING AND BUDDING ROSES

Roses are often grafted because some of the varieties are difficult to root from cuttings. By graftage, other varieties are improved in growth, yield of bloom, and earliness. The best stocks are perpetually active, and the plants, being furnished with a good root system, are caused to bloom at a younger age.

ROSE STOCKS

In considering the stock for the Rose one more desired characteristic should be added to those given on page 88; the stock for greenhouse Roses should be perpetual growing.

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*Good, John M. Springfield Roses. American Rose Annual, 1917, 2d ed., p. 51.

MANETTI STOCK

The Manetti is a form of the China Rose. It is obtained from France and Scotland, but many do not like the French-grown Manetti because it is not as well graded as Scotch, although French is cheaper. The Manetti is not an ideal stock, for although it is perpetual growing, vigorous, and responds to fertilizer readily, it suckers badly.

CANINA STOCK

The Canina stock is used in England, although it is not good here. Many of our garden Roses are imported and are often budded on *Rosa canina*; but they do not succeed because they have a tendency to stand still in December to February.

Standard or tree Roses are budded upon Canina. Seedling Canina have a deep root system, making them less liable to drought injury

Ezon Kempenaar, before the Newport Horticultural Society, February 8, 1916, described the method of growing *R. canina* stock from seed:

"The ripe seed pods are collected in September; those from strong shoots are best.

Two weeks after gathering the pods are placed in a barrel and stirred about with a stout stick until all broken up; water is added which brings the refuse and infertile seeds to the surface, which is skimmed off, leaving only the fertile seeds which are taken and thoroughly incorporated with sand and are placed in boxes, which are then buried in the open ground about 10 inches below the surface, where they remain until Spring. They are then sown in beds just as soon as the ground is workable. About May 1 the seedlings will begin to make their appearance, and as soon as large enough are transplanted in rows from 4 inches to 5 inches apart, and the following Spring are planted out in nursery rows 18 inches apart and 6 inches between the plants; at transplanting the tops are cut back, leaving only three or four eyes."

CAROLINA STOCK

The Carolina Rose is a native and is adapted for low, damp ground and for ordinary conditions it suffers from drought, making it useless under outdoor conditions because of our hot and dry Summers. It is not very useful under glass because it has a period of rest.

MULTIFLORA STOCK

R. multiflora makes an excellent stock, for it is hardy, vigorous,

and does not sprout from the roots. It is, however, difficult to obtain and the roots are subject to attacks of the nematode, or eel worm. It is propagated by hardwood cuttings.

SETIGERA STOCK

Writing of *R. setigera*, Joseph Meehan says:

"Some of the Southern nurserymen already use it, and find it a better one than the Manetti in their soil, and it does not sucker. It is fairly well known here, and those familiar with it know what a strong, vigorous grower it is. There is no question of its hardiness at all, being a northern Rose; it propagates readily from cuttings and seeds; and if one had a stock of it, unsold for grafting or budding purposes, it is still salable for planting for its beauty. Those not familiar with it will have an idea of its character when told it is the parent of the old climbing Rose, Prairie Queen."

BUDDING ROSES

Manetti stocks growing in the field are shield budded in July, when an active eye is used, or in August, using a dormant eye.

Fig. 89. Standard Roses. The various Hybrid Teas, Teas and Hybrid Perpetuals are successfully budded or grafted upon upright stocks of *R. canina*, *R. rugosa* and other shrubby sorts. Such plants are called Standard Roses

The early buds will start growth immediately. It will be Spring before the August bud grows. (See page 99.)

Many Hybrid Teas, Hybrid Perpetuals, and Tea Roses for outdoor use are budded rather then grafted.

GRAFTING TO INCREASE YIELD

If more growers realized the increase in yield, due to grafting, more would attempt to graft their own Roses. Alexander Montgomery, Jr.,* writes: "It seems to be the general opinion, among those who had never grown grafted stock, that the superiority over own-root is chiefly during the early Autumn months. In order to dispel any such notion, I shall give the figures of the cut by months from a house of own-root Roses, and also from the same house planted with grafts. While these figures do not take into consideration the quality of the flowers, still, assuming that the grades are at least equal, (and I believe it is generally admitted that they are,) they present evidence which ought to satisfy the most skeptical.

Month	Own Root	Grafted
August	6,899	8,653
September	11,317	20,950
October	11,614	9,325
November	10,373	16,558
December	5,829	8,503
January	7,277	10,653
February	4,958	6,775
March	7,634	9,997
April	10,009	13,602
May	13,834	20,813
June	12,991	16,624
Total	102,735	142,453

This is an interesting record for several reasons. It shows that the same bench space produced forty per cent more flowers on grafted than on own-root plants, a real money difference. The increase is well distributed through the season, the month of December showing an increase of fifty per cent, as compared with the own-root stock."

Some growers believe that Mrs. George Shawyer should not be grafted because the Manetti does not seem to push it.

GRAFTING CASE

The smaller growers who have refrained from going to the trouble of grafting, could easily build a small frame, which will be handy

*Montgomery, Alexander, Jr., History and Culture of Grafted Roses for Forcing.

for many other uses. Most Rose grafting cases are built like a small even-span greenhouse over a greenhouse bench.

E. G. Hill has built his grafting cases so that the top is flat and merely covered by panes of overlapping glass. The case should be 12 to 15 inches high and divided into sections, each large enough for one day's grafting.

A simple case may be made by building up the sides of a bench and covering with a hotbed sash hinged to the side of the bench. Such cases should be tight and perfectly controlled. A uniform temperature of 80 degrees is maintained. A layer of coal ashes which is kept moist will supply the humidity for the early growth of the grafts.

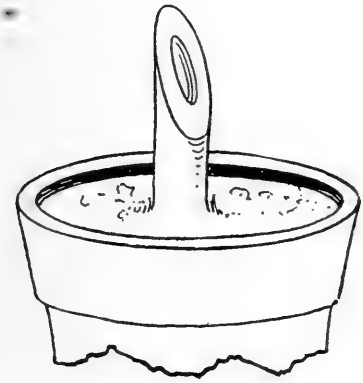

Fig. 90

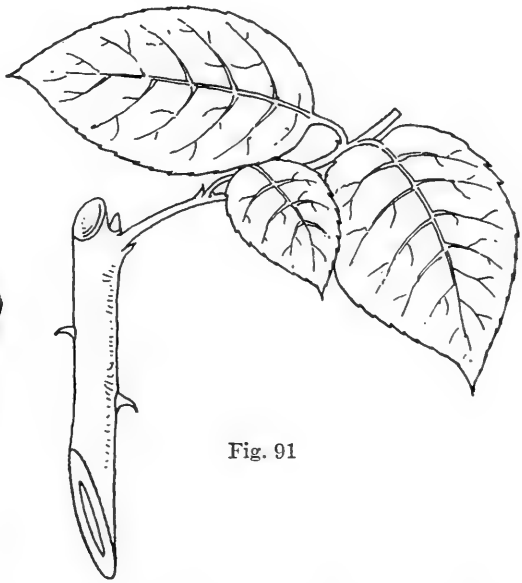

Fig. 91

Fig. 90. Rose stock cut ready for grafting From Holmes Com. Rose Culture, p. 36
Fig. 91. Rose cion for grafting. From Holmes Com. Rose Culture, p. 33
(See page 136)

PREPARATION FOR GRAFTING

The Manetti is received in December and potted in 2½ inch pots. Pot firmly in a good Rose soil and place in a house with a temperature of 50 degrees. Some growers place the pots under the Carnation benches. They are syringed twice a day to soften the wood, causing them to start to grow more uniformly. They should be examined at regular intervals to find when the white roots have well started. Then they are grafted. Cions should be selected which are of the same sort as the wood used for cuttings.

GRAFTING OPERATIONS

The splice graft (see figs. 61, 90 and 91) is used, by which method the stocks are cut off an inch from the soil with a long slanting cut and the cion is prepared with a similar oblique cut. The cion is then placed on the stub of the stock with cambium layers in contact on one side, at least, and firmly tied with raffia.

As soon as the plants are ready they are placed in the grafting case; the sashes are tightly closed and left so for about five days unless too much moisture has accumulated; then open the sash the thickness of a pot label. At the end of this time the case is opened gradually for five or ten minutes a day; a little longer time for ventilation being allowed each day.

It will be three weeks before the grafts are sufficiently knitted to permit their being taken from the frames. They may be placed on a shallow bench where air is circulating and where syringing may be done from both sides.

RAPID PROPAGATION OF NEW VARIETIES

The following notes are from Mr. G. W. Oliver:

"When, as a result of crossing two varieties, a good seedling is secured and tested, the next problem to present itself is to get up a large stock in as short a period as possible so that it can be put on the market. There are various ways to accomplish this result, but there is only one way to get the maximum number of plants so that cuttings can be rooted for distribution. What is needed is a very quick vegetating stock. The Manetti is too slow for this purpose and it cannot very well be used in Winter. There is a variety introduced by the office of Seed and Plant Introduction (No. 22,449, United States Department of Agriculture), which is better for this work than the Manetti and others. This plant is a rampant grower. The bud graft takes quickly on the bases of young stock plants, and when the roots are in good growing condition fine unions are the result. In a few weeks we get growths a foot or more in length. The growing point is then nipped out and the wood firms up quickly, so that bud wood can be secured for further propagation. To depend upon cuttings alone for increasing a new variety is too slow. Bud grafting gives much quicker results. The bud graft* is simply a piece of matured wood with a single bud. Take a bud stick; remove the leaves and the prickles, if present, from about one-half inch from the stem. To remove the bud grafts place the edge of the knife blade about three-sixteenths of an inch

* This is a modification of the side graft. (See p. 93 and fig. 60.)

below the opposite side of the leaf joint, cut diagonally down and through the stem about three-quarters of an inch, then turn the bud stick and remove a small slice diagonally from the base of the bud graft which, after cutting from the bud stick, is now ready for inserting into the stock. To prepare the incision in the stock for the reception of the bud graft, simply make a diagonal cut long enough to receive the bud graft, placing the long side of the cut surface of the bud graft so that it will unite perfectly with the inner cut surface of the stock. In a warm house the union will be perfect in two or three weeks. The top of the stock can then be removed gradually. As soon as the ripened shoots are ready they, in their turn, are used in propagating."

Root cuttings. The fleshy rooted sorts, as *R. gallica*, especially the Moss Roses, *R. damascena*, *R. nitida*, *R. rugosa*, and *R. blanda*, may be propagated by root cuttings. Cut up the roots in Autumn and store in sand. Plant out in Spring.

Layers. Dr. Mulford,* writes that *R. Hugonis* is difficult to grow from cuttings and is therefore grown by layers. Let them get thoroughly rooted before cutting from parent plant. Mound layers are best.

For many of the trailing roses, like *R. Wichuraiana*, continuous layers are useful.

Trenching method. A modification of layering is described by C. D. Beadle,† Superintendent of the Biltmore Estate. Many of the Briar Roses (like Persian Yellow, Austrian Copper, Penzance Sweet Briars), Damask Roses (including the two-color and striped Roses), and many other types are readily propagated by the trenching process. The plants of the varieties to be propagated are planted out in nursery rows in an almost flat position leaning one against another. The plants are then almost covered with soil, which soil may be gradually filled in as the shoots advance in growth. At the close of the first growing season, the trenched plants are dug and the vertical shoots are cut from the horizontal branches at their base. Many of the shoots will have rooted, but this is not necessary. The shoots will, however, be covered with "root-bark," a tissue differing from the shoots above the soil. The cuttings, rooted or unrooted, as the case may be, are planted in nursery rows, or in cutting-beds, and grown for several seasons.

Seedling inarch. (For discussion of a method of getting seedlings to bloom quickly see page 106, also see figs. 77-79.)

* Mulford, F. L. Roses for the Home. Farmers' Bullt. 750, p. 27.
†Beadle, C. D. The Trenching Method of Rose Propagation. American Rose Annual, 1917, 2d ed., p. 51.

VIOLET PROPAGATION

Rooted cuttings of the Violet taken in February result in good, clean stock for the next year. They are placed in the sand bench and treated as softwood cuttings. Violets are, however, most easily propagated by division, but there is more danger of spreading disease. By the latter method the plants are divided so that each cutting will have a few roots and a piece of soft stem and a growing shoot. Flats are filled with soil in which the cuttings are placed. They are left for several days in a shady place, usually under a greenhouse bench, after which they are placed in frames until the season warms up, when they are set in the field about 10 inches apart in the row for singles, and 8 inches apart for the doubles. The rows for convenient cultivation should be 15 to 18 inches apart. Constant Summer cultivation results in good plants.

IMPROVING THE VIOLET CROP

The various varieties of Violets seem adapted to certain localities only, and it is highly advisable for each grower to select the variety, and strain of that variety, which meets his conditions best. Dr. Galloway* suggests a method of doing this. The grower should go over his crop, attempting to find those plants which give the most flowers, typically colored, long stemmed, and disease resistant. Suppose one hundred plants are selected, place a stake at the side of each and tie a large shipping tag to the stake upon which the daily picking may be written. Some plants may be found to give 50 flowers; another may produce 150 flowers; some will bloom most in December and January and others in March. Select the strain which produces the most flowers when they are worth the most. At the end of the first year eliminate all plants not producing ninety flowers. Each plant will give ten good cuttings, so that if fifty plants are selected the first year, five hundred good plants are assured for the second. Keep the selected plants labeled. The details of this method can be improved upon by the ingenuity of the grower.

*Galloway, B. T. Commercial Violet Culture.

CHAPTER VII

HERBACEOUS PERENNIALS

In this list of herbaceous perennials are included the commoner sorts of plants, not woody, which live more than one year. They are all genera of plants which are hardy in the Northern States. The writer acknowledges the help of Professor David Lumsden in preparing this list.

† Grown from seed usually not blooming until the second year.

*—Bloom first year from seed, but the perennials are not at their best until the second year.

A—Some species are annuals which, obviously bloom the first year from seed.

D—May be propagated by division.

E—Everlasting or Immortelle flowers.

G—Grasses.

K—May be propagated by suckers or stolons.

R—May be propagated by root cuttings.

S—May be propagated by stem cuttings.

D Acanthus†
D Achillea*
D Aconitum*
S,D Acorus†
S,D Actæa†
D Adonis*
Agrostemma (See Lychnis)
S,D Ajuga†
D Althæa (certain strains*)
A,S,D Alyssum*
S,D Amsonia†
A,D,R Anchusa†
D Anemone†
D Anthemis*
D Aquilegia†
D,R Arabis*
S,D Arenaria†
D Armeria†
D Arnica
A,D Artemisia†
G,D Arundo
D,R Asclepias†
D Asperula*
D Asphodelus
S,D Aster*
S,D Aubrietia†
D Auricula*
D Baptisia†
D Bellis*
R,K,D Bocconia*
D Boltonia†
A,D Borago†
S,D Callirhoe†
A,D Campanula†
S,D Caryopteris†
S Cassia†
D Catananche*
A,S,D Centaurea†
D Centranthus†
A,D Cerastium*
S,R Ceratostigma†
Chelone*
A,S,D Chrysanthemum†
D Cimicifuga†
S,D Clematis†
D Clintonia
A,D Coreopsis*
R,D Coronilla†
G,D Cortaderia
D Corydalis†
A,S,D Delphinium*
A,S,D Dianthus†
R,D Dicentra
D Dictamnus
Digitalis†
R,D Dodecatheon
D Doronicum*
D Draba†
D Dracocephalum†
D Echinacea†
D Echinops†
D Epimedium
D Erigeron†
D Eryngium†
S,D Eupatorium†
D Funkia
A,R,S,D Gaillardia*
D Galega†
A,D Galium*
D Gaura†
D Gentiana†
D Geum†
G,D Gynerium†

A,S,R,D Gypsophila*
D Hæmadorum
D Hedysarum†
S,D Helenium†
A,K,S,D Helianthus*
D Helleborus†
D Hepatica†
D Heracleum*
S,D Hesperis†
S,D Heuchera†
S,D Hyssopus†
A,S,D Iberis*
D Inula†
D Iris (California species must be from seed)
D Liatris†
A,D Linaria*
A,D Linum*
A,D Lobelia*
S Lotus†
A,D Lupinus†
A,S,D Lychnis*
S,D Lysimachia
S,D Lythrum†
D Mandragora†
S,D Menispermum
K,S,D Mentha†
D Mertensia†
S Mesembryanthemum†
R,S,D Monarda†
A,S,D Myosotis*
A,K,S,D Œnothera†
A,D Papaver (Iceland)*
D Pentstemon†
R,D Peony
G,A,D Phalaris†
S,D Phlomis†
A,R,S,D Phlox
S,D Physostegia†
D Platycodon*
Plumbago (see Ceratostigma)
R,D Podophyllum†
D Polemonium†
D Polygonatum
R,S,D Polygonum†
D Potentilla†
D Primula†
S,D Ranunculus†
D Rheum†
R,K Romneya†
A,S,D Rudbeckia†
A,S,D Salvia*
D Sanguinaria†
S,R,D Saponaria†
A,K,D Saxifraga†
A,D Scabiosa†
S,D Sedum†
S,D Senecio*
D Sidalcea†
A,S,D Silene†
D Silphium†
D Sisyrinchium
S,D Solidago†
D Stachys†
E,A Statice†
R,D Stokesia†
S,D Tanacetum
D Thalictrum†
R,D Thermopsis†
S,D Tradescantia†
D Trollius
D Valeriana†
S,D Verbascum†
S,D Veronica†
D Violas*
S,R,D Yucca†

ANNUALS

E Acroclinium*
S Ageratum*
S Alonsoa*
Amaranthus*
S Antirrhinum*
Arctotis*
Argemone*
Balsam*
Brachycome*
Browallia*
Cacalia*
Calendula*
Callistephus (China Aster)*
Celosia*
Cerinthe*
Clarkia*
Cleome*
Collinsia*
Coreopsis (Calliopsis)*
Cosmos*
Datura*
Diascia*
Dimorphotheca*
Emilia*
Erysimum*
Eschscholtzia*
Gilia*
Godetia*
E Gomphrena*
E Helichrysum*
E Helipterum*
G Hordeum*
Layia*
Madia*
S Mathiola (Stocks)*
Mentzelia*
Mimulus*
Nasturtium*
Nemesia*
Nemophila*
Nicotiana*
Nigella*
G Pennisetum*
S Petunia*
Phacelia*
A Poinsettia*
Portulaca*
Reseda (Mignonette)*
E Rhodanthe*
Ricinus*
Salpiglossis*
Sanvitalia*
Schizanthus*
Sweet Peas*
Tagetes (Marigold)*
Torenia*
S Verbena*
E Xeranthemum*
Zinnia*

BULBOUS PLANTS AND THEIR PROPAGATION

B—Bulblets
C—Cormels
Co—Corm
D—Natural division
O—Offsets
R—Rhizomes which may be divided
S—Seed
Sx—Western species, by seed only
T—Cuttings
Tu—Tubers and tuberous roots
*—Sometimes grafted to preserve rare or weak varieties
†Spring flowering, out of doors
‡—Winter flowering
X—Summer flowering, hardy
Z—Summer flowering, not hardy

Achimenes R,T,z
Agapanthus D,z
Allium S,O,B,‡,†
Alstrœmeria S,D,z
Amaryllis S,D,O,‡
Amorphophallus O,S,z
Anemone S,D,‡,†
Anomatheca (see Lapeyrousia)
Antholyza D,z
Apios Tu,Z
Arisæma Co, or Tu,S,†
Arum O,S,‡
Babiana C,S,‡
Begonia, tuberous S, Tu,z
Bessera O,z
Bloomeria Co,S,†
Boussingaultia B, z
Brodiæa S, O,‡
Bulbocodium D,†
Caladium Tu,z
Calochortus Co,D,‡
Camassia S,D,X
Canna R,z
Chionodoxa O, S,†
Clintonia D,†
Clivia D,z
Colchicum D,S,X
Convallaria R,†
Cooperia D,z
Crinum D,z
Crocosmia O,S,z
Crocus D,C,S,†
Crown Imperial D,†
Dahlia*, S,D,T,Tu (see p. 75),z
Dracunculus Tu,O,‡
Eranthis D, †
Eremurus D,S,X
Erythronium O,Sx,†
Eucharis O,z
Freesia O,S(2-3 yrs.),‡
Fritillaria O, ‡
Funkia D,R,X
Galanthus D, †
Galtonia S,D,z
Geissorhiza Co,D
Gesneria S,‡
Gladiolus (see pp. 73-74), C,C,S,z
Gloriosa D of Tu,O,z
Gloxinia S(see p. 26)
Helleborus R,D,†
Hyacinth (see p. 66), ‡,†
Hymenocallis O,z
Imantophyllum (see Clivia)
Iris, bulbous D,‡,†
Iris, rhizomatous R,S, †,X
Iris, Californian species Sx,X,
Ismene (see Hymenocallis)
Ixia O,‡
Ixiolirion D,†
Kniphofia S (a strain Burpee has developed),D,X
Lachenalia D,S,‡
Lapeyrousia Co,D,X
Leucojum D,O,†X,
Lilium (see pp. 39-71) B, ‡,†,X
Lily of the Valley R,†
Lycoris D,z
Milla D,z
Montbretia (see Tritonia)
Moræa Co,D,z
Muscari O,S,†
Nægelia O,‡
Narcissus D,‡,† (see p. 71)
Narthecium R,X
Nemastylis D,z
Nerine O,z
Ornithogalum O,‡
Oxalis D,O,‡,z
Pancratium O,S,z
Polygonatum R,D,T
Puschkinia D,†
Ranunculus S,D,†
Richardia (see Zantedeschia)
Scilla O,‡,†
Smilacina R,†
Sparaxis D,‡
Spiræa (Astilbe) D,S,‡
Sprekelia D,‡,z
Tigridia C,S,z
Trillium R,S,†
Triteleia S,O,†
Tritoma (see Kniphofia)
Tritonia D,‡,X
Tuberose O,z
Tulip (see p. 71), ‡,†
Vallota D,O
Viola (certain species R),S
Watsonia C,D,‡,z
Zantedeschia D,O,S,‡,z
Zephyranthes D,S,‡,z

CHAPTER VIII

TREE AND SHRUB LIST

Many of these notes are derived from those made by Mr. Joseph Meehan in The Florists' Exchange

ABELIA.

CUTTINGS. Hard and half-ripened wood.

LAYERS. In greenhouse best.

ABIES. Firs.

SEEDS. Keep dry during Winter, sow in Spring. Many of the seeds are infertile.

GRAFTING. Grafted on seedlings, use veneer graft. Grafting in greenhouse in late Summer. Use only upright growing shoots for cions, others do not make shapely trees.

ABUTILON. Flowering Maple.

SEEDS. Sow in March. Will bloom in Autumn.

CUTTINGS. Hard or soft wood.

GRAFTING. Any strong growing species may be used upon which to graft the trailing sort, *A. Megapotamicum*, in order to make a standard plant.

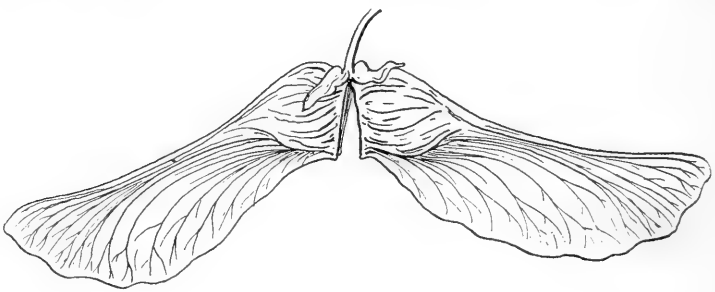

Fig. 92. A Maple key

ACER. Maple. Box Elder.

SEEDS. Many of the species grow nicely from seed sown as soon as ripe.

CUTTINGS. Some species root from hardwood cuttings, *A. negundo*, especially.

LAYERS. *A. rufinerve*, *A. rubrum*, *A. cappadocicum* (*colchicum*) var. *rubrum*, *A. platanoides* var. *Schwedleri*, *A. platanoides* var. *globosa* and *A. palmatum*, are best propagated by cutting down a tree and encouraging long shoots to grow which are layered. Sometimes it is not necessary to cut down the trees to induce the growths. It takes some Maples two years to root.

ACER—Continued

GRAFTING AND BUDDING. Varieties are grafted or budded on types, for example, *A. saccharinum* var *Wieri* is budded on its species *A. saccharinum;* Schwedler's Maple, and *A. globosa* are grafted or budded on *A. platanoides*; *A. palmatum* (*polymorphum*) *atropurpureum* and *dissectum* grafted on *A. polymorphum*; *A negundo* var. *variegata* grafted on *A. negundo.* Two-year-old seedlings are best. Grafted in April. Budded in August. The Japanese Maples are usually grafted in the greenhouse.

INARCHING. Many of the Japanese Maples are inarched on seedlings. Best done from June to September.

ACTINIDIA. Japan Gooseberry.

SEEDS. Sown in Spring.

CUTTINGS. Best use green shoots in Summer. Roots form readily, but buds are tardy to grow.

ADENOCARPUS.

CUTTINGS. Unripe wood in greenhouse.

ÆSCULUS. Horsechestnut. Buckeye.

SEEDS. Many species grow readily if sown as soon as ripe. *Æ. carnea* (*rubicunda*) rarely seeds.

ROOT CUTTINGS. *Æ. parviflora* is so propagated.

BUDDING. *Æ. carnea* (*rubicunda*) and *Æ. hippocastanum* var. *flore pleno* are budded on *Æ. hippocastanum* in July or veneer grafted under glass during August upon year-old seedlings.

DIVISION. Some of the dwarf sorts are best propagated by division of the crowns.

AILANTHUS. Tree of Heaven.

SEEDS. Preserve during Winter, sown shallow in Spring.

SUCKERS when roots are injured.

ROOT CUTTINGS. Propagate from pistillate trees; female trees have bad odor.

AKEBIA.

CUTTINGS. Hard wood, or soft wood in Summer.

LAYERS. Of hard or soft wood.

ALBIZZIA.

SEEDS. Sow seed as soon as ripe.

ALNUS. Alder.

SEEDS. Sow in Spring. Cover lightly. Keep moist.

CUTTINGS. Ripe wood.

GRAFTING AND BUDDING. Bud or graft varieties on the type. *A. firma* is best grafted on *A. glutinosa.* The Heart-leaved Alder (*A. cordifolia*) is useful as stock for those sorts to be grown on a dry soil.

AMELANCHIER. June Berry. Shad Bush.

SEEDS. Sow as soon as ripe.

CUTTINGS. Hard wood.

ROOT CUTTINGS. Bury in sand in cellar during Winter, plant in Spring horizontally.

BUDDING AND GRAFTING. Dwarf sorts grafted on tall stocks. *Crataegus* may be used as stock.

AMORPHA. False Indigo.
SEEDS. Sow seed as soon as ripe. This is commonest method.
CUTTINGS. Hard wood cuttings. Take in Autumn.

AMPELOPSIS. Boston Ivy. Virginia Creeper. Woodbine.
SEEDS. Sow seeds as soon as ripe or keep in moist sand until Spring.
CUTTINGS. Hard wood or soft wood in Summer.
LAYERS. Simple layers used.

ANDROMEDA.
SEEDS. Very fine. Sow in pots in Spring, place in frames in mixture of sphagnum, fine loam; cover with glass. Germinate in two months but grow slowly.
CUTTINGS. Soft wood in Summer.
LAYERS. Root slowly.

ARALIA.
SEEDS. Good; when they can be obtained.
ROOT CUTTINGS. In Spring. About 2 to 3 inches long; set out in rows or take in Autumn and store in sphagnum moss.
GRAFTING. Some of the exotic sorts require grafting upon strong growers. Done in greenhouse.

ARBUTUS. Strawberry Tree.
SEEDS. Sown in Autumn or early Spring.
CUTTINGS. Half-ripe in Autumn placed in peaty soil.
GRAFTING AND BUDDING. Budded on seedling stock of the European species *A. Unedo.* Veneer graft used.

ASIMINA. Pawpaw. Custard Apple.
SEEDS. Self sow. Or stratify and sow in Spring.
LAYERS. In Autumn.
SUCKERS when roots are injured.
GRAFTING. *A. triloba* seedlings are used as stock for the weaker growers and varieties.

AUCUBA. Gold-dust Tree.
SEEDS. Sown soon after maturity.
CUTTINGS. Green or half-ripe wood.
LAYERS. Made of berried branches.
GRAFTING. Varieties are often grafted on the type.

AZALEA.
SEEDS. Sow seed when ripe. Use leaf mold and loam. Best sown in greenhouse.
CUTTINGS. Half-ripe wood. Indoor grown plants root more easily than outdoor ones. It takes several years for cutting grown plants to bloom.
GRAFTING. See Rhododendron. Veneer graft used indoors in the Summer. *A. viscosa* and *A. nudiflora* make excellent stocks; especially the first, which is the stronger grower.
LAYERS. *A. viscosa* and *A. amœna.* Simple layers. Spring.

BENZOIN (Lindera). Spice Bush. Wild Allspice.
SEEDS. Sow seeds as soon as ripe, using a peaty soil.
CUTTINGS. Green wood, but are difficult to root.

BERBERIS. Barberry.

SEEDS. Sow seeds as soon as ripe, sowing in a seed bed, covering bed with leaves during Winter. Keep seedlings in partial shade at first. Even the Purple-leaved Barberry comes true to seed.

CUTTINGS. Readily propagated by green cuttings in June. The hard wood cuttings do not root readily.

GRAFTING. Mr. Dunbar suggests grafting the rarer sorts on the Purple Barberry; the suckers are thus easily distinguished.

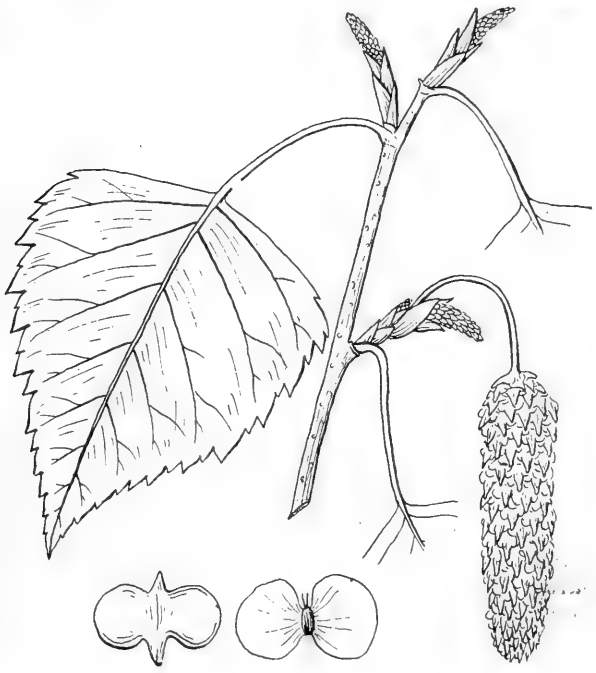

Fig. 93. The seed cone of the Birch

BETULA. Birch. (See fig. 93.)

SEEDS. Sow seeds as soon as ripe. If planting is deferred until Autumn poor germination results.

LAYERS. The lower growing sorts may be layered.

BUDDING AND GRAFTING. Easily done on seedlings of *B. nigra*, the Red Birch; *B. lenta*, the American Sweet Birch; or *B. papyrifera*, the Paper Birch.

B. Youngi pendula, *B. pyramidalis*, *B. pendula*, are budded chiefly, but may also be grafted.

BIGNONIA. Trumpet Flower.

CUTTINGS. Evergreen sorts best placed under bell jars to root.

LAYERS. Simple layers used.

ROOT CUTTINGS IN GREENHOUSE. Of larger rooted sorts.

BLACKBERRY.
ROOT CUTTINGS. Fall; about thickness of lead pencil. Cut into 2 to 3 inch lengths. Store in sand or sawdust until Spring.

BLUEBERRY. (See Vaccinium.)

BUDDLEIA. Summer Lilac. Butterfly Bush.
SEEDS. Sown under glass.
CUTTINGS. Use either soft or hard wood cuttings.

BUXUS. Box Tree.
SEEDS. Very slowly grown from seeds.
CUTTINGS. Made of late growths taken in Winter, root by Spring; or younger wood may be rooted in Summer. Pot and grow in frames for a season.
DIVISION. Low growing, but old Box plants may be broken into small pieces.

CALLICARPA. French Mulberry.
CUTTINGS. Soft wood in Spring. Place under bell jar or with bottom heat. Hard wood cuttings also used.

CALLUNA. Heather.
(See Vaccinium; these shrubs could, no doubt, be propagated by the methods mentioned.)
CUTTINGS. Green wood under glass.

CALOPHACA. Lentil Shrub.
SEEDS. Sow in Spring. Give good ventilation.
GRAFTING. The Laburnum (*Cytisus vulgare*) is used as stock for *C. wolgarica* in order to make graceful trees; the cions are inserted at height of six feet or more.

CALYCANTHUS. Sweet Shrub.
Calycanthus lævigatus is much sold as *C. floridus,* but it does not have the fragrance. *C. floridus* rarely seeds; *C. lævigatus* frequently produces seeds.
CUTTINGS. Soft wood in Summer or hard wood in Autumn.
ROOT CUTTINGS. Bury roots in sand during Winter; toward Spring cut up into inch lengths and start in greenhouse.

CAMELLIA.
CUTTINGS. Matured young wood with bottom heat. Summer.
GRAFTING. The single flowered stocks from seed or cuttings are best.

CAMPHORA. Camphor.
SEEDS. Seeds ripen in Florida in early Winter and should be sown when ripe.

CAMPSIS (Tecoma). Trumpet Creeper.
CUTTINGS. Soft and hard wood.
ROOT CUTTINGS. Of the *C. radicans.*
GRAFTING. The yellow flowered variety is grafted upon the type.

CARAGANA. Siberian Pea Tree.
SEEDS. Keep until Spring before sowing, then soak in warm water 48 hours.
GRAFTING. *C. arborescens* seedlings are used as stocks. When five to six feet tall the stocks are worked with the weeping or pendulous sorts.

CARPINUS. Hornbeam. Blue Beech.

SEEDS. Sow as soon as ripe; seeds germinate very unevenly. Keep soil moist by covering bed.

GRAFTING. Seedlings of *C. caroliniana* (*americana*) or *C. betulus* are used for the cut-leaved and Oak-leaved sorts.

CARYA. Hickory Nuts.

SEEDS. Sow in November or in early Spring, but keep in moist sand all Winter.

GRAFTING. The various Caryas are often grafted on the Butternut or *C. cordiformis* (*amara*) which is potted a year previously. Veneer or splice grafts are used. Baltet mentions using terminal bud grafting. After wrapping with twine and waxing, the graft is covered with a bag made of waxed paper. The bag serves to hold the moisture, preventing evaporation from the cion.

CARYOPTERIS. Blue Spiræa.

SEEDS. Pick the seeds in Autumn. Sow in February. Pot seedlings.

CUTTINGS. Pot plants. Bring into heat in February. Take soft wood cuttings.

CASTANEA. Chestnut. Chinquapin.

SEEDS. *C. pumila* Chinquapin. Sow seed as soon as ripe. Squirrels and mice will eat the seed, so protect them. Sow in flats rather than seed bed, or keep in moist sand during Winter, sowing in Spring to avoid the pests.

C. americana. Sow seeds as soon as ripe, or if kept till Spring they must be kept from drying out; if put in glass jar tightly corked they keep nicely.

GRAFTING. Makes them fruit earlier. The grafting is done in the Spring, but not until trees are about to burst into leaf. Seedlings are grafted by whip grafting. No method meets with satisfactory results. The Chestnut may be propagated on the Oak.

CASTANOPSIS.

SEEDS. Sow seeds as soon as ripe or keep moist until Spring, then sow

CATALPA. Indian Bean.

SEEDS. Sow seeds in Spring.

CUTTINGS. Made in Spring; set in nursery rows immediately.

GRAFTING. *C. Bungei* (see fig. 94) and *C. bignonioides* are budded or grafted on *C. speciosa*, late in season, at height of five to six feet. When grafting use the splice graft. When budded, the buds are placed on both sides of the stock. Cut bud sticks early and keep in cool, damp place until June, when bark lifts nicely.

CEANOTHUS. New Jersey Tea.

SEEDS. Seeds sown in Spring.

CUTTINGS. Either ripe or green wood.

ROOT CUTTINGS. Made in Autumn, placed in flats of sandy soil to root.

CEDRELA.
SEEDS. Grow readily.
CUTTINGS. Hard wood with bottom heat.
ROOT CUTTINGS. Cut down the growth if the first shoot by this method is not straight.

CEDRUS. True Cedars.
SEEDS. Sown in Spring.
GRAFTING. *C. Deodara*, the Deodar Cedar, and *C. Libani*, the Cedar of Lebanon, best grafted on seedlings of species or on *C. atlantica*, the Mt. Atlas Cedar. Use veneer graft.

CELTIS. Nettle Tree. Sugar Berry.
SEEDS. Sow when ripe.
CUTTINGS. Hard wood.
LAYERS. Useful when possible to make.
GRAFTING. Graft rarer roots on *C. occidentalis*.

CEPHALANTHUS. Button Bush.
SEEDS. Grow readily.
CUTTINGS. Hard wood or green wood.

Fig. 94. Catalpa Bungei. This type of tree is obtained by budding *Catalpa Bungei* upon *C. speciosa* (See page 147)

CERCIDIPHYLLUM.
SEEDS. Keep moist until sown.
CUTTINGS. Half-ripened shoots in Summer.
LAYERS. Cut back old plants early in Spring to force long shoots, then bend over and root. Mix some sand in soil about the plants for better rooting.

CERCIS. Judas Tree. Red Bud.
SEEDS. *C. japonica* and *C. canadensis*. Grow from seeds. Do not bother with cuttings.
C. japonica is superior to *C. canadensis*.
LAYERS. Mound.

CHAMÆCYPARIS. Cypress. White Cedar.
(See Retinispora, which is similar.)

CHILOPSIS. Desert Willow.
CUTTINGS. Ripe wood under glass.

CHIMONANTHUS. Chinese Allspice.
SEEDS. Self seeds where seeds ripen properly or sow in warm greenhouse.
LAYERS. Spring; they root by Autumn.

CHIONANTHUS. Fringe Tree.
SEEDS. Store seeds in damp sand. Sow in Spring. It will be a year before seedlings appear. If preferred the seeds may be kept in flats of moist sand a whole year before sowing.
GRAFTING. May be grafted on the White Ash (*Fraxinus americana*) or the European Ash (*F. excelsior*). This method is quicker than from seeds. May graft in greenhouse.

CINNAMOMUM. (See Camphora).

CISTUS. Rock Rose.
SEEDS. Seeds germinate nicely sown in Spring.
CUTTINGS. Spring or late Summer.

CITRUS TRIFOLIATA. Hardy Orange.
SEEDS. May be stored in moist sand and sown in Spring or sown in greenhouse. For Orange and Lemon see Orange.

CLADRASTIS (*Maackia*). Yellow Wood.
SEEDS. Grow readily from seeds when they can be secured.
ROOT CUTTINGS. *C. tinctoria*. Roots dug in early Winter, cut into three inch lengths, kept in damp moss in cool place and started in pots indoors or in open ground.

CLEMATIS.
SEEDS. When sown out of doors in Spring germinate in three months. Better store in sand as soon as ripe. Sown as soon as ripe in greenhouse place under greenhouse bench.
CUTTINGS. *C. coccinea* and others. Soft wood cuttings in Summer. Internode cuttings when soft wood root best.
LAYERS. Continuous layers are useful.
GRAFTING. Large flowering sorts are grafted on *C. flammula* or *C. viticella*.

CLERODENDRON.
SEEDS. Sown when ripe.
CUTTINGS. Nearly ripe wood.
ROOT CUTTINGS. *C. trichotomum*. In early Spring from pieces of root dug from around old plants. Use pieces two inches long.

CLETHRA. White Alder. Pepperidge.

SEEDS. Sown in pans in sandy or peaty soil.

CUTTINGS. Green wood taken from forced plants in Spring. Use bottom heat.

DIVISION. Of clumps.

COLUTEA. Bladder Senna.

SEEDS. Seed freely and grow readily.

CUTTINGS. Hard wood.

GRAFTED. Varieties grafted on *C. arborescens.*

CORNUS. Dogwood.

SEEDS. Do not germinate until second year.

CUTTINGS. All species with willowy, soft growth are propagated by hard wood cuttings. Soft wood in Summer also.

BUDDING AND GRAFTING. *C. florida* var. *rubra* grafted on the type.

LAYERS. Continuous layers may be made of many of the shrubby sorts.

CORYLOPSIS.

SEEDS. Sown in Spring.

CUTTINGS. Half-ripe wood in Summer under glass.

GRAFTING. Perhaps can be grafted on Witch Hazel in Winter in greenhouse.

Few shoots are normally produced, so that cuttings and layers are slow.

CORYLUS. Hazelnut. Filbert.

SEEDS. Seeds sown in Autumn or stratified until Spring. Seed grown stock gives superior root system.

LAYERS. Purple-leaved sorts are propagated by this method. The old plants cut down and young shoots growing from this operation are layered.

GRAFTING AND BUDDING. On the type, seldom done.

COTONEASTER.

SEEDS. Sow in Autumn or stratify.

CUTTINGS. Evergreen sorts best propagated by cuttings.

GRAFTING. Deciduous sorts are grafted on Quince or Hawthorn stock.

CRATAEGUS. Hawthorn. Thorn Apple.

SEEDS. Seeds gathered in Winter and stratified.

CUTTINGS. Cuttings of most by either hard or soft wood.

BUDDING. The doubles, especially, are budded on almost any American species such as *C. coccinea* or *C. crus-galli.* Bud in July. Hawthorns mature early in season.

CRYPTOMERIA. Japan Cedar.

CUTTINGS. Half-ripe wood under glass in sand.

GRAFTING. Horticultural varieties are grafted.

CUNNINGHAMIA. Chinese Fir.

CUTTINGS. Half-ripe wood in late Summer.

CURRANTS. See Ribes.

CYDONIA. Quince.
CUTTINGS. Hard wood in Autumn.
ROOT CUTTINGS. Autumn or Winter. Cut up roots into pieces three inches long. Keep in cellar until Spring, then plant in rows so that top of cuttings is on level with soil.
GRAFTING. Use varieties on types, especially the strong growing Angers and Fontenay.

CYTISUS. Scotch Broom, also called Genista.
SEEDS. Sown in May.
CUTTINGS. Tender shoots planted in enclosed frames or under bell jar.
GRAFTING. The stronger growing sorts are used as stocks for the smaller and trailing species.

DAPHNE.
SEEDS. Sow seeds as soon as ripe.
CUTTINGS. *D. cneorum.* Half-ripe wood.
GRAFTING. Graft *D. cneorum* on *D. mezereum* indoors in Winter. Use veneer grafts on stock grown in pots. Rarely grafted.

DAVIDIA.
SEEDS. Sow in Spring.
BUDDED. Possibly can be budded on *Cornus florida.*

DEUTZIA.
CUTTINGS. Ripened wood and half-ripe wood taken from plants in greenhouses, or soft wood in Summer.

DEWBERRIES.
ROOT CUTTINGS. See Blackberry.

DIERVILLA. Weigela.
SEEDS. Not difficult to raise, but do not come true.
CUTTINGS. Half-ripened shoots in Summer. Hard wood cuttings root readily.

DIMORPHANTHUS.
SEEDS. Sow seeds as soon as ripe. Gather soon after ripening, for birds will get them. Sow immediately.
ROOT CUTTINGS. Dig up the plants in April or May. Cut roots in three inch lengths and set in rows.

DIOSPYROS. Persimmon.
SEEDS. Sow seeds as soon as ripe or stratify until Spring.
CUTTINGS. Half-ripened wood.
GRAFTING. Graft named sorts on *D. virginiana,* the seedlings, of which often make plants large enough for budding the first year.

DIRCA. Leather Wood.
SEEDS. Ripen early. Sow when ripe.

ELÆAGNUS. Oleaster. Wild Olive.
SEEDS. Sow seeds as soon as ripe or place in damp soil until October; then sow out of doors. Certain plants from seed produce no berries.
CUTTINGS. Hard wood.
GRAFTING. *E. umbellata* used as stock for other sorts. *E. Simoni* grafted on *E. longipes* because it blooms so late that it seeds poorly.

EUCALYPTUS. Blue Gum.

SEEDS. Very rapid grower. Sown in May or June in California.

EUONYMUS. Burning Bush. Spindle Tree. Wahoo.

CUTTINGS. *E. japonicus.* Grow plants in rich soil for propagating. Half-ripe wood Midsummer. Hard wood cuttings may also be used.

LAYERS. Evergreen species readily propagated by this method.

GRAFTING. *E. americanus.* Graft on *E. atropurpureus* or *E. europæus* to make its display of berries more attractive.

EXOCHORDA. Pearl Bush.

SEEDS. Grow easily. Does not grow readily from cuttings or layers.

CUTTINGS. Soft wood best in Summer.

GRAFTING. Grafted by splice graft on own roots.

FAGUS. Beech.

SEEDS. Mix nuts with sand, keep cool till Spring or sow in Autumn.

GRAFTING. Blood-leaved, Tricolor, Weeping, Cut-leaved, grafted on seedling of type in early Spring.

INARCH. May be inarched in July by setting pots of seedlings around a specimen and uniting the branches.

LAYERS. Weeping varieties are layered.

FICUS. Fig (*F. carica.*)

CUTTINGS. Hard wood cuttings in Early Spring.

GRAFTING. Only practiced when varieties are poor growers; then graft on type.

FIG. (See Ficus.)

FORSYTHIA. Golden Bell.

CUTTINGS. Hard wood root very easily. Soft wood in Summer.

GRAFTING. *F. suspensa* is grafted on *F. viridissima* to get height.

LAYERS. Very easily propagated by this method.

FRAXINUS. Ash.

SEEDS. Jenkins writes:

> White Ash seed will seldom grow well the first season after planting, unless subjected to special treatment. There is a theory in regard to many seeds difficult to propagate, that a gummy, resinous, or oily epidermis covers them, interfering with the action of the air necessary to produce germination. Excellent results have followed the immersion of such seed in an alkali, in acetic, or dilute sulphuric acid. Care must be used, however, that the acid, or alkali, does not destroy the integuments of the seed in addition to this air-proof covering.

GRAFTING. The Green, Golden-weeping, Golden-barked, etc., are grafted or budded on *F. excelsior*, the European Ash. Bud in July, low for all but weeping sorts.

GELSEMIUM. Carolina Jasmine.

A greenhouse vine in the North.

CUTTINGS. Hard wood in Spring.

GINKGO. Maidenhair Tree.

SEEDS. Sow seed in Spring, but keep moist through the Winter.

GRAFTING. Use male trees only; the female trees produce ill-smelling fruits. Graft on seedlings. Also budded (see fig. 95).

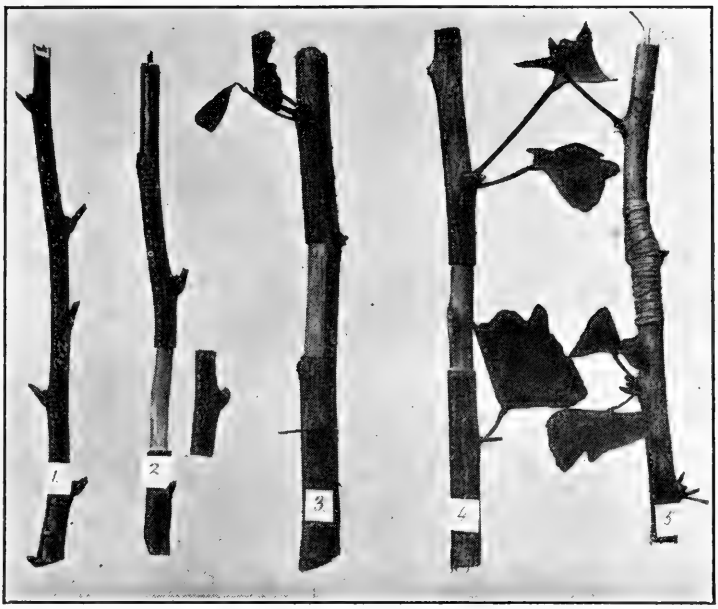

Fig. 95. Budding the Ginkgo. 1, A bud stick. 2, Ring bud removed. 3, Patch bud removed. 4, Stock ready for ring bud. 5. Ring bud applied to stock, showing the careful wrapping with raffia (See page 152)

GLEDITSIA. Honey Locust.
SEEDS. Scald seeds. Sow in Spring.
GRAFTING. *G. triacanthos* var. *inermis*, the Thornless Honey Locust is grafted on seedlings of the type. This type is better for cities because it is less offensive.

GOOSEBERRY. (See Ribes.)

GORDONIA. Loblolly Bay.
CUTTINGS. Half-ripened wood. Use sand and water method or place in greenhouse propagating bench.

GRAPE. (See Vitis.)

GYMNOCLADUS. Kentucky Coffee Tree.
SEEDS. Scald seeds.
CUTTINGS. Hard wood.

HALESIA. Snowdrop Tree. Silver-Bell.
SEEDS. Sow seeds as soon as ripe, otherwise they take two or three years to germinate.
CUTTINGS. Green wood from plants grown indoors.
ROOT CUTTINGS. Spring or Autumn.
GRAFTING. Most of genera of this family may be grafted on *H. tetraptera*.

HALIMODENDRON. Silver Leaf.
LAYERS. Root slowly.
GRAFTING. Use *Caragana arborea* as a stock.

HAMAMELIS. Witch Hazel.

SEEDS. Joseph Meehan gives the following notes:

> The shrub flowers in October and November, and the seed pods form then, but do not ripen until the next August or September. The pods are to be gathered then, when one or two by bursting open show the time has come for it. These pods are placed on a tray and set in the sun, that they may open at once. But they must have a sieve set over them, as when the pods open they eject the seeds at the same time, sometimes to quite a distance. This is not known to all who attempt to secure the seeds, and many are disappointed in finding themselves short of the seeds they expected. Seeds sown in Spring, and covered lightly, usually grow very well. Because of the shooting character of the seeds this shrub should be called the Revolver Shrub.

GRAFTING. The Japanese species are grafted on the American, indoors.

HIBISCUS. Rose of Sharon. Althæa.

SEEDS. Not true to color from seeds.

CUTTINGS. Hard wood.

LAYERS. Mound layering is often used.

GRAFTING. Graft named varieties on seedlings.

HIPPOPHÆ. Sea Buckthorn.

SEEDS. Sow seeds as soon as ripe. Keep plants until they flower to determine sex.

CUTTINGS. Hard wood does not root well.

LAYERS. Best method. Be sure to propagate both male and female plants.

HOVENIA.

SEEDS. Grows readily from seeds.

CUTTINGS. Half-ripe wood in early Summer.

LAYERS. Late Spring.

HUCKLEBERRY. (See Vaccinium.)

HYDRANGEA.

SEEDS. Many varieties seed freely.

CUTTINGS. Hard wood cuttings root readily in Spring. Green wood cuttings in Summer under glass. The harder wooded sorts are best propagated by green wood cuttings. Climbing sorts are difficult to root.

LAYERS. Cut down the bush the previous season to force the production of many shoots for layering.

HYPERICUM. St. John's Wort.

SEEDS. Seed is very fine; sow carefully.

CUTTINGS. Green wood cuttings in September.

DIVISION OF PLANTS. Hardy species.

IDESIA. Japan Cherry.

SEEDS. Japanese seedsmen offer seeds.

CUTTINGS. Soft wood cuttings.

ROOT CUTTINGS. Make in Autumn, plant in Spring.

ILEX. Holly.

SEEDS. Propagate plants of both sexes. Joseph Meehan writes:

> The commoner sorts are propagated by seeds. As there will be an abundance of seed in the florists' stores in a short time with the advent

of Christmas, a supply should be collected by those who wish to sow them. If both the native one of the North, *Ilex opaca*, and the English species, *I. aquifolium*, there are usually a lot of berries in the boxes in which the supplies reach the florists' stores.

Holly seeds do not germinate under a year or more. The way to proceed with the seeds is to mix them with sand in a box as soon as they are ripe or in early Winter. The box may be kept in a shed or building through the Winter; when Spring comes the mass should be washed out that the seeds be freed of pulp, as if allowed to remain as they were, the pulp is apt to cause fungus to form, to the detriment of the seeds. After the seeds are cleaned they are to receive another mixture of fresh clean sand and again be placed in a box, there to remain until Autumn, when they should be sown. The seedlings may be expected in late Spring.

It is better to treat the seeds as recommended than to sow them as soon as ripe as some do. Such sowings render a bed useless a whole season, and, worse, it requires weeding and care, which preserving in a box for a season obviates.

CUTTINGS. Deciduous sorts propagated by hard wood cuttings, especially *I. crenata.*

LAYERS. Cut down plants to force shoots; then make little upward cuts in stems and insert a pebble to keep the cut open. Heap sand around the plants, cover the shoots all but their tips. When layered in Spring they root by Autumn, but they should be allowed to remain for two Summers.

BUDDING. Budded in Spring from starting buds; or in Autumn from dormant ones. This method is used in order to insure having a plant which will produce berries abundantly. *I. opaca*, the American Holly, is an excellent stock, but the seedlings of *I. aquifolium* being easier to obtain, the latter species is also used.

GRAFTING. Veneer grafting used in August under glass. Select short shoots of branches producing berries for use as cions.

INDIGOFERA. Indigo Plant.
CUTTINGS. Green wood.

ITEA. Willow Shrub.
SEEDS. Can be grown from seed.
CUTTINGS. Hard wood.

JASMINUM. Jasmine. Jessamine.
CUTTINGS. Nearly mature wood. Layers and Suckers.

JUGLANS. Walnuts and Butternut. (See fig. 96.)
SEEDS. Most of the Walnuts should be treated much as Joseph Meehan advises for the English Walnut, *Juglans regia*:

> The nuts of the English Walnut require treatment different from that accorded many other kinds of nuts. It won't do in the North to sow them in Autumn; as a rule they rot when so treated. They should be kept indoors, in a rather cool place, mixed with slightly damp sand, and then sown outdoors in Spring, when every one may be expected to grow. Seedlings from imported nuts, and even those from home grown trees, are apt to lose their terminal buds when young. It is, therefore, wise to give them some protection, such as forest leaves provide, in an endeavor to preserve them. Another good plan is to let seedlings remain in their seed beds for two or three years before transplanting them; one protects the other in this way; they are more

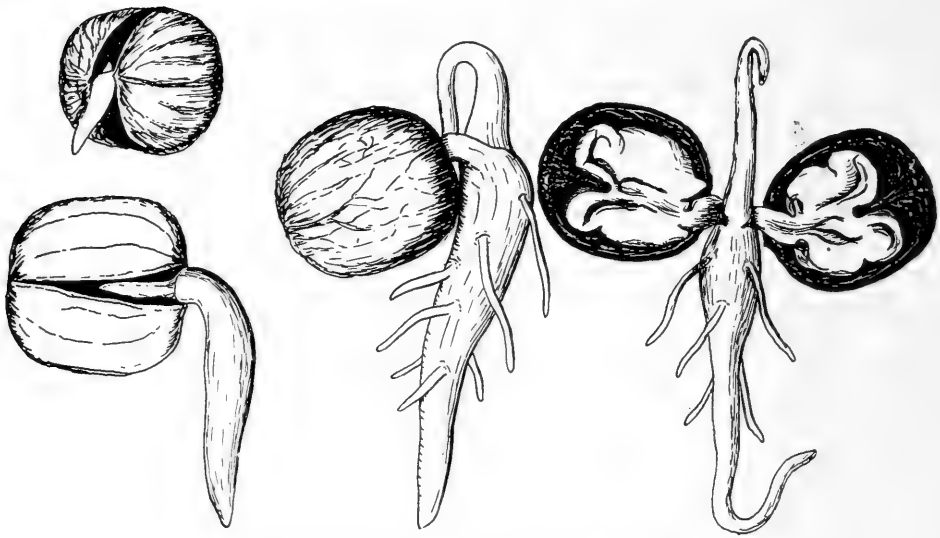

Fig. 96. Germination of an English Walnut

JUGLANS—Continued

easily preserved in Winter, and the close growth in the beds causes them to make height instead of branches, all in the interest of the grower.

There are many varieties of the English Walnut, the thin shelled, the early fruiting and a number of others, all differing in their nuts from the type. These it is not safe to rely on as coming true from seed. Of a hundred nuts, of any one kind of them, while some might be the same as the parent, many would not.

GRAFTING AND BUDDING. *Juglans cinerea*, Butternut, can be grafted by terminal bud graft. *Juglans regia*, English Walnut, budded on Butternut or Black Walnut in Summer, when the sap is flowing strongly.

JUNIPERUS. Juniper. Red Cedar.

SEEDS. Very hard; should be softened, according to Fuller, by soaking in strong potash water for several days.

CUTTINGS. Grow readily from soft unripe cuttings in greenhouse or mature wood cuttings in frames. (See fig. 24.)

KALMIA. Mountain Laurel.

SEEDS. Sow seeds in Spring in a mixture of sand, peat and loam in pans or flats and keep in greenhouse or coldframe. Transplant seedlings early into other flats. Do not put out in open for a year.

CUTTINGS. Most species, except *K. latifolia*, grow nicely from half-ripened wood cuttings.

GRAFTING. *Kalmia latifolia* varieties are side grafted on seedlings in greenhouse.

Most American nurserymen collect plants from the wild.

KERRIA. Corchorus. Globe Flower.

CUTTINGS. Young wood under glass in Summer, also hard wood.

KOELREUTERIA. Varnish Tree. Bladder Pod.

SEEDS. Produced freely. Stratify.

LAGERSTRŒMIA. Crape Myrtle.
SEEDS. Obtain from the South.
CUTTINGS. Hard wood, except the white varieties. Green cuttings may be made in the greenhouse.
ROOT CUTTINGS. Most successful method with the white variety.

LARIX. Larch. Tamarack.
SEEDS. Keep dry during Winter. Sow in Spring. Shade seedlings.
GRAFTING. Whip or cleft graft out of doors; veneer graft indoors. This latter method is best. Use European Larch, *L. europæa*, mostly.

LAURUS. Sweet Bay. Laurel.
SEEDS. Sow as soon as ripe, then they will germinate in a few weeks.
CUTTINGS. Half-ripe wood placed under glass.

LEDUM. Labrador Tea.
SEEDS. Sow in Spring.

LEMON. (See Orange.)

LESPEDEZA. Bush Clover.
CUTTINGS. *L. Sieboldi.* Half-ripened shoots in Summer. Top dies down in Winter.
LAYERS. *L.* (*Desmodium*) *bicolor.* In Summer. Take up in Autumn and protect for Winter.

LEUCOTHOE.
SEEDS. Sown in sphagnum moss and sand; pricked off in flats, and in early Spring planted out of doors.
CUTTINGS. Half-ripe wood cuttings placed in sand with bottom heat.
LAYERS. Underground runners.

LIBOCEDRUS. Incense Cedar.
SEEDS. Sow in Spring.
CUTTINGS. Late Summer in greenhouse, root slowly.
GRAFTING. Graft on *Thuya* and *Chamæcyparis.*

LIGUSTRUM. Privet.
SEEDS. Some may be raised from seed but Regel's Privet being a variety of *L. Ibota* does not come true.
CUTTINGS. Soft wood cuttings in Summer rooted in greenhouse. The prunings from the hedge may easily be cut into foot lengths and are easily rooted in the Spring.

LINDERA. (See Benzoin.)

LIQUIDAMBER. Sweet Gum. (See fig. 97.)
SEEDS. Stratify as soon as ripe. May not grow until second year. Require moist seed bed, therefore, water in the dry Summer.

LIRIODENDRON. Tulip Tree. White Wood.
SEEDS. Sown as soon as ripe in Autumn in a light soil with some leaf mold in it. Young plants make many long succulent roots, so they should be transplanted for several succeeding Springs. Usually less than half of the seeds grow.
GRAFTING. Sometimes grafted or budded on seedlings.

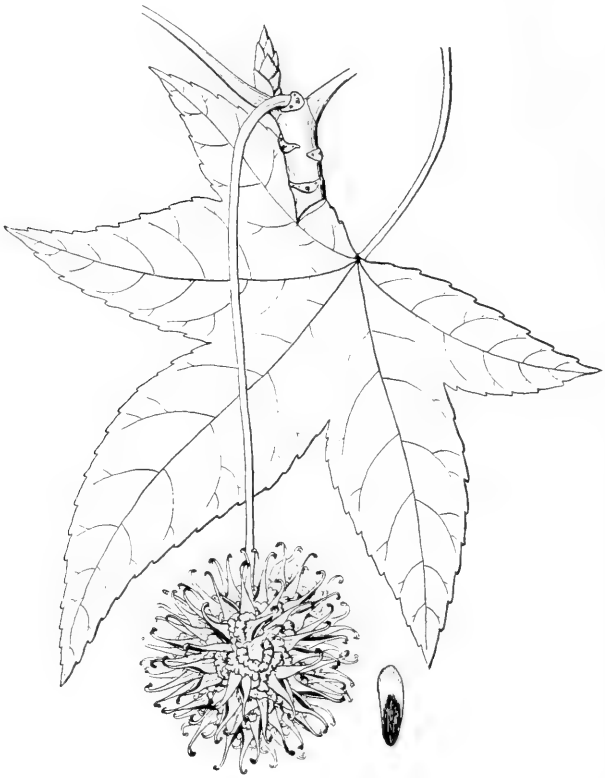

Fig. 97. The seed ball of the Sweet Gum. (See page 157)

LONICERA. Honeysuckle.
SEEDS. Sown in Autumn or stratify.
CUTTINGS. Either hard or soft wood. Soft wood rooted under glass.
LAYERS. Put down compound layers in Autumn or early Spring.

LYCIUM. Matrimony Vine.
SEEDS. Sow seeds as soon as ripe.
CUTTINGS. Hard wood, one year old. Soft wood in Summer.

MACLURA. (Toxylon) Osage Orange.
SEEDS. In Spring soak seed in warm water for forty-eight hours, then sow.
CUTTINGS. Green wood indoors.

MAGNOLIA.
SEEDS. Jenkins writes:

> After the red seeds of Magnolia are gathered from the pods, put them in a tub, or bucket, with enough water to barely cover them. Stir occasionally. In a few days the red, pulpy covering will be softened and may be rubbed from the black seed, or seed proper, in the hands; or, place the seeds in a coarse sieve and rub the pulp through the meshes into a running stream. The meshes of the sieve must be fine enough to retain the black seed. Then mix lime or wood ashes with the seed to cut the oily matter that appears to interfere with germination.

MAGNOLIA—Continued

Joseph Meehan writes:

Sow the seeds in early Spring, keeping them in a moist condition from the time they are gathered. Some sow the seeds in Autumn, some after they are gathered, placing a covering of leaves over them for the Winter. But keeping them in slightly damp soil all Winter and sowing early in Spring is a sure way; of course, watching the seeds right along through the Winter to see that everything is right

Layering. The old way of layering is the most solid of all. This is the time to cut back almost to the ground the stocks desired for layering purposes. Take some real heavy plants and cut them back to but a few eyes above the ground. This will cause the growth of strong, young shoots, which are just the sort needed for layering. The work should be done as soon as the shoots are of length enough to permit of it. If put down early, they will be nicely rooted by Fall, but should not be cut off from the parent plants before Spring. Old hands at propagating aver that but little is lost by allowing the layers to remain undisturbed for two years. In this way, too, the old plants are permitted to have a year's rest from layering, strengthening them, as the cutting down and layering the same plants year after year weakens them. This will lead propagators to have two sets of plants for layering, working one set one year, the other the next, which is much the better plan.

BUDDING. Use *M. acuminata;* the Cucumber Tree, or *M. tripetala*, the Umbrella Magnolia, as a stock. For standards the bud is inserted at height of five to six feet.

GRAFTING. *M. tripetala* better because of abundance of fibrous roots which makes transplanting safer. Performed under glass. Side cleft grafting is preferred. To increase the size of *M. glauca* it is successfully grafted on some larger growing species.

INARCHING. Successful.

MAHONIA. Oregon Grape.

SEEDS. Grow easily if sown soon after ripening.

CUTTINGS. Half-ripe wood under glass.

MEDLAR. (See Mespilus.)

MELIA. Pride of India. China Tree.

SEEDS. Rather difficult to raise. Sow seeds as soon as ripe. The *M. Azedarach* var. *umbraculiformis* breeds true to seed.

CUTTINGS. Hard wood.

MESPILUS. Medlar.

GRAFTING. Best use *Crataegus* as stock, but seedling Medlar and Quince can be used.

MISTLETOE. (See Phoradendron.)

MORUS. Mulberry. (See fig. 98.)

SEEDS. Wash and keep cool and dry until Spring; then sow; they germinate in several weeks. They may be sown in the Autumn.

CUTTINGS. The Russian type, *M. alba*, roots easily; the wild one, *M. rubra*, and Downing's Everbearing do not.

GRAFTING. *M. rubra* and *M. alba* make the best stocks for Downing. Weeping varieties are grafted at height of five or six feet above the soil. Grafting is practiced in early April. Root grafting in Winter may also be used.

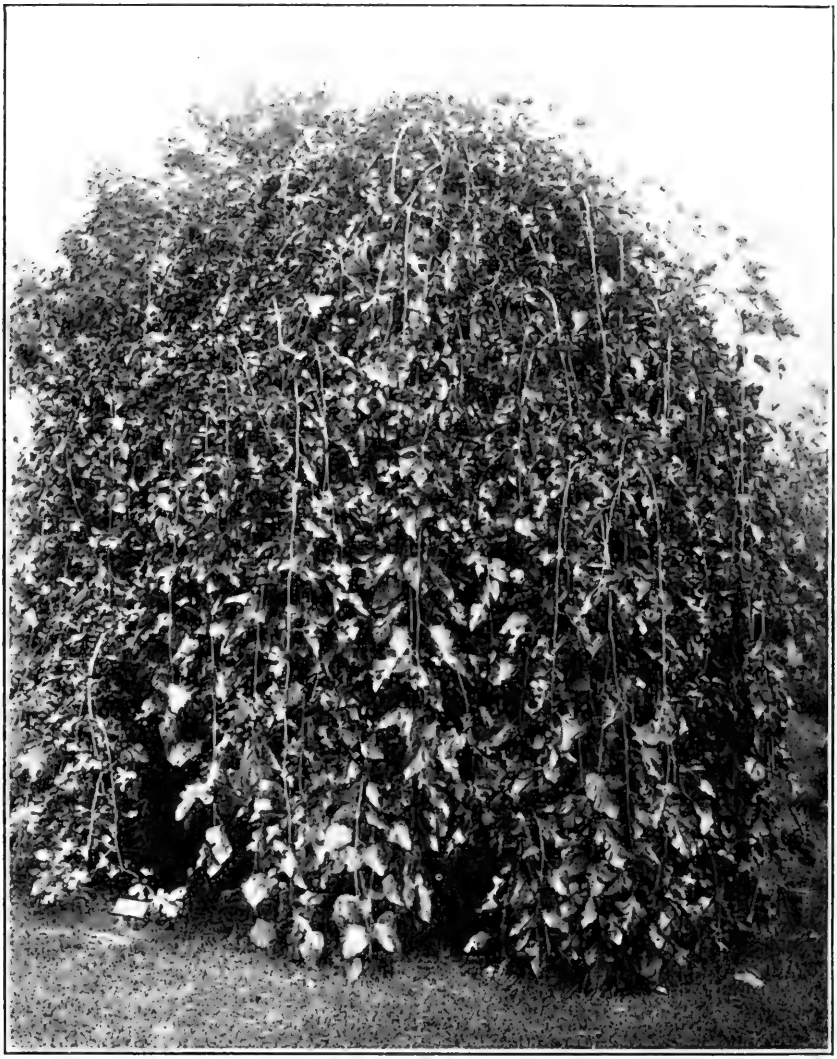

Fig. 98. Teas' Weeping Mulberry (See page 159)

MYRICA. Wax Myrtle.

SEEDS. Seeds grow slowly. Sow in Spring.

SUCKERS. Especially *M. gale.*

NANDINA.

SEEDS. Obtained from California.

NECTARINE.

Same stock and method of treatment as for Peach, page 114.

NERIUM. Oleander.
CUTTINGS. Hard wood. Soft wood rooted in water easily. Take cuttings after flowering.
LAYERS. Chinese layers are successful.

NEVIUSIA. Snow Wreath.
This is a *Spiræa* without petals.
CUTTINGS. Green wood cuttings under glass.

NYSSA. Sour Gum. Tupelo.
SEEDS. Autumn collected seed freed of pulp and sown immediately; or store in damp sand during Winter.
GRAFTING. Weeping form grafted on type.
The trees are difficult to transplant and should be raised in pots.

OLEA. Olive. (See Osmanthus.)
CUTTINGS. From Fuller we read:

> In warm climates, where the Olive flourishes, the cuttings are planted in the open ground in the Autumn. In European countries large truncheons or cuttings are used instead of those of moderate size or lengths, but for no better reason than because it is the general practice or custom. Chips cut from an old Olive tree stem will readily produce sprouts if planted in a warm soil and kept moist; in fact, the entire surface of this tree will produce adventitious buds very freely, if placed in a position to receive heat and moisture.

ORANGE.
BUDDING. Indoors. They may be budded at any season when they are making active growth. Use round bud wood rather than flat, and propagate from bearing trees.

OSMANTHUS. Sweet Olive. Also called *Olea fragrans.*
SEEDS. Not easily obtainable.
CUTTINGS. Half-ripe wood late in Summer.
BUDDING. May be budded on Privet.

OSTRYA. Ironwood. Hop Hornbeam.
SEEDS. Sow as soon as ripe or stratify.
GRAFTING. May graft the varieties on common species.

OXYDENDRON. Sorrel Tree.
SEEDS. Sow in frames. Keep shaded and moist until they germinate. The plants are apt to be rather difficult to grow the first year.
LAYERS. Very slow to grow.

PÆONIA. Shrubby sorts, *P. Moutan.*
CUTTINGS. Taken with heel in Summer and placed in cool greenhouse.
LAYERING. Layers require about two years to root.
GRAFTING. Root grafting. Use the large fleshy roots for stocks and graft by the side graft. Graft in early Autumn and store for Winter. Both root and stock grafting may be used. They may also be grafted on the herbaceous sorts; use a splice or cleft graft.

PALIURUS. Christ's Thorn.
SEEDS. Stratify or sow as soon as ripe.
ROOT CUTTINGS. Store in moist sand during Winter.

PARROTIA.
CUTTINGS. Green wood under glass.

PASSIFLORA. Passion Flower.

CUTTINGS. Take growths from January to April; place in warm propagating bench, shaded and moist. Pot in loam, peat and sand.

LAYERS. Compound layers used.

PAULOWNIA.

SEEDS. Sow in Spring. Seedlings damp-off easily.

CUTTINGS. Green wood under glass.

ROOT CUTTINGS. Cut into three-inch lengths, plant outdoors or in greenhouse in the Spring.

LEAF CUTTINGS. Petioles cut short, leaves placed in sand covered with a bell jar.

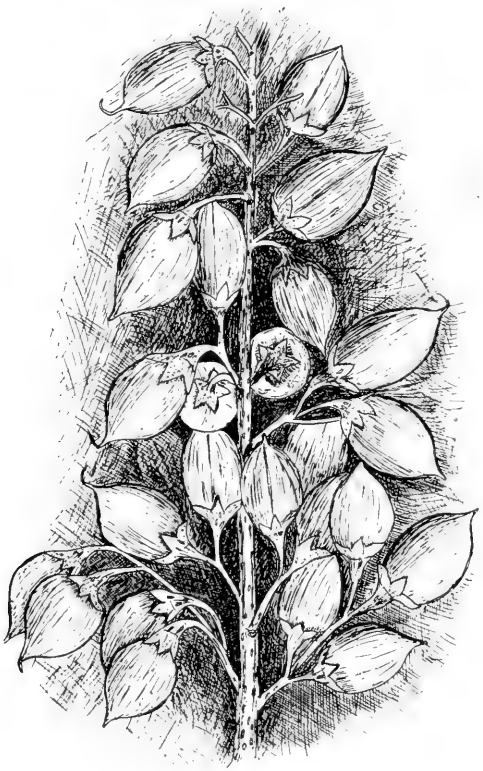

Fig. 99. Seed vessels of *Paulownia tomentosa*

PAVIA. Buckeye. Dwarf Horse Chestnut.

SEEDS. Very easily grown from seed if sown soon after ripening.

PHELLODENDRON. Cork Tree.

SEEDS. Freely produced, and germinate readily when sown in Autumn.

GRAFTING. The Chinese Cork Tree (*P. amurense*) is grafted on *P. japonicum* since *P. amurense* is much superior in corkiness of bark.

PHILADELPHUS. Erroneously called Syringa. Mock Orange.
SEEDS. They often self sow. May be sown in Spring.
CUTTINGS. Hard wood made in Autumn, set in Spring.

PHORADENDRON. Mistletoe.
SEEDS. Joseph Meehan writes:

> It takes patience to increase the Mistletoe, but those who wish to try it may proceed thus: Take the berries and press them to a branch, the under side of the branch preferred, until they burst. They are so viscid that they will adhere to the bark, but that birds shall not disturb them, tie them fast with a piece of muslin. Do not be impatient to see the plants, for nothing will be seen for a year, and then only a swelling of the bark. But this swelling indicates that all is well, and the next season some growth may be expected. There is a difference of opinion as to the cutting of a notch in the bark to hold the berries. Late authorities say it is better not to do so. The natural way finds no slit bark, and with the bandage of muslin to hold the seed in place, there can be no necessity for notching the branch.
>
> The Mistletoe is a parasite, living off the juices of the trees it attaches itself to. There are two sorts that come to our markets; the old Mistletoe of Europe and that of our own country. The European one is *Viscum album*, ours, *Phoradendron flavescens*, both being of the same general character.
>
> In Europe its host trees are generally the Apple, Poplar, Hawthorn, Linden, Maple and Mountain Ash; rarely the Oak. In our country it is found on Oaks, Elms, Apples, Locust, Hickories, etc.; and it is always interesting wherever found growing.

PHOTINIA.
CUTTINGS. Ripened wood.
LAYERS. Roots readily from layers covered in Spring.
GRAFTING. Worked on Hawthorn, Apple roots or Quince stock.

PHYSIANTHUS.
CUTTINGS. Made in late Winter.

PHYSOCARPUS. Ninebark.
CUTTINGS. Hard wood or green wood.

PICEA. Spruce.
SEEDS. Keep dry and cool through the Winter. Sow in Spring.
CUTTINGS. The dwarf forms are especially easily grown from cuttings.
GRAFTING. Seedlings of the Norway Spruce, *P. excelsa*, make the best stocks because of their adaptability to soils, hardiness and good growth. Veneer grafting in Spring or August in the greenhouse.

PICKNEYA.
SEEDS. Grow readily, but the plants are not hardy.

PIERIS.
SEEDS. (See Andromeda.)
CUTTINGS. Nearly ripe wood. August, under glass.

PINUS. Pine.
SEEDS. Sow in beds, about three feet wide so that they may be weeded. After growing one year they are transplanted just as buds are swelling. Shade the young plants early in growth, but gradually allow the beds to have the full sunlight, else damping-off will occur. Keep them sparsely watered.

PINUS—Continued

GRAFTING. Veneer grafting is used to work various rarer varieties on the type. The plants may be potted and grafted indoors. In grafting out of doors the terminal bud graft is best used. (See p. 97 and fig. 67.) Fuller writes that the two and three leaved sorts, *P. sylvestris*, *P. Mughus compacta*, *P. pyrenaica* and *P. densiflora*, should be used in grafting varieties of the same number of needles. The Austrian Pine (*P. nigra* var. *austriaca*) may be used as a stock for the Western Pines (*P. ponderosa*, *P. Coulteri*, and *P. Sabiniana*), all of which have coarse grained wood. The rapid, free growing, three-needle sorts are preferred for the others; for example, the Red Pine (*P. resinosa*) is the best stock for allied species and varieties. The White Pine (*P. Strobus*) a five-leaf sort, is best used for the other five-leaved species, *P. flexilis*, *P. excelsa*, *P. Cembra*, and *P. Mandschurica*.

PLATANUS. Button-wood. Plane Tree. Sycamore.

SEEDS. Propagate the Oriental Plane only.

CUTTINGS. Hard wood taken in Autumn.

POMEGRANATE. See Punica.

POPULUS. Poplar.

SEEDS. Sow as soon as ripe. Plant shallow, water if soil becomes dry.

CUTTINGS. Hard wood root easily, one or two-year-old wood used.

BUDDING AND GRAFTING. Varieties are worked on rapid growing species.

POTENTILLA. Shrubby Cinquefoil. Five Finger.

CUTTINGS. Mature wood taken in Autumn.

PRUNUS. Propagation of ornamental species only.

SEEDS. See under Peach and Plum, pp. 114 and 117.

CUTTINGS. Mature wood used for some ornamentals and European Plum.

ROOT CUTTINGS. Plants from cuttings are apt to sucker easily.

BUDDING. Shield bud on seedling stock.

Prunus. Amygdalus. Almond (see fig. 100).

BUDDING AND GRAFTING. The ornamental horticultural varieties are budded on the Peach or the Plum. The Plum is usually preferred because it is not attacked by borers and succeeds well in a clay soil. If the Plum is not a strong grower, however, there is danger of the roots being inadequate for the best development of the Almond. *P. Amygdalus* var. *nana* is best budded at a height of three feet. (See also Plums, p. 117, and Peaches, p. 114.)

ROOT CUTTINGS. *P. A. nana* is successfully propagated by cuttings of large roots made in Autumn stored in damp moss until Spring.

Prunus. Cerasus. Ornamental Cherries.

BUDDING. Use the Mazzard stock, usually, especially for budding *P. Cerasus Sieboldi rosea plena* (Jap. Weeping Cherry) and *sinensis plena* (Chinese Double Flowering Cherry). For weeping sorts, two buds; for others one is sufficient to make a head. Careful attention to heading back the growth of bud will help to make greater symmetry. Spring grafting is not so successful. (Refer also to Cherries, p. 113.)

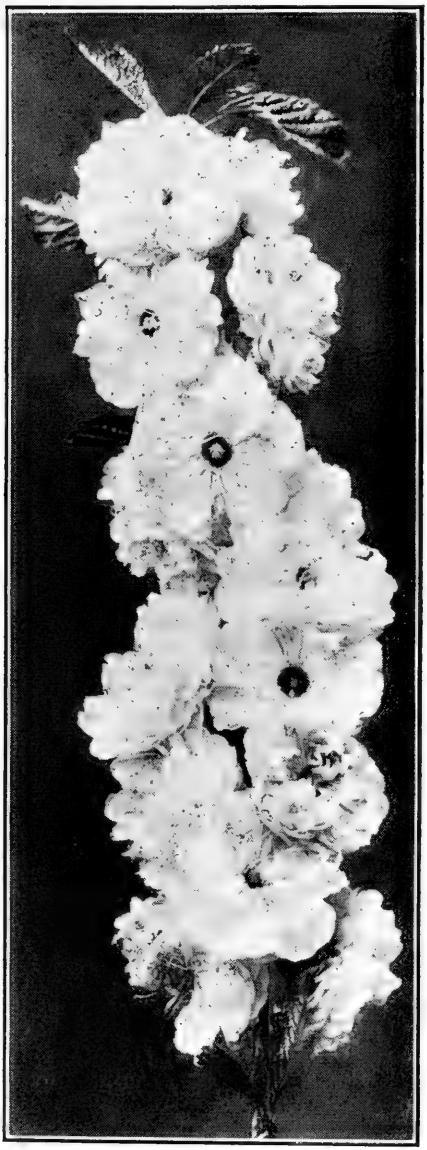

Fig. 100.—Double flowering Almond. The cut shows a characteristic branch of *Prunus triloba* var. *plena*. This variety when grown as a standard and worked upon the Plum is often short-lived. It is best propagated by layering or root grafting. It makes an excellent subject for forcing, but is also used for gardens (See page 164)

PSEUDOLARIX. Golden Larch.

SEEDS. Seed obtained from Japan.

GRAFTING. Graft on Larch outdoors, or better still, in the greenhouse. For indoor grafting pot plants in Spring so that they are established by Autumn and can be stored until late Winter, then brought into heat to start growth. When the buds swell, it is time to graft. Cut cions in Winter and hold dormant in cool conditions.

PSEUDOTSUGA. Douglas Spruce.

SEEDS. Generally propagated by seeds. Eastern growers should demand Eastern or Colorado seed, as the California seed is tender.

GRAFTING. The weeping form is grafted on the common stock.

INARCHING. Used on weeping form.

PTELEA. Hop Tree.

SEEDS. Sown in Autumn or stratify in sand.

LAYERS. Varieties of Hop Tree are easily layered.

GRAFTING AND BUDDING. Graft under glass or bud out of doors on seedlings.

PTEROCARYA. Winged Walnut.

SEEDS. Sown in Autumn or stratified.

PTEROSTYRAX. Wistaria Tree.

SEEDS. Ripen in Autumn; sow immediately or in Spring.

CUTTINGS. Green wood under glass, in Summer.

GRAFTING. May be grafted on seedling *Halesia.*

PUNICA. Pomegranate.

CUTTINGS. Hard wood.

GRAFTING. May be grafted on wild type.

PYRUS. Apples, Pears, Crabs.

Ornamental species only; commercial fruit discussed on pp. 111-118.

SEEDS. The botanical species *P. coronaria, ioensis*, etc. come true.

BUDDING. Budding of *Pyrus coronaria* and Bechtels' Double Flowering Crab. Mid-July or later on common Apple stock. Should be budded near end of growing season. When budded earlier the union does not take place so well.

Pyrus Malus. Apple.

GRAFTING. The commonest stock for the Apple is the wild apple of Europe, but for the Siberian Crab varieties *P. prunifolia, P. angustifolia* or *P. coronaria* are used. For dwarfing the Apple, Paradise and Doucin stocks are used, both of which are small types of *P. Malus.* (See p. 113.)

QUERCUS. Oak.

SEEDS. Joseph Meehan writes:

> Many Oaks are of the class which commence to grow as soon as the acorns fall, and these sorts require sowing within a week or so after they are ripe. In this class are the White Oak, Chestnut Oak, Rock Chestnut, Chinquapin, and maybe others. If not sown within a week or two after falling they will not grow, unless in the meantime they have been in a damp place. The trouble is, that they either lose vitality by drying up or the radicle pushes out so far, because of damp surroundings, that they cannot be handled satisfactorily afterward. Beds should be prepared for them at once. Those of about three feet width are best, as affording opportunity to weed the seedlings without treading on the beds. Such beds made now, and spread with acorns, the latter covered with two inches of soil, should give a treat in the way of seedlings next Spring. Before Winter sets in a covering of forest leaves should be placed over the beds, to keep the acorns free from the freezings and thawings they would otherwise be subjected to.
>
> The first of these early sprouting acorns to ripen is the little Chinquapin Oak, *Quercus prinoides.* Next come the two Chestnut Oaks, *Quercus prinus* and *Q. castanea,* followed by the White Oak, *Q. alba.*

QUERCUS—Continued

At this writing, September 28, the *prinoides* and *prinus* are ripe, and the *alba* just about ready to fall from the trees.

There is a great call in foreign countries for our White Oak; but between the difficulty of shipping acorns of it in good condition and the embargo placed on plants from this country, the demand cannot be met at all. This, the White Oak, is the most valuable of all our Oaks for timber purposes, although others are valuable and all serve a good purpose for fuel.

CUTTINGS. The evergreen species may be increased by this method.

GRAFTING. *Q. Robur* var. *fastigiata* is grafted on *Q. Robur*, the English Oak, in Winter; on potted plants or on outdoor plants in Spring. In grafting the Oaks choose allied species for stocks.

INARCHING. Varieties inarched on type.

QUINCE. (See Cydonia.)

RAPHIOLEPIS. Indian Hawthorn.

CUTTINGS. Cuttings of ripe wood under glass late in Summer.

GRAFTING. Used on *Cratægus*.

RASPBERRY. (See Rubus.)

RETINISPORA. (Often spelled Retinospora.)

CUTTINGS. A rapid method, taken in early Winter, placed in greenhouse with a little bottom heat. (See fig. 22.)

Juvenile forms are said to be produced of these Retinisporas by propagating from seedlings and continuing to propagate from the slower growing branches.

RHAMNUS. Common Buckthorn.

SEEDS. Stratified in Autumn.

CUTTINGS. Hard wood.

GRAFTING. Some of rarer sorts are grafted on *R. cathartica*.

RHODODENDRON.

SEEDS. The seed is very fine and frequently when falling beneath the old plants will grow nicely. In the greenhouse they may be sown from January to March in a soil consisting of sand, peat and a little loam. Do not cover, except by a layer of sphagnum and place a pane of glass over the pots. Immediately upon germination the glass must be removed.

CUTTINGS. Half-ripe wood is used and placed in sand benches under glass. When they have callused they may be given a little bottom heat. Heel cuttings will be the best sort to use.

LAYERS. Chinese layering is successful though it is not used as widely as simple layers. Commonly the low branched plants are selected. The branches of last season's growth are chosen, an incision is made in the part below the soil, and the growth is pegged down. Although the shoot will root soon it should be allowed to remain for several seasons. To layer the higher branched plants the soil may be mounded up rather high. Such soil should be mostly leaf mold (see fig. 45).

GRAFTING. *R. catawbiense* and *R. maximum* are the best stocks; the Belgian nurseries have been using mostly *R. ponticum*. Veneer grafting is mostly practiced, although cleft and saddle grafting may be used. Let the grafts be made low on the plants. Do not

head the stock plant back until the second year. Grafting is done late in Summer or early in Autumn; no wax is used, but the union should be tied with sphagnum; the plants are kept in humid condition and shaded.

RHODOTYPOS. White Kerria.

SEEDS. A very free seeder. Even self-sows. Sow when ripened.
CUTTINGS. Either hard or soft wood.

RHUS. Sumac. Smoke Tree.

SEEDS. Sown in Autumn or stratify.
CUTTINGS. Hard wood.
ROOT CUTTINGS. Especially of *R. typhina* var. *laciniata*, the Fern-leaved Sumac. Cut into three-inch lengths, bury in sand until Spring, then set out in rows.
LAYERS. Many species may be layered.

RIBES. Currant. Gooseberry.

SEEDS. Germinate readily.
CUTTINGS. Hard wood. Make in Autumn. Best method for Currant.
LAYERS. Mound layers, especially of Gooseberry (see fig. 49.) The varieties may also be tip layered.
BUDDING AND GRAFTING. Used with horticultural varieties.

When tree or standard plants are wanted, strong stocks, such as *R. aureum*, are used for the Currant, and perhaps *R. rotundifolium*, the Round-leaved Gooseberry, would be useful for the Gooseberry varieties. It is a strong, tall grower.

ROBINIA. Locust.

SEEDS. Soak in hot water or scald before sowing.
CUTTINGS. Soft wood of *R. hispida* and other species in Summer.
ROOT CUTTINGS. *R. viscosa* and *R. hispida* especially are propagated by this method.

ROSE. (See page 129.)

RUBUS. Raspberries.

SEEDS. Grow easily.
DIVISION. Divide clumps for varieties.
ROOT CUTTINGS. Take cuttings three inches long. Good root system by this method.
LAYERS. The red Raspberries are especially easy to tip layer. (See fig. 46.) Pinch out the terminal buds of branches layered and several plants may be obtained instead of one. (See also fig. 48.)

SALISBURIA. (See Ginkgo.)

SALIX. Willow.

SEEDS. Not used.
CUTTINGS. Very easily rooted from hard wood cuttings. Propagate *S. viminalis*, *S. triandra*, *S. cordata*, and *S. Forbyana* for tying nursery stock, some others break instead of bending.
GRAFTING. The Kilmarnock Pussy Willow, a variety of *S. caprea*, is frequently grafted on *S. caprea* to give stronger shoots.

SAMBUCUS. Elderberry.
SEEDS. Grow readily.
CUTTINGS. Best propagate the Golden Elder by hard wood cuttings, although it comes rather true from seeds. Other species may be rooted from cuttings also.
ROOT CUTTINGS. Many of the sorts may be propagated by this method.
SUCKER. Readily propagated by this method.

SASSAFRAS.
SEEDS. The best method is by seed. Ripen in Autumn; sow immediately.
SUCKERS. Start when roots are injured.

SCIADOPITYS. Umbrella Pine.
SEEDS. Very slow growth from seeds.
CUTTINGS. More rapid than seeds but plants are apt to be as symmetrical.

SEQUOIA. (Giant Tree of California.)
CUTTINGS. (See Thuya, page 171.)

SHEPHERDIA. Buffalo Berry.
SEEDS. Grow readily. As the sexes are distinct, seedling plants must be grown until the sex can be determined. Seedlings are rather sensitive to strong sun.

SKIMMIA.
SEEDS. By seeds both sexed plants are obtained, so that one waits for flowering to determine the berry producers.
CUTTINGS. Produce the plant exactly. Use half-ripe wood under glass.

SOPHORA. Japan Pagoda Tree.
SEEDS. Germinate readily when fresh.
CUTTINGS. Hard wood or green wood; the latter are best grown from indoor plants.
GRAFTING. Varieties are grafted on seedlings of the type.

SORBUS. Mountain Ash.
SEEDS. Crush fruits and wash out the seeds; sow immediately or store in damp sand until Spring.
GRAFTING AND BUDDING. Varieties are grafted or budded on *S. aucuparia*, *S. americana*, or *Cratægus*.

SPIRÆA. Bridal Wreath and Meadow Sweet.
SEEDS. Many sorts grow nicely from seed.
CUTTINGS. Soft wood cuttings taken in late Spring of some sorts, especially *S. bumalda* var. Anthony Waterer. Hard wood cuttings are much used.

STAPHYLEA. Bladder Nut.
CUTTINGS. Young growth placed under glass.
ROOT CUTTINGS. Use the larger roots.

STEPHANANDRA.
CUTTINGS. Green wood used mostly.
ROOT CUTTINGS. *S. incisa* (*flexuosa*) especially. Make cuttings in Spring. Give bottom heat.

STERCULIA. Japan Varnish Tree. Chinese Parasol Tree.
SEEDS. Easily grown if they can be obtained.
CUTTINGS. Soft wood rooted in Summer.

STEWARTIA.
SEEDS. Seed produced abundantly.
CUTTINGS. Difficult to root. Use half-ripened ones.
LAYERS. Best.

STIGMAPHYLLON.
CUTTINGS. Soft wood heel cuttings rooted with bottom heat.

STUARTIA. (See Stewartia.)

STYRAX. Storax.
SEEDS. Produced in profusion. Seed sown as soon as ripe.
CUTTINGS. Do not root well.
LAYERS. Useful.
GRAFTING. Sometimes grafted on *Halesia*.

SYMPHORICARPOS. Indian Currant. Snowberry.
CUTTINGS. Hard wood and green wood.
UNDERGROUND STEMS. Spread quickly.
SUCKERS. Produced abundantly.

SYMPLOCOS. Sweet Leaf. Horse-Sugar.
SEEDS. Rarely germinate until second year after planting.
CUTTINGS. Under glass. Green wood.

SYRINGA. Lilac.
SEEDS. Raise seedlings for budding. Easily grown.
CUTTINGS. Green wood in Spring. Place in greenhouse. Good plants are produced by Autumn. Hard wood cuttings are very easily rooted.
BUDDING. Budded on *Ligustrum* (California Privet) the plant flowers earlier than when propagated from cuttings. Bud in September, for the sap in Privet is running very late. Such budding also results in dwarfing.
LAYERS. Also useful.

TAMARINDUS. Tamarind.
SEEDS. Readily grown from seed sown in hotbed or in greenhouse, with bottom heat.
CUTTINGS. Under glass.

TAMARIX. Tamarisk.
SEEDS. Fine, cover lightly.
CUTTINGS. Hard wood, plant in open soil in Autumn or Spring. Soft wood in Summer.

TAXODIUM. Bald Cypress.
SEEDS. Sow in Spring. Germinate quickly.
CUTTINGS. Use young shoots in Summer. Sand and water method should be successful.
GRAFTING. The weeping form, the variegated, and the Oriental species, are grafted on common stock. Grafting in Spring outdoors, near the soil. Shade the cions with paper or flower pot. Or in August the plants may be veneer grafted in greenhouse.

TAXUS. Yew.

SEEDS. Wash seeds free from pulp and keep in damp sand, until Spring.

CUTTINGS. This is method usually employed. Use green cuttings under glass or mature shoots in Autumn placed in frames.

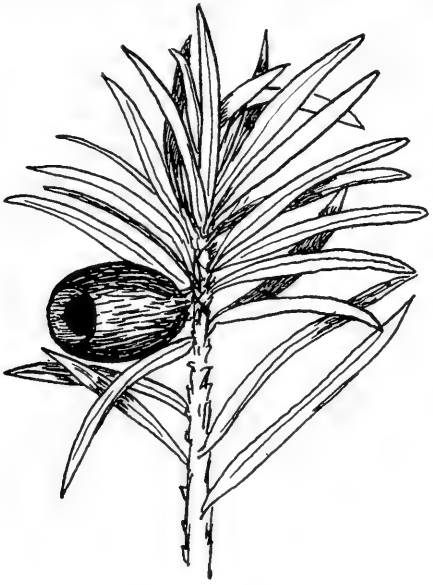

Fig. 101. A Yewberry

TECOMA. (See Campsis.)

THEA. Tea.

THUYA. (Also spelled Thuja). Arborvitæ. White Cedar.

SEEDS. Many forms are good from seed. Sown in Spring. Water frequently.

CUTTINGS. For golden form use cuttings made in January. The Siberian Arborvitæ must be propagated by this method' as it does not come true from seed.

GRAFTING. Pot common Arborvitæ in Autumn; keep in cool house until several weeks before grafting. After grafting, keep air of house moist and shade must be given for several weeks. *T. occidentalis* var. *aurea* or George Peabody is grafted on type.

THUJOPSIS.

CUTTINGS. Plants are usually bushy and globular.

GRAFTING. As in Thuya. Plants are not so long lived.

TILIA. Basswood. Linden, Whitewood.

SEEDS. Sown as soon as ripe or stratified.

LAYERS. Young tree cut down, the resulting growths are layered.

GRAFTED AND BUDDED. Rarer sorts grafted in the Spring, or later; in August, they may be budded on type stock.

Mr. Rehder notes that grafted or layered trees remain one-sided for years because the branches have a tendency to make a horizontal instead of an upright growth.

TORREYA. Stinking Yew.
(See Taxus for propagation.)

TSUGA. Hemlock.
CUTTINGS. Partially ripened wood used.
GRAFTING. Use *T. canadensis* as a stock.

ULEX. Furze. Gorse.
SEEDS. Sown in Spring when frost is past.
CUTTINGS. Green or hard wood.
GRAFTING. Grafted in Spring on *U. europæus.*

ULMUS. Elm. (See fig. 102.)
SEEDS. Sow when ripe. Most Elms ripen seeds in May or June. but *U. parvifolia* ripens its seeds in October and November.
CUTTINGS. Hard wood.
GRAFTING. It is best to graft or bud upon allied species. Use *U. americana, U. campestris, U. foliacea* and *U. glabra* as stocks. The whip and splice graft is mostly used. To obtain the beautiful specimens of the Camperdown or Umbrella Elm, a form of *U. glabra* (*montana*), this sort is grafted on tall stems; at a height of 7 to 8 feet is best, otherwise the mature tree appears dwarfed. Watch the head for the first few seasons and prune so that it will be well balanced.

UNGNADIA. Mexican Buckeye. Spanish Buckeye
SEEDS. Sow as soon as ripe. Seeds retain their vitality only a short time.

VACCINIUM. Blueberry. Huckleberry.
The notes here offered is a summary of the extensive researches of Dr. Frederick V. Coville.*
STUMPING. The easiest way to propagate the swamp Blueberry is by a special process of layering named "stumping." The directions are as follows:

1. In late Fall, Winter, or Spring, preferably in early Spring before the buds have begun to push, cut off at the surface of the ground either the whole of the plant or as many of the stems as it is desired to devote to this method of propagation. The stems that are cut off are discarded, or they may be used for cuttings, as described under "Tubering" or "Winter cuttings."

2. Cover the stumps to the depth of 2 to 3 inches with a mixture of clean sand and sifted peat, 2 to 4 parts of sand to 1 of peat, by bulk. A rough box or frame may be built on the ground to keep the sand bed in place.

3. Care must be taken that the sand bed be not allowed to become dry except at the surface during the Summer.

4. The new growth from the stumps, which without the sand would consist of stems merely, is transformed in working its way through the sand bed into scaly, erect, or nearly erect rootstocks which, on reaching the surface of the sand, continue their development into leafy shoots. (See fig. 103.) Although roots are formed only sparingly on the covered bases of stems, they develop abundantly during Spring and

*Coville, F. V. Directions for Blueberry Culture. Professional Paper Bull. 334, United States Dept. of Agriculture.

Fig. 102. Camperdown Elm. The Camperdown Elm (*Ulmus glabra* var. *Camperdownii*) is either budded or grafted at a height of seven to eight feet upon *U. americana*, *U. campestris*, *U. glabra* or *U. foliacea*

VACCINIUM—Continued

early Summer on these artificially produced rootstocks, and by the end of Autumn all the shoots should be well rooted at the base. They should remain in place in the sand bed till late Winter or early Spring, undisturbed and exposed to outdoor freezing temperatures; but the sand should be mulched with leaves, preferably those of Red Oaks.

5. Early in the following Spring, before the buds have begun to push, open the bed and sever each rooted shoot carefully from the stump. Discard the upper portion of the shoot, making the cut at such a point as to leave on the basal portion about three buds above the former level of the sand bed. If the cut at the basal end of the rooted shoot is not smooth or the wood is cracked, recut the surface with a sharp, thin-

VACCINIUM—Continued

bladed knife. The discarded upper portion of the shoot may be used for Winter cuttings, as described on pages 8 to 11.

6. Set the rooted shoots in a coldframe or a cool greenhouse in clean earthenware pots of suitable size, ordinarily 3-inch pots, in a soil mixture consisting of two parts, by bulk, of rotted upland peat and one part of sand.

7. Cover the frame with muslin or other white shade suspended above the glass, giving the plants plenty of light but no direct sunlight, and

Fig. 103. New shoots on a stumped Blueberry. The three shoots shown grew after the plant had been cut to the stump. Their white color at the base indicates the depth of the propagating bed through which they forced their way and from which the plant was taken to be photographed. Roots had already begun to develop. Used through the courtesy of Dr. F. V. Coville of the United States Department of Agriculture

VACCINIUM—Continued

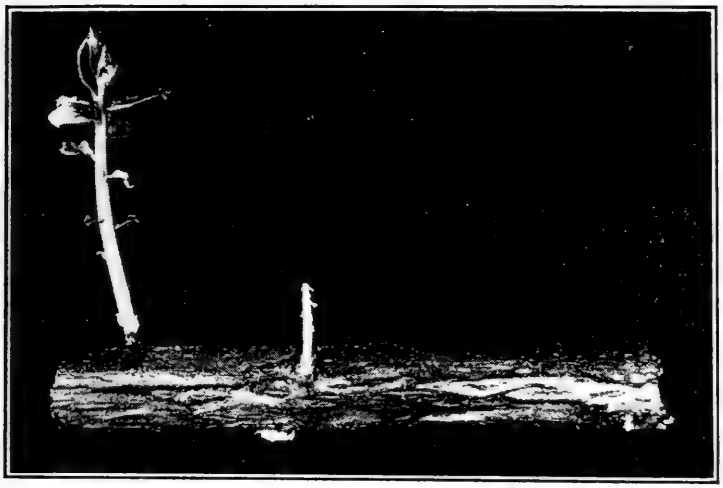

Fig. 104. Tubered Blueberry Cutting with young sprouts developing. Used through the courtesy of Dr. F. V. Coville of the United States Department of Agriculture

for the first two or three months keep the temperature at not to exceed 65 degrees F. if practicable. When subjected to high temperatures the newly cut shoots are liable to die and rot from the base upward. The outer surface of the pots should never be allowed to become dry. The desired condition may be assured by bedding, or "plunging," the pots in moist sand up to the rim.

8. Watering should be as infrequent as practicable, only sufficient to keep the soil moist but well aerated.

9. The frame should receive ventilation, but not enough to cause the new twigs to drop. These are most susceptible to over-ventilation and to over-heating when they have nearly completed their growth.

10. After the new twigs have stopped growing and their wood becomes hard, new root growth takes place. Then secondary twig growth follows, either from the apex of the new twigs or from another bud lower down on the old wood of the original rooted shoot. Until this secondary twig growth takes place the life of the plant is not assured.

11. Those plants that make sufficient growth to require repotting during the first Summer should be set in clean pots of two inches larger diameter in a standard Blueberry-soil mixture.

Soil Mixture for Blueberries. Use "one part of clean or washed sand, nine parts of rotted upland peat, either chopped or rubbed through a sieve, and three parts of clean, broken crocks, or flower pots. No loam and especially no lime should be used. Manure is not necessary. The peat most successfully used for potting Blueberry plants is an upland peat procured in Kalmia, or Laurel, thickets. Oak leaves raked, stacked, and rotted for about eighteen months without lime or manure are also good."

Tubering. Cuttings by ordinary methods have been seldom rooted. Tubering is a method by which new shoots are forced in such a way that their basal portions are much like scaly root stocks stem.

VACCINIUM—Continued

Cuttings are taken from outdoor plants between midwinter and early Spring, before the buds have begun to make their Spring growth.

The cuttings are placed horizontally in a shallow box or other cutting bed of pure clean sand and covered to the depth of about half an inch.

Fig. 105. Tubered Blueberry cutting with sprouts rooting at the base. The sprout at the left in figure 104 had emerged from the sand and begun to develop green leaves above the surface. The sprout near the center of figure 104 is younger, the whole of it still in the rootstock stage. The two sprouts in figure 105 are developing roots on their lower parts, above the dying wood of the old cutting and beneath the surface of the cutting bed. Used through the courtesy of Dr. F. V. Coville of the United States Department of Agriculture

Within a few weeks new growth will begin to appear above the sand. (See fig. 104.) When the shoots have reached a length proportionate to their vigor, commonly one to three inches, their further growth is self-terminated by the death of the tip. After the leaves have reached their full size and acquired the dark-green color of maturity the time has come for the development of roots.

When a shoot is well rooted, with roots one to two inches in length, it is ready to be potted. If the shoot has not already disconnected itself from the dead cutting, it should be carefully severed with a sharp knife. In the process of tubering, the behavior of the cuttings is essentially identical with that of real tubers, like those of the potato. The original cutting dies, but the sprouts that arose from it root at the base and form independent plants.

VIBURNUM. Includes Snowball. High Bush Cranberry.

SEEDS. Wash free from pulp; sown in Autumn or mix with dry sand; keep in a cool place and sow in Spring.

CUTTINGS. Soft wood in Summer root readily. Hard wood cuttings are easily rooted.

LAYERS. Early Summer.

VITEX. Chaste Tree. Hemp Bush.

SEEDS. Freely produced.

CUTTINGS. Soft or hard wood; the hard wood cuttings may set in a protected place in the Autumn.

VITIS. Grape.

SEEDS. Rarely come true to type but for raising seedlings of new varieties, the seeds are removed from the pulp and stored in moist sand until Spring when they may be sown in flats or in the open soil. Except for the tender types, the seeds may benefit by being frozen during the Winter.

CUTTINGS. Single eye cuttings may be used when wood is scarce, or valuable. A small piece of wood should be left on each side of the eye so that the cutting is about one and a half inches long. These cuttings are made in February from wood stored through the Winter in a cool cellar. They are placed in propagating bench with slight bottom heat. The best wood for use in making cuttings is that which is rather short jointed. The most common type of cutting, however, is five to seven inches long, made in the Autumn and stored in a sandy soil out of doors or in a cool cellar. They are placed up-side down to hasten the callus. In the Spring the cuttings are set in the nursery row.

GRAFTING. Grapes are grafted in earliest Spring or Autumn. The soil around the plants is removed and the cion is inserted beneath the soil. Merely tie with raffia. If grafting has been neglected until the sap flows, the stocks may be grafted after the buds burst. This will eliminate the excess bleeding. The European Grape is usually grafted on American stocks because of its susceptibility to root louse injury. After grafting very early in Spring or in Autumn Mr. Fuller* suggests protecting the cion from frost by covering with an inverted flower pot and straw.

LAYERS. The simplest method of propagating is by continuous layers. Bend down a cane and cover a few inches deep with soil. Nearly all the nodes will root. Practiced in Autumn or Spring.

WISTARIA. (Also spelled Wisteria.)

SEEDS. Grow readily but do not reproduce varieties.

CUTTINGS. Ripened wood rooted under glass.

ROOT CUTTINGS. One inch or more long.

LAYERS. Easily rooted.

GRAFTING. Horticultural varieties grafted on *W. frutescens.*

XANTHOCERAS.

SEEDS. Few produced but usually all grow if sown in greenhouse.

ROOT CUTTINGS. Roots cut into three inch pieces in Autumn and stored in sand until February, then placed where they may start into growth with a light bottom heat.

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* Fuller. A. S.—Grape Culturist.

XANTHORRHIZA. Shrubby Yellow-Root. (Also spelled Zanthorrhiza.)

SEEDS. Sown in Autumn or early Spring. Seedlings are weak when young.

ROOT DIVISIONS. In Autumn or Early Spring.

XANTHOXYLUM. Prickly Ash. Toothache Tree. (Also spelled Zanthoxylum.)

ROOT CUTTINGS. Easiest method.

YUCCA.

ROOT CUTTINGS. Cut up thick roots into two inch pieces, place one to two inches deep.

CHAPTER IX

BOOK LIST

The following books will prove of use to supplement the brief discussion of the propagation of plants found in the present volume.

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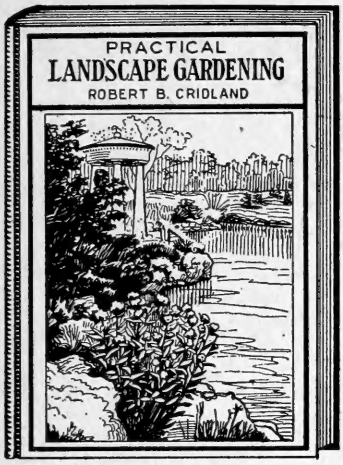
White, Edward A. 1915. PRINCIPLES OF FLORICULTURE.



The first edition was an unusually large one for the subject, but so overwhelming was its success that a second edition was called for within 18 months

SECOND EDITION

Practical Landscape Gardening

By ROBERT B. CRIDLAND
Landscape architect of more than twenty years' experience and national reputation.

First practical book ever written for people of moderate income. Through its conciseness and lucidity of expression, rarely met with in technical or semi-technical guides, the reader is encouraged at the ease with which he can acquire all needful instruction on every detail connected with landscape gardening and to the embellishment of the home grounds. Owners of suburban homes, flower and garden lovers, florists and nurserymen, park commissioners and civic officials, and students of landscape architecture will find help and inspiration within its covers such as no other book has ever afforded.

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1—**The Importance of All Careful Planning.**—Six halftone illustrations showing completed results.

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3—**Arrangements of Walks, Drives and Entrances.**—Twelve illustrations of approaches or entrances, ten driveways and three walks.

4—**Construction of Walks and Drives.**—Twenty-five teaching illustrations of cement, macadam, flagstone, slate and other walks, cement approaches and gutters, bituminous and cement driveways, etc.

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8—**Architectural Features.**—Eight halftones showing bird bath, fountains and pools, garden seats, pergolas and other features, together with plans for the construction of garden houses, entrances, pergolas, etc.

9—**Hardy Borders and Rose Gardens.**—Fifteen attractive halftones and plans of borders and rose gardens.

10—**Wild Gardens and Rock Gardens.**—Seven illustrations, together with plan showing how to build a dry retaining wall for planting.

11—**Planting Plans.**—Twenty-four plans showing a variety of artistic arrangements possible on small properties. These plans are keyed and accompanied by planting lists which have been tested in actual practice.

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