



Class SB355

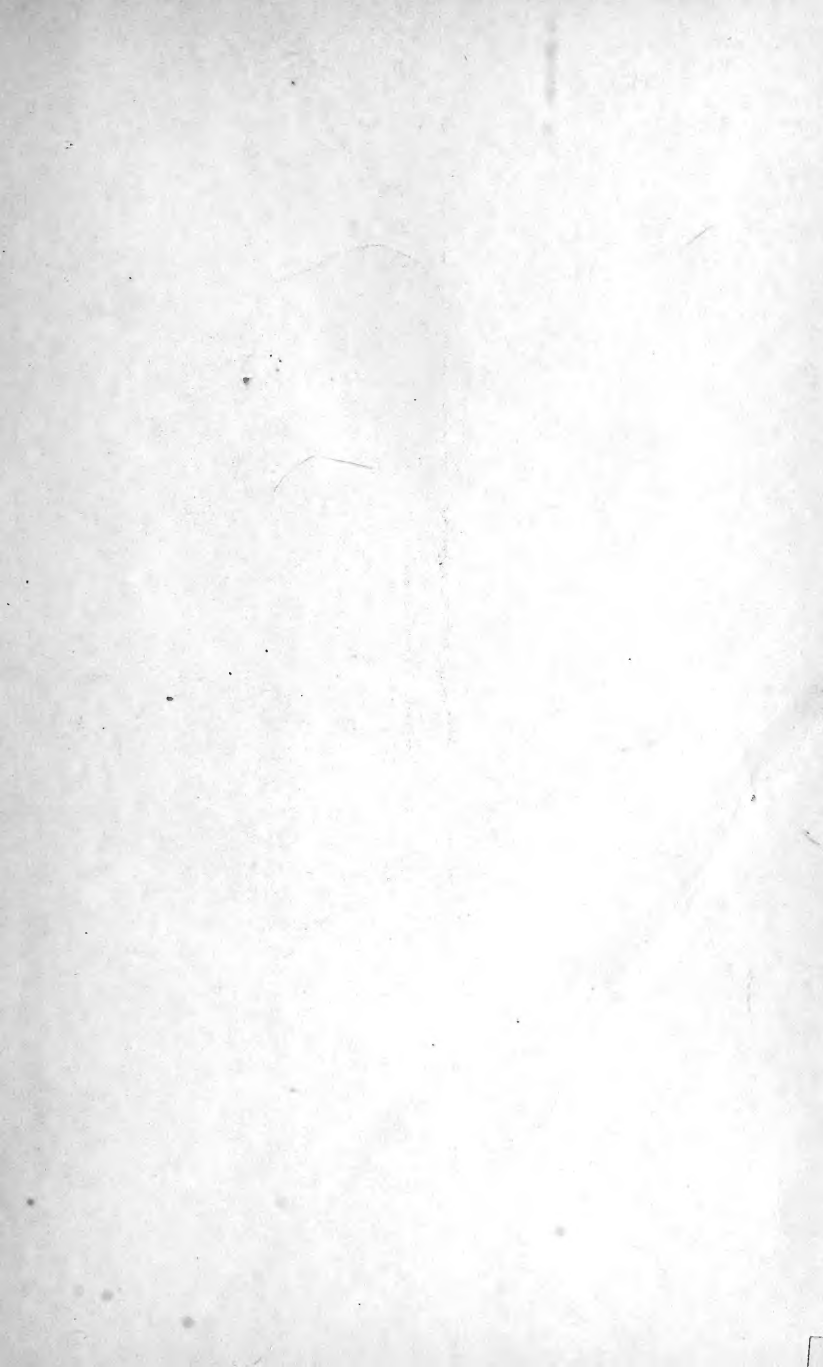
Book G823

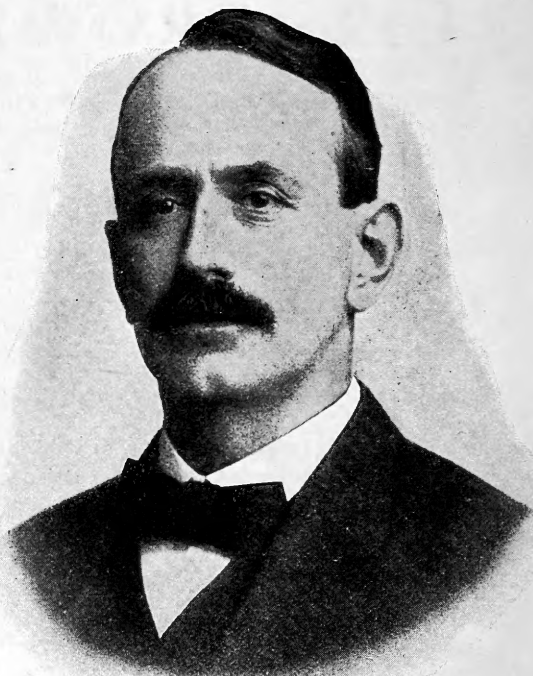
Copyright N^o 1912
copy 2

COPYRIGHT DEPOSIT.









SAMUEL B. GREEN
Late Professor of Horticulture and Forestry,
University of Minnesota.

POPULAR FRUIT GROWING

PREPARED ESPECIALLY FOR BEGINNERS AND
AS A TEXT BOOK FOR SCHOOLS
AND COLLEGES.

BY
SAMUEL B. GREEN

PROFESSOR OF HORTICULTURE AND FORESTRY IN THE
UNIVERSITY OF MINNESOTA.

Author of "Vegetable Gardening," "Amateur Fruit Growing,"
"Forestry in Minnesota," "Principles of American
Forestry," "Farm Wind-Breaks
and Shelter Belts," Etc.

FOURTH EDITION, Revised.

1 9 1 2



Copy 2

SB 355
G 823
1912
copy 2

Copyright, 1909, 1910

By

SAMUEL B. GREEN.

Copyright, 1912

By

MRS. ALICE H. GREEN.

PREFACE.

The development of the teaching of Agriculture has made necessary, and has been largely dependent on, the making of text-books of various kinds adapted to the special technical work for which our best agricultural schools stand.

When these agricultural colleges started there were no text-books adapted to their special lines of work, and the demand necessitated the hasty preparation of text-books which are now being replaced by those that are more complete and better adapted in every way for teaching purposes.

This book is the result of the development of the teaching of Fruit Growing in the University of Minnesota and is, in a way, a compilation of lectures on Fruit Growing given to the students which have been carefully revised and considerably extended. At the end of each chapter are suggestive questions on the matter presented.

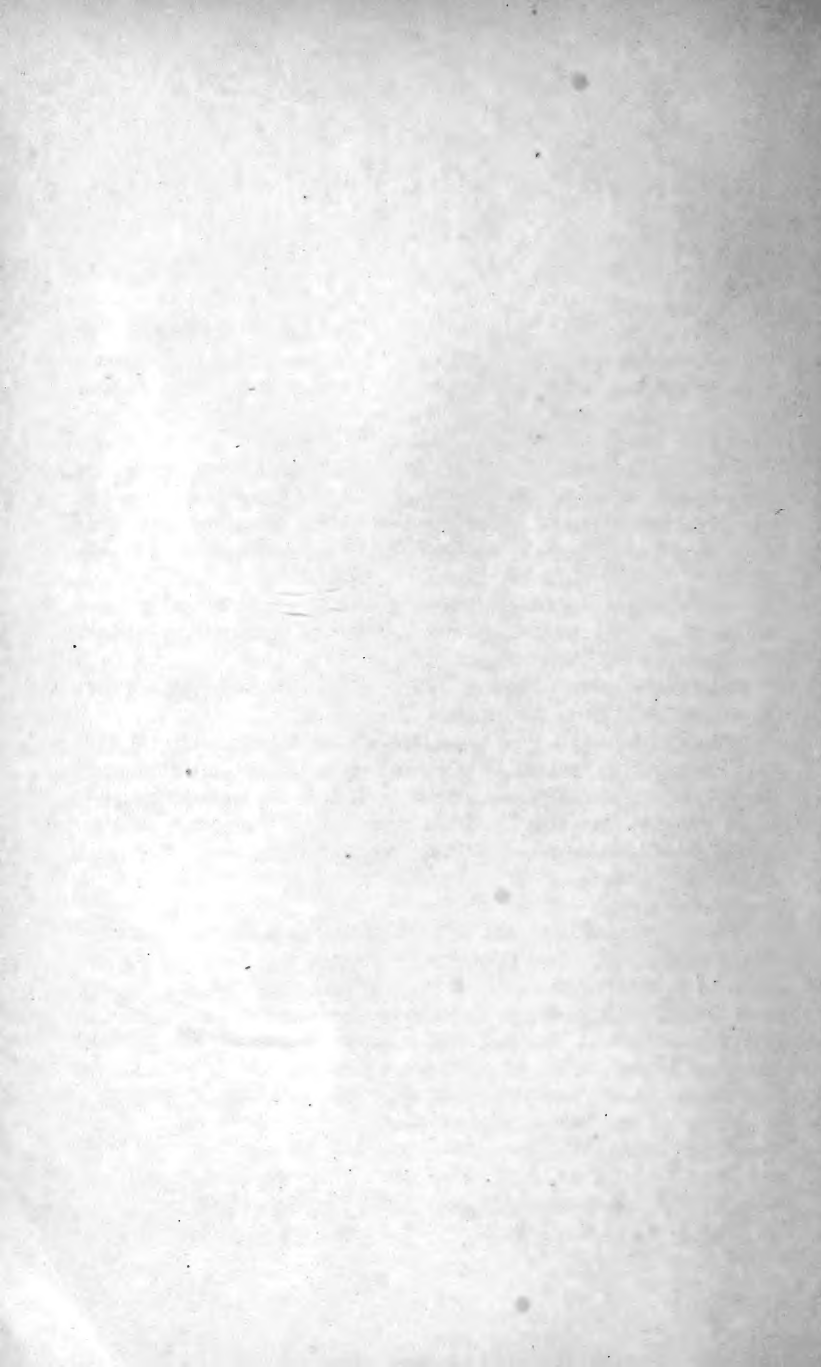
An appendix is added which contains formulas for fungicides, insecticides and grafting waxes, etc.; lists of fruits recommended for special typical states and rules for naming fruits. The fruit lists are from the professors of Horticulture of the various Agricultural Colleges and from secretaries of the various Horticultural Societies.

In the preparation of this work I have had the earnest and intelligent assistance of Miss Jeannette Foster. I am also under obligations to my assistant in Horticulture, Mr. A. R. Kohler, who prepared the pages on Spraying and Spraying machinery; to Mr. Elvin Peterson, student of the College of Agriculture, who has made many of the drawings; to Prof. Frederick Washburn for cuts which he has loaned; to Prof. E. M. Freeman for many suggestions embodied in the chapter on Plant Diseases and to Mr. A. G. Ruggles for suggestions in regard to the chapter on Insects Injurious to Fruits. I am also under obligations to those who have assisted by furnishing data for the fruit list and in other ways aided in its preparation.

SAMUEL B. GREEN,

St. Anthony Park, Minn.

March 1, 1910.



PREFACE TO THE FOURTH REVISED EDITION.

The large use of Popular Fruit Growing in all sections of the country and the ever-changing horticultural conditions have made it seem best to revise some portions of the book before this, the Fourth Edition, goes to press. Some rearrangement of the subject matter has been made in order to conform more closely to the usual plan of teaching fruit growing in American schools and colleges. In a number of cases, additional material has been incorporated where conditions have changed or experience has shown that the subject was not discussed at sufficient length in former editions.

It is but fitting at this time to add to this preface a short biography of the teacher and scientist who originally prepared the work.

Samuel B. Green was born in 1859 at Chelsea, .Mass., and died July 11, 1910, in Itasca Park, Minnesota.

In 1879 he graduated from Massachusetts Agricultural College at a time when agriculture was not looked on very favorably as an occupation for one to follow. The independence of purpose shown in the selection of this course was characteristic of Professor Green throughout his life. Whenever possible, he did the thing that appeared to him to be right, regardless of what others thought or said.

Ten years following graduation were spent in practical nursery and farm work, gradually gaining the experience that would be of value to him in later life. In 1888 he came to Minnesota as Horticulturist of the Experiment Station and Professor of Horticulture in the University, which positions he held till his death. There were very few students and practically no equipment in the Department of Horticulture at the time of Professor Green's coming. He not only built up a strong Horticultural Division and very greatly advanced the horticultural interests of the state, but also helped to establish the School and College of Agriculture on the solid foundation on which they exist in Minnesota today. He also found time to serve the state in

many other ways, as a member and for nearly four years as President of the State Horticultural Society, member of the American Pomological Society, Society of American Foresters, and other similar organizations. During the later years of his life he took up work in forestry with enthusiasm, establishing a strong course in forestry in the University and developing a system of summer training for foresters in Itasca Park. Early in 1910 he was made Dean of the College of Forestry.

Professor Green was the author of many bulletins and books along horticultural lines. He is perhaps best known as author of Vegetable Gardening, Amateur Fruit Growing, Popular Fruit Growing, Forestry in Minnesota, Principles of American Forestry, and Farm Hedges and Windbreaks. Thus much of his work is preserved in permanent form and will live after him.

LE ROY CADY.

St. Anthony Park, Minn.,
November 25, 1911.

CONTENTS.

CHAPTER I.

Desirable Factors in a Fruit Growing Section.—Accessibility. Location. Soils. Topography. Business Aspect.

CHAPTER II.

Principles of Plant Growth.—Parts of Plant. Parts of Flower. Pollination. Hybrids. Assimilation. Transpiration. Rest Period. Classification of Plants. Varieties.

CHAPTER III.

The Planting and Care of the Orchard.—Selection of Varieties. Selection of Nursery Stock. Preparation of Land. Laying Out the Orchard. Setting the Trees. Cultivation. Mulching. Cover Crops. Plant Food. Manuring. Irrigation.

CHAPTER IV.

Pruning.—Reasons for Pruning. Effect of Pruning. Pruning the Young Tree. Starting the Head. When to Prune. How to Make the Cuts. Tools. Training the Apple Tree. Renewing Old Trees.

CHAPTER V.

Orchard Protection.—Injuries. Frost Protection. Foretelling Frost. Orchard Heating.

CHAPTER VI.

Insects Injurious to Fruits.—State Inspection. Chewing Insects. Sucking Insects. Root Insects. Beneficial Insects. Parasites. Predaceous Insects. Apple Insects and Remedies. Pear Insects and Remedies. Peach Insects and Remedies. Plum Insects and Remedies. Insect Enemies of the Grape. Insect Enemies of the Bush Fruits. Strawberry Insects and Remedies.

CHAPTER VII.

Diseases Injurious to Fruits.—Apple Diseases and Remedies. Pear Diseases and Remedies. Quince Diseases and Remedies.

Plum Diseases and Remedies. Peach Diseases and Remedies. Cherry Diseases and Remedies. Grape Diseases and Remedies. Strawberry Diseases and Remedies. Blackberry Diseases and Remedies. Raspberry Diseases and Remedies. Gooseberry Diseases and Remedies. Currant Diseases and Remedies.

CHAPTER VIII.

Spraying and Spraying Apparatus.—Dust Spraying. Liquid Spraying. Spraying Apparatus.

CHAPTER IX.

Harvesting and Marketing.—Picking. Peddling. Associations. Packing. Packages. Package Laws. Barrels. Packing Barrels. Grades of Fruit. Cold Storage.

CHAPTER X.

Propagation of Fruit Plants.—Seed. Stratification. Offsets. Cuttings. Budding. Grafting. Inarching.

CHAPTER XI.

Pome Fruits.—**Apples:** Classes of, Propagation, Apple Orchards, Trees, Seedlings, Root Grafting, Planting, Heeling In, Cultivation, Pruning, Mulching, Varieties. **Pear:** Origin, Chinese Sand Pear, Standard Pears, Dwarf Pears, Propagation, Soil and Cultivation, Planting, Pruning, Insects and Diseases, Varieties, Packing. **Quince:** Propagation, Planting, Pruning, Insects and Diseases, Varieties.

CHAPTER XII.

Stone Fruits.—**Plum:** Origin, Propagation, Stocks, Soil, Planting, Insects, Varieties. **Cherry:** Origin, Soil, Planting, Time of Planting, Age of Trees, Cultivation, Propagation, Pruning, Picking and Marketing, Insects and Diseases, Varieties. **Peach:** Origin, Groups, Propagation, Planting, Pruning, Soil, Insects and Diseases, Varieties. **Nectarine:** Origin. **Apricot:** Origin, Stocks, Planting, Pruning, Insects and Diseases, Varieties.

CHAPTER XIII.

Grapes.—Origin, Propagation, Soil, Planting, Training and Pruning, Single Post Method, High Renewal Method, Kniffen

Method, 4-Cane Kniffen Method, 2-Cane High Renewal Method, Munson Method, Tying Material, Thinning, Manuring, Girdling.

CHAPTER XIV.

Small Fruits.—**Strawberry:** Origin, Location, Soil, Manuring, Planting Methods, Trimming, Protection, Renewing, Burning, Picking and Marketing, Varieties. **Currant:** Origin, Soil and Planting, Pruning, Protection, Marketing, Varieties. **Gooseberry:** Origin, Propagation, Planting, Pruning, Marketing, Insects, Diseases. **Raspberry:** Origin, Classes, Propagation, Location, Soil, Manuring, Planting, Cultivation, Pruning, Thinning, Mulching, Protection, Picking, Marketing. **Blackberry and Dewberry:** Groups, Propagation, Soils, Planting, Cultivation, Pruning. **Cranberry:** Location, Soil, Cultivation, Drainage, Planting, Picking. **Juneberry:** Origin, Propagation, Cultivation, Varieties. **Sand Cherry:** Distribution, Propagation. **Bullberry or Buffalo Berry:** Distribution, Propagation. **Mulberries:** Origin, Propagation, Varieties. **Persimmon:** American Persimmon, Where Found, Value of Fruit, Method of Propagation, Japanese Persimmon, Value of Fruit, Propagation.

CHAPTER XV.

Nuts.—**Pecan:** Origin, Soil, Harvesting, Marketing, Insects, Grafting. **Chestnut:** Groups. **Chinquapins:** Propagation, Planting, Insects, Diseases. **English Walnut:** Propagation, Harvesting, Marketing. **Japanese Walnut.** **Black Walnut.** **Almond:** Soil, Planting, Propagation, Marketing. **Hazel:** Origin, Flower.

APPENDIX.

Appendix.—Spraying Calendar. Fungicides. Insecticides. Grafting Waxes. Rules for Naming Fruits. Lists of Fruit Recommended for Different States. Distances Apart for Planting Fruits. List of Horticultural Books, Periodicals and Bulletins.



Popular Fruit Growing.

CHAPTER I.

FACTORS THAT MAKE UP A GOOD FRUIT-GROWING SECTION.

Accessibility.—One of the first requisites for success in fruit growing is ready communication with a good market. This may be obtained by nearness to the market itself, or to shipping facilities where transportation to the market centers may be had at reasonable rates. Water communication is often better than rail, especially for those kinds of fruits that are easily injured by rough handling. Two or more competing lines of communication generally tend to give the shipper better service than when one road has the monopoly. Accessibility is of the first importance though it will not entirely take the place of suitable soil conditions; however, it may sometimes make it profitable to use an inferior soil. The distance which fruit can be hauled with safety or profit depends largely on the nature of the product itself. The apple grower can afford to be farther from shipping facilities than the peach or berry grower, as his fruit is less likely to be damaged in hauling. Growers of perishable fruits should not be more than two or three miles from a shipping station.

Good wagon roads make it easy to get to market quickly with large loads of produce in good condition and form a very important factor in the development of any fruit section.

If the location is so far from the consumer that the produce must be shipped by a common carrier it is important that enough fruit be raised in the section to make the business of handling and shipping it one of sufficient importance to command special attention from the carrier and the buyers, so as to make it a place where buyers will go for fruit. In starting a fruit industry

in a new place the pioneers often labor under the disadvantage of not having enough of their product to make it worth while to ship it. This difficulty can be overcome in new sections by starting the industry on a large scale so that shipments may be made in carload lots and by co-operation in selling.

Soils.—The only sure way of determining the value of a soil for a particular fruit is by field-trial, because so many factors enter into the makeup of a good fruit soil that it is easy to make mistakes, and yet the best fruit soils have many evident points in common. There is hardly any soil but which under favorable conditions will be found adapted to some class of fruits. For instance, the pear prefers a rather heavy clay soil; the peach and cherry quite open and porous soils. The strawberry and blackberry will often do well on soil too sandy for other fruits although either one suffers from drought on a heavy soil. The currant and gooseberry prefer an open clay loam but will adapt themselves to almost any location. Then there are locations, such as the lands adapted to the Yellow Newtown or Albemarle Pippin apple in Virginia, so wondrously fitted to special fruits that it seems impossible to raise these in perfection elsewhere.

In the case of apples and many other tree fruits the condition of the subsoil is generally of more importance than the surface soil, although the condition of the latter must not be overlooked. It is desirable to have a surface soil that can be cultivated easily and will not bake hard after rains. Soil that is extremely rich in plant food is usually undesirable for apples, pears and peaches, especially if too rich in nitrogen. On such land the trees generally grow large and frequently do not bear until quite mature. The unripened buds and wood, common under such conditions, kill back in winter and the vigorous growth of early summer seems to be predisposed to fire blight or similar diseases.

Loess loam is the name given to an open clay soil which is made up largely of clay and small shells. On such land we generally find in the North a vigorous growth of maple, hackberry and white oak. It is perhaps the best kind of an all around fruit soil and any of our fruits will do well in it.

A limestone soil, where the roots can reach the underlying lime rock or soil and which has much lime in its makeup, is especially favorable for all our fruits and comes next to or may

equal in value the loess loams. In parts of Florida the coral rock and the old shells in the sand help to make good fruit soil.

Heavy clay loam may be better adapted to agriculture than to fruit raising, but if such soil is thoroughly underdrained and given a proper rotation of cover crops, manure and general cultivation, it will often be found adapted to a goodly number of fruits and especially to apples, pears, currants, gooseberries and the sweet cherries. Such a soil requires a very careful management in order to get the best results from it.

Sandy loam underlaid with a good, open clay subsoil is almost ideal for any of the small fruits and grapes. It is the easiest kind of soil to handle and can be cultivated shortly after a rain without becoming lumpy or sticking to the tools, and it easily forms a dust blanket. Implements scour in it very readily, which is no small convenience. Altogether, it is the most pleasant kind of soil to cultivate and well adapted to a long list of fruit plants.

Sandy soil dries out so quickly that crops on it suffer from drought. This is especially true where the soil particles are coarse. It gives quick returns from manure applied to it but does not hold soluble manures. In general it is not adapted to any of the fruit crops unless it can be irrigated, or is located where the water table is within the reach of the roots. Under such conditions this soil may, with proper management, give good results with strawberries, blackcap raspberries, plums, sour cherries and peaches, and with many of the subtropical fruits.

Mucky soil is not well adapted to fruits of any kind but some kinds of strawberries and blackberries will occasionally yield enormously on such land where it is well drained. When muck is applied to sandy or clay land, it is often beneficial.

Flat, black prairie soil is seldom sufficiently adapted to any kind of fruit to become the foundation of an important fruit industry, although many kinds of fruits may do well enough on it to make them desirable for planting in the home garden.

Clay soil, underlaid with gravel at a depth of from two to four feet, may be used for sour cherries, peaches and plums, but crops on it are liable to suffer from drought and such lands

should generally be avoided for fruits. It dries out easily and yet the surface soil, being of clay, becomes lumpy unless carefully handled. It has most of the disadvantages of both a stiff clay and sandy soil.

Topography.—The topography of a country is the “lay of the land;” i. e., whether hilly, rolling or flat. A rolling country gives good water drainage and our cultivated fruits, with the exception of the cranberry, are intolerant of surplus water in the soil. A rolling country also gives many high slopes where there is comparative immunity from unseasonable frosts. Its various slopes are adapted to a variety of crops. For these reasons good fruit sections are generally located where the land is hilly but land that is quite flat may sometimes prove valuable for fruit when near large water areas so that there is secured comparative immunity from frosts and when sufficiently elevated to secure good drainage. As a rule, however, flat land is not well adapted to fruit growing.

The direction of the slope is an important matter, but one which is so influenced by local conditions and by the class of fruits which is to be grown that no definite rule can be given. In the Northern states, a northeast slope is generally regarded as best for the tree fruits, as it warms up slowly in the spring and the trees are less likely to start early and suffer injury from late spring frosts and the hot, dry winds of summer. Locations near large bodies of water, especially those so situated that the prevailing winter winds blow across this water and are tempered by it, are particularly favorable for fruit growing, as the danger from frost injury is greatly reduced. The peach belt along the eastern shore of Lake Michigan, which is as far north as southern Minnesota, is a familiar example of the tempering effect of water. It is possible to grow fruit in that locality, owing to the freedom from frosts, which could not be produced some distance farther south, in Indiana and Illinois, in districts where there is no protection from cold northwest winds.

BUSINESS ASPECT.

Fruit Growing as a Business.—Success in any business is largely a personal matter and success in fruit growing likewise

depends much on the individual and his adaptability. The demand for fruit is on the increase and the consumption of fresh fruits per capita is now greater than a few years ago. With the introduction of improved methods of storing and shipping, fresh fruit is destined to play a more important part in the diet of every American. Comparatively a few years ago fresh fruit was regarded as a luxury but now it is looked upon as a staple article of diet with special hygienic values.

Overproduction of Fruit.—There is occasionally an overproduction of fruit in some districts, but it is rare that there is an overproduction of good fruit. Our chief trouble is that our methods of distribution are faulty and our people do not get the fruit they want. Fruits that can be readily used for canning or drying purposes are most stable in price because, when low in price, it is easy to dispose of the surplus. Fruits which keep over a considerable period, as winter apples, are more stable in price than those that are perishable, as berries or peaches. The tendency is certainly toward cheaper good fruit, but there is also a growing discriminating taste for fruit of the best quality and the number of consumers who are willing and able to pay a fair price for a good article is fast increasing. As wealth increases this discrimination in favor of the best will become even more pronounced than it is today.

The successful fruit grower must be well grounded in the principles of growing fruit and the many problems that are sure to present themselves in the course of the annual round of duties. Not only is it desirable that he know how to grow fruit but he must know how to market it. In other words, he must be a good business man. Some of the most successful fruit growers and horticulturists have been men who were not raised in the work but have taken it up late in life and succeeded largely because of their business training and ability. This is not to say that farmers' sons do not make good farmers, but they often fail to get the most out of their farm practice owing to the lack of business training. In this respect another man may perhaps excel, although he may not understand the practice of handling the land. The fruit industry is especially suited to the man of

ready resources who can quickly adapt himself to changes of situation.

Choice of Locations.—Most people who are making a specialty of fruit growing, and most farmers who contemplate a change to fruit growing, are held fast by social ties, by land holdings or in other ways, so that they cannot easily change their location even if they wished to do so, therefore the choice of location for them is a settled fact. If they engage in fruit growing at all it must be in their present surroundings. To them it is a selection of crops and methods of management best suited to their conditions. If fruit growing cannot be made profitable where they are they had better devote their land to other purposes.

On the other hand, there is a small class of people who wish to grow fruit of certain kinds who do have the opportunity of changing their location. For such, it would be a good plan to visit the principal fruit sections and thoroughly study their conditions and probable future before locating permanently. In making such a study it is not well to be too quick to form an opinion as there are many factors to be considered. Rarely, indeed, is it desirable for a grower to change from a line of fruit growing that he is thoroughly acquainted with to one that is very different. Occasionally it may be desirable or necessary to do so, but in any case the change should be made with great caution. The successful apple grower of Missouri may make a successful California orange grower after he has had experience, but he will have much that is new to learn before he can do this. The man who is starting anew in the growing of fruit of any kind will generally find it best to start in a small way and not risk too much on a single venture.

QUESTIONS—CHAPTER I.

1. What is meant by accessibility?
2. What are the characteristics of a good fruit growing section?
3. What soils are best adapted to different fruits?
4. What is the composition of limestone soil? Of clay loam? Of sandy loam? Of sandy soil? Of mucky soil? Of prairie soil? Of clay soil?
5. What is meant by the topography of a country?
6. What is the best location for fruit growing?
7. What are some of the things upon which the success of fruit growing depends?
8. What is the result of an overproduction of fruit?
9. What are some of the problems with which a fruit grower has to contend?

CHAPTER II.

SOME FUNDAMENTAL PRINCIPLES OF PLANT GROWTH.

The roots of plants are made up of several distinct parts. The main central root is termed the tap root when it extends directly downward into the earth, as in the roots of Bur Oak and Black Walnut. When a plant has several spreading roots it is said to have surface roots, but such roots may sometimes divide and go deep into the ground; for example, the roots of the Red Oak and White Pine. Root fibres or rootlets is the term used for the smaller division of roots. The foregoing roots have hard bark and do not feed the plant. They do little more than anchor it in place. The roots feed through what are known as the root hairs, which are soft, fresh, young roots, generally white in color.

The collar or crown of a plant is that portion where the roots and top unite. It is close to the surface of the ground. This portion of the tree is frequently injured by borers, by ice and in other ways. It is a good plan, especially in the case of young trees, to protect them in winter with a bank of earth around the collar.

The stems of plants may be annual, as in the case of many garden plants; biennial, as in the case of the raspberry and blackberry, and perennial, as in the currants, gooseberries and fruit trees. Runners are creeping stems, as in the case of the strawberry. Suckers are stems springing up from roots or underground stems. Thorns are modified branches and live for indefinite periods while prickles, like those on the gooseberry, are modifications of the bark and live but one year.

The bark covers the whole exterior of the trunk, branches and roots and serves as a protection. It is made up of two parts, the outer or corky layer which is dead bark, and the inner, or live bark. These vary much in appearance and thickness on different kinds of trees. For instance, on the White Birch the corky layer is pure white, very thin and tough, while on our White Pine it is very dark brown and often an inch or

more in thickness and quite brittle. This covering of bark is quite impervious to disease where intact, but there are generally many small breaks in its surface through which disease may enter and once inside the bark it is well protected.

Cracks in the live bark are most common in early summer when growth is rapid. Diseases may also enter through some wound, and hence the desirability of covering large wounds with some impervious material to keep disease out of the plant.

Buds are the portions of plants which always tip new growth. They are often opposite, as in the case of the Maple, or alternate as in the apple, pear, plum or peach. **Adventitious buds** are those that start apparently without system. Theoretically, botanists say that any cell may grow into a bud so that

buds may appear in almost any place on the trunk, roots, or branches, and in the case of the orange a single seed may grow three plants, one of which is the result of ordinary sexual union while the other two may be looked upon as being adventitious. Buds may produce leaves or flowers. The former are termed leaf buds and the latter flower buds. These are illustrated in Fig. 1. They vary in shape, time of formation and location in different plants. Flower buds are more liable to winter injury than leaf buds. Plants that are growing fast are quite liable to form only leaf buds and often fail to form flower buds.

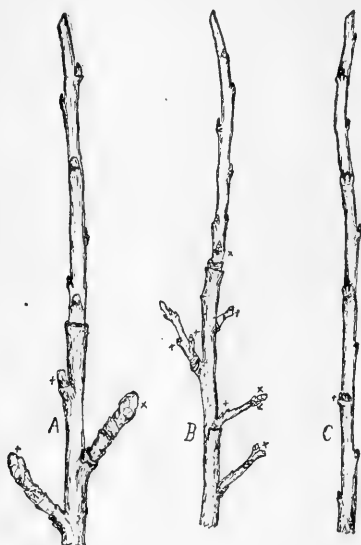


Fig. 1.—Fruit buds of: a.—Apple. b.—Plum. c.—Peach. The crosses indicate fruit buds.

When growth is rather slow naturally or when checked by artificial means, fruit buds are formed. In the case of some trees that do not come into bear-

ing readily, girdling is sometimes practiced in order to throw the plant into bearing. This may be done in a variety of ways but should not be attempted except in the case of trees that seem hopeless otherwise.

Girdling may be done successfully as follows:

With an ordinary cross-cut saw, cut in a spiral direction around the trunk or branch to be treated and have the cut end just under where it commenced but several inches below. In this way the circulation of sap is only sufficiently impeded to cause flower buds to form. Such wounds seldom cause serious injury to vigorous trees. This work should be done in June if at all, but is seldom a desirable practice.



Fig. 2.—Trunk of apple tree two inches in diameter one year after girdling with saw.

The leaves of plants are made up of loose, open tissue enclosed in a thin membrane. This membrane has openings in it through which the plant takes in carbonic acid gas, i. e. carbon dioxide from the air, and throws off large quantities of water. It is through these openings, called stomata, that diseases frequently enter the plant. Such openings also occur in the young twigs of some plants. It is in its green portions that the plant absorbs and assimilates food, and since this green portion is formed almost exclusively in our fruit plants only in the presence of direct sunlight, the importance of lots of sunlight for best development of these plants is evident.

The flower is the portion of the tree designed for the production of seed. All the parts of our fruit plants in a natural state seem to facilitate this object. Flowers are often imperfect, as in the case of some forest trees, but in our common cultivated fruit plants the flowers are generally perfect and only such flowers are referred to here. But flowers that are perfect may be self-sterile, that is, may not be fertile to their own pollen but need to be cross fertilized.

The parts of the flower and the purpose of each.—The parts of the flower are modified leaves. The outside covering of the flower of our common fruits is termed the calyx. Its purpose is to protect the more tender organs and it is generally green in color. The next row of modified leaves of the flower is called the corolla. This is generally white or of some conspicuous



Fig. 3.—Flower of Duchess of Oldenberg apple.

color. It serves as a protection and also by its coloring attracts insects which assist in pollination. The next row of modified leaves are the stamens. They are of various forms, generally tipped with a small pouch-like vessel in which the male element, known as pollen, is formed. The stem is called the filament and the pouch the anther. The pistils are the female organs made up of ovary or seed pod, style or stem, and stigma, which latter is the part that receives and holds the pollen which grows through it to the seed. The bright colored por-

tions and the nectar attract insects that aid in transferring the pollen from one flower to another. The edible portions of the fruit attract birds and other animals, including man, who aid in distributing the seed.

Fruit.—A true fruit as defined by botanists is the ripened seed vessel and its contents. This agrees with the horticultural

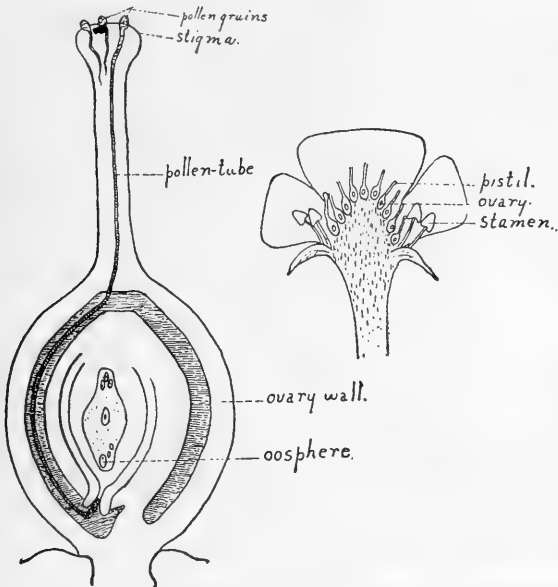


Fig. 4.—Diagrammatic drawing showing how pollen grains grow down the pistil of the strawberry and unite with the contents of the ovary in the act of fertilization; At the right, cross section through flower of strawberry, showing its parts.

turists' definition so far as fruits such as apples, pears, peaches, apricots, plums, gooseberries and currants are concerned, but in the case of strawberries, blackberries and mulberries, this definition would allow us to claim only the single grains on the sides of the berries as fruits, while in these fruits, we commonly consider the fleshy center a part of the fruit. These latter fruits are in structure much like an ear of corn with an

edible cob. The word fruit as used by the fruit grower had a certain definite, well understood significance before the dawn of scientific botany and the botanists should not attempt to change the significance of the word.

Pollen.—Pollen grains vary in form but are cell-like in structure and have the power of making a root-like growth into the tissues of the pistil to the ovary where the contents of the pollen grain unites with and fertilizes the ovule. Without this process taking place, seed is not produced and it is seldom that fruit is formed at all. Pollen from one distinct kind of fruit will not fertilize the ovule of another of a different, distinct kind but each is restricted to a very close limit. For instance, the pollen of one variety of the apple will fertilize other apples but will not fertilize the plum. When varieties of the same or nearly allied fruits are fertilized with the pollen from one or another, they are said to be crossed and the operation is termed **crossing**. The results from this work are seldom well marked in the crossed fruit although the skillful operator may sometimes be able to see it. But the results of the cross will show in the seedlings from the crossed fruit and it must not be expected that the seedlings will partake equally of the nature of each, for we know from much experience that the results of such crosses are uncertain and irregular.

Pollination.—Under natural conditions flowers are pollenized in various ways, but chiefly by wind, in the case of plants that have inconspicuous flowers such as corn, pine, spruce and poplar; and by insects in our cultivated fruits and most other plants which have conspicuous flowers. Some flowers are probably pollenized in both ways.

Hybrids.—Where a cross is made between very unlike forms, as between the sand cherry and the plum, the result is generally termed a hybrid. The difference between crosses and hybrids is only one of degree and of late years there has been a tendency to do away with the use of the term hybrid altogether. There is a very common impression that hybrids are exceedingly rare and of more value than ordinary crosses but such is far from being the case, as they are frequently of little value for any purpose and often fail to form seed and even to set fruit.

Fruit Plants from Seed.—While our wild plants come nearly true from seed, our cultivated fruits, which have come from them, will not come true but will show a decided tendency to resemble the wild, inferior forms. Although an occasional seedling may be a decided improvement over the cultivated kinds there is not one chance in a thousand of getting better fruits than those we now have by saving seed. This comes from the fact that we do not grow our fruits from seed but by grafting, budding, etc. If they were grown for many generations from

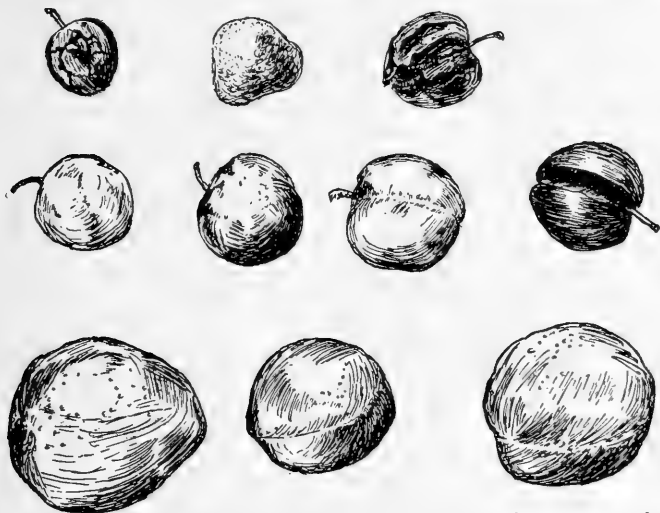


Fig. 5.—Showing variation in sizes and shapes of plums grown from the same lot of seed.

seed it would undoubtedly be possible to get them to come as true to type as our garden vegetables. It must be noticed that as there are no two plants exactly alike the strongest tendency in plants is to be unlike. Some cultivated fruit plants that come nearly true from seed are a few local varieties of the peach, the Wyant plum and such strawberries as the Alpine and St. Anthony de Padua.

The yearly round of life in plants consists of a rapid growth in the spring, during which time the plant is using up

the store of food accumulated the year before. After this rapid growth has passed comes a period of slower growth in which the wood is said to ripen. That is, it becomes hard by reason of its cells becoming filled with starch or other plant food which is used to start growth in the spring. When this is completed active growth stops, but plant food is probably being stored up as long as the leaves still remain green. When we have warm, moist weather late in autumn, active growth sometimes starts again and some of this plant food is changed to unstable compounds which may result in winter killing. Some varieties are much more liable to start in this way than others. No characteristic of hardness in plants is more certain than early maturity of wood.

Assimilation.—Plants are made up of various tissues and these are composed of numerous cells. The material of which the cells are composed is largely carbon. This carbon is derived from the carbon dioxide of the air which enters the leaves, and, under the action of light, air and water is decomposed; the oxygen is given off and the carbon is retained and, combining with water obtained from the roots, forms starch, sugar, gum and other plant foods. This process of food making is called assimilation and can be carried on only in the green parts of the plant and in these, only when exposed to light and air. Hence foliage, air and light are essential elements for plant growth, and the greater the quantity and better the development of foliage and the more light this foliage has at its disposal for its work the more vigorously will the tree grow.

In general, therefore, the growth of the fruit and wood may be reduced either by the removal of foliage, which reduces the working surface, or by shading, which somewhat checks the activity of the foliage by hindering light action.

Transpiration.—The flow of sap in trees is not well understood. In a general way it may be said that the sapwood transmits the water from the roots to the leaves, where a part enters into the assimilated sap and goes to build up the plant, and the remainder, which is by far the greater part, passes off as vapor. The amount thus transpired varies greatly with the species, age of the tree, amount of foliage at work, amount of

light at its disposal, climatic conditions and the condition of tree growth. The amount of water transpired is so large in comparison to the amount retained in the tree that while an acre of forest may store in its trees 1000 pounds of carbon, 15 or 20 pounds of mineral substance and 5000 pounds of water



Fig. 6.—Abnormal flower of strawberry with seven petals; not unusual.

in a year, it may have taken from the soil and given off to the air from 500,000 to 1,500,000 pounds of water or from one-quarter to one-half as much as agricultural crops. It has been estimated that the leaves of deciduous trees transpire one-sixth to one-third as much water as an equal surface of water. Large deciduous trees undoubtedly give off as much as a barrel of water a day in dry summer weather. Coniferous trees transpire much less water than most deciduous trees, frequently not over one-sixth as much.

Mineral substances are taken up by plants in small quantities and consist mostly of lime, magnesia, potash and phosphorus. They are carried to the leaves where they are used, (perhaps also on their passage through the tree), with a part of the water in food preparation. The main part of the mineral substances taken up remains, as the water transpires in the leaves and young twigs, and is returned to the soil when the leaves are shed.

Rest period of plants.—With very few exceptions, all plants require an occasional rest period for their best development. Some species get it naturally by being dried and others by being frozen. Even when plants are kept under growing conditions the year round, they have periods of rest and of active growth. During the rest period plants undergo very few changes, and yet there is undoubtedly some growth during mild weather in winter, and as evaporation must be going on most of the time from twigs and buds water must be supplied from the roots.

Classification of fruits.—The commercial fruits of the world may be grouped under the following heads, of which only the more important Northern grown fruits are referred to here.

Class I. Orchard culture or tree fruit culture.

Sub-class

- I. Pomaceous fruits: Apple, pear, quince.
- II. Drupaceous or stone fruits: Plums, peach, cherry.
- III. Citrus fruits: Orange, lemon, lime, etc.
- IV. Moraceous fruits: Mulberry, fig.
- V. Anonaceous fruits: Pawpaw.
- VI. Myrtaceous fruits: Guava.
- VII. Sapotaceous fruits: Sapodilla.
- VIII. Anacardiaceous fruits: Mango.
- IX. Ebenaceous fruits: Persimmon.
- X. Leguminous fruits: St. Johns bread, tamarind.
- XI. Nut fruits: Nuts of various kinds.
- XII. Palmaceous fruits: Cocoanut, date, etc.
- XIII. Miscellaneous tree fruits: Olive, pomegranate.

FUNDAMENTAL PRINCIPLES OF PLANT GROWTH. 29

Class II. Vine fruit culture.

Sub-class

I. Viticultural fruits: Grape.

II. Passifloraceous fruits: Granadilla.

Class III. Small fruit culture.

Sub-class

I. Bush fruits:

Group (a) Rubaceous fruits: Raspberry, blackberry.

(b) Ribaceous fruits: Currants and gooseberries.

(c) Miscellaneous fruits: Juneberry, buffalo-berry.

II. Strawberry culture: Strawberry.

III. Cranberry culture: Common cranberry.

Class IV. Non-woody or herb-like fruits.

Sub-class

I. Musaceous fruits: Banana.

II. Pineapple.

III. Cactaceous fruits: Prickly pear.

It has been estimated that there are more than ten thousand varieties of our commonly cultivated fruits in America. In order to study these satisfactorily some method must be found to classify them. This matter will be found worked out in the various books on systematic pomology. Botanists have found it convenient to group plants under the head of class, order, genus, species, varieties. The same classification, of course, applies to the larger groups in horticulture; but the horticulturist has gone farther than the botanist with his classification and has divided his plants into varieties.

A variety is made up of a group of individuals which differ from the rest of its species in certain recognizable particulars which are transmitted from generation to generation without material modification. The horticulturist makes into groups more or less definite the varieties having certain important traits in common, as, for instance, when he groups certain varieties of vegetables or fruits together. New varieties of fruits are being continually offered by the trade, and, although not one in ten of those sent out is as good as those commonly grown, yet from time to time marked improvement is made.

QUESTIONS—CHAPTER II.

1. What is the root system of plants made up of?
2. Of what value are these parts to the plant?
3. What is meant by "collar or crown?"
4. Why does this portion of the tree need protection?
5. When are plants annuals? biennials? perennials?

6. What are runners? suckers? thorns? prickles?
7. Of what use is the bark?
8. What is it made up of?
9. How do these parts vary in different plants?
10. What are the buds?
11. What are adventitious buds?
12. What are the characteristics of the leaf? flower? bud?
13. How are fruit buds formed?
14. What is meant by girdling?
15. How is it accomplished?
16. What are leaves made up of?
17. How are they constructed?
18. What functions do the leaves perform for the plant?
19. What functions do the flowers perform for the plant?
20. What are the different parts of the flower?
21. How is each constructed and for what purpose?
22. What is a fruit as defined by botanists? by horticulturists?
23. How is it constructed?
24. What is pollen?
25. What are its characteristics?
26. How are plants crossed?
27. What is meant by the term "hybrid?"
28. How are flowers pollinated?
29. To what extent do fruit plants come true from seed?
30. What is the cause of this?
31. What local varieties come true from seed?
32. What course of growth does the plant take throughout the year?
33. What is meant by the process of assimilation?
34. How is it carried on in plants?
35. What is the result of removing foliage from a plant?
36. What is meant by transpiration?
37. What approximate amounts are transpired from the leaves of deciduous trees?
38. What minerals are taken up from the ground by plants?
39. How is it returned to the soil?
40. What is the need of a rest period for plants?
41. How should they be cared for during this period?
42. How may commercial fruits be grouped?
43. What is the most convenient way of classing fruits?
44. What is a variety?

CHAPTER III.

THE PLANTING AND CARE OF THE ORCHARD.

Selection of Varieties.—When a decision has been reached as to the kinds of fruits which are to be grown and a location has been selected, it is necessary to choose the particular varieties which are best suited to the purpose in mind. Those which are grown for home use or for a special nearby market may be quite different from those grown for shipment to a distant market. It often happens that varieties of the very best quality do not carry well or are not of attractive appearance; these should be grown for home use or for the special market where quality is the first consideration, while for the distant market the only varieties which should be grown are those which ship well and are attractive. Quality is rather a secondary matter in a market fruit, though discriminating buyers are often willing to pay a premium for varieties of particularly good quality.

Varieties of fruits to grow.—The varieties of fruits best adapted to a given location cannot be named without special and careful study. Some varieties are very profitable in one locality but close by, in another locality, they may be a failure. The matter of selection of varieties for profitable culture is one of the most important subjects the fruit grower has to consider. There are many new varieties of fruit introduced each year and only a few of them are any better than old standard sorts, while the greater part have very serious faults.

Among the varieties of fruit in cultivation, we may distinguish two general classes:

(a) Varieties of great vigor and productiveness, adapted for a wide range of country. These are oftentimes somewhat inferior to the best in quality but are of good appearance and good enough in quality for the average market. Among such varieties may be named the Duchess of Oldenburg, Talman Sweet and Ben Davis apples; Bartlett and Anjou pears; Lombard and Quackenboss plums; Crawford and Elberta peaches; Concord

and Niagara grapes; King and Marlboro raspberries; Snyder blackberry, and Dunlap, Splendid and Bederwood strawberries. These varieties do well over a large extent of country. Some of them may not bring the highest prices in our markets but they sell well and are the popular standards.

(b) Varieties that are very particular about location and are not generally successful, but, where they do well, produce fruit of very superior quality. Among this class of fruits may be mentioned the Yellow Newtown, Gravenstein and Williams apples; Green Gage plum; Bosc pear; Columbia peach; Iona grape; Herstine raspberry; Lawton blackberry and Jucunda strawberry.

In selecting varieties for growing the fruit grower should choose those that are adapted to his market for it is there they are to be finally tested. The fruit grower's success is dependent on how the market regards his product, and he should not expect to change the prevailing desires of people very much. There is, however, much in the power of a good example and there is a growing number of people who are particular as to the quality of their food and are willing to pay a fair price for it. The fruit grower should not try to sell white strawberries, raspberries or currants, for the general markets demand that they be red in color and blackberries must be black and not red or white. It is not worth while to attempt to change prevailing opinions in such matters for the sake of pushing some new variety, no matter how good its quality. By this it is not meant that the market will not use the unusual kinds but it does not desire them. In general, the market wants large size, bright, warm colors and at least fair quality in fruits.

The fruit grower should not select varieties because they are doing well elsewhere but should become familiar with the experience of fruit growers in his section and get in touch with the officers of the experiment station of his state and advise with them in these matters. The reports of his local horticultural society should be very helpful and they must be poor indeed if he cannot get some benefit from them.

Choose varieties that will pollenize well together.—It should be more generally known that there are some varieties of fruits

that are self-sterile and will not be productive unless near other similar kinds. The following partial lists show varieties that are both self-sterile and self-fertile but it is quite possible that some of these may be self-sterile at one time and self-fertile at another time or in another locality.

Fruit	Self-sterile	Self-fertile
Plums	Miner Wild Goose Mariana Itasca	Robinson De Soto Forest Garden Cheney
Grapes	Brighton Wilder	Concord Niagara Agawam Delaware
Apples	Winesap Gravenstein Northern Spy	Ben Davis Duchess Baldwin Red Astrakan
Pears	Bartlett Anjou Nelis	Flemish Beauty Clairgeau Kieffer

An experiment with the Kieffer pear at the Michigan Agricultural College during the summer of 1907 seems to indicate that the Kieffer ought sometimes to go on the self-sterile list. A Kieffer tree was enclosed in a canopy of muslin with one branch left outside the canopy. The air within the canopy was made to circulate daily by artificial means during the blossoming period so as to insure pollination of at least some of the flowers. Not a fruit set under the canopy, while the branch that was left outside and was free to receive foreign pollen set fruit freely.

Preparing the land.

(a) The land on which the fruit plantation is to stand should be in as good condition as possible before the fruit plants

are set out. Do not leave this work to be done after the plants are set for it costs more to do it then and the plants will very likely be injured in the process.

(b) New land should be thoroughly cleared of stumps and roots before the orchard is planted, and better results will be obtained if the land is cultivated for a year or two before the trees are set.

(c) Old land should be in good physical condition and should contain a good supply of humus. While heavy fertilization is not necessary, the soil should be rich enough to enable the trees to make a good growth, but must not be too rich in nitrogen.

(d) Fall plowing is almost always desirable, whether the trees are to be set in the fall or the spring. If the planting is to be done in the fall, the plowing should be completed several weeks previous, to give the soil time to settle. Deep plowing is usually best, as it is desirable to have the soil mellow and easily penetrated by roots to a considerable depth. If the subsoil is a hardpan clay it is often desirable to explode dynamite in the holes to loosen the lower layers.

Time to Plant.

(a) In severe locations and with the more tender kinds of fruits early spring is undoubtedly the best time for planting. It is also the best time for the beginner, as there is less liability of failure in spring planting.

(b) For the hardy fruits, such as apples, plums and pears, in sections where there is little danger of winter injury, autumn is possibly the best season for planting.

(c) It is often desirable to plant in autumn even though extra care is required in order to save the crowding of work in the spring. In severe locations autumn planting may often be practiced successfully, providing the stems of plants are laid flat on the ground after planting and covered with a few inches of earth, and afterwards mulched on the approach of winter. In doing such work the location of the top of the tree should be marked with a stake so that it may be found easily in the spring when it is to be uncovered. Autumn planting is often a convenient practice and may save the necessity of doing such work in the spring when fruit growers are generally crowded.

Where to Buy.—As nursery stock cannot be fully judged by its appearance as easily as many other lines of merchandise, buyers are very dependent upon the representations made to them by the parties from whom they purchase. As a rule, it is desirable to buy of the nearest reliable man who will furnish what is wanted at a fair price. Purchasers will often find it advantageous to deal directly with the principal instead of through his agent. Expect to pay a fair price and be suspicious of bargain counter nursery stock, for the buyer in any case is greatly dependent upon the honesty of the seller for the genuineness of his stock. You cannot always tell what it is by its appearance. It may not even be true to name.

Selecting the Tree Nursery Stock.

(a) It is important to secure vigorous, thrifty nursery stock that is free from scale insects, root lice or other injurious insects or diseases.

(b) Select trees that have their bark green and smooth and that have made a thrifty growth the year before.

(c) In the case of grafted fruits the fruit grower should insist upon having his stock worked on roots adapted to his location. This feature does not need so much attention in the best fruit sections, but in cold, northern climates, in the extreme South and in some other locations it is a matter of first importance. This matter is discussed under the propagation of each fruit.

(d) In order to make early autumn delivery it is customary in some nurseries to strip the leaves from the trees. This is not the best practice and such trees should not be selected.

Age of Nursery Stock to Buy.

As a rule young, thrifty nursery stock is to be preferred. The tendency among beginners is to use stock which is too old. Old plants are much more injured by moving than those that are young and often give poorer results.

Shapes of Trees.

(a) The general public wants a tree that is of good form and the nurserymen prefer to grow that kind.

(b) Some of our best varieties are so crooked that they do not look well and hence have not been pushed by our nursery-men.

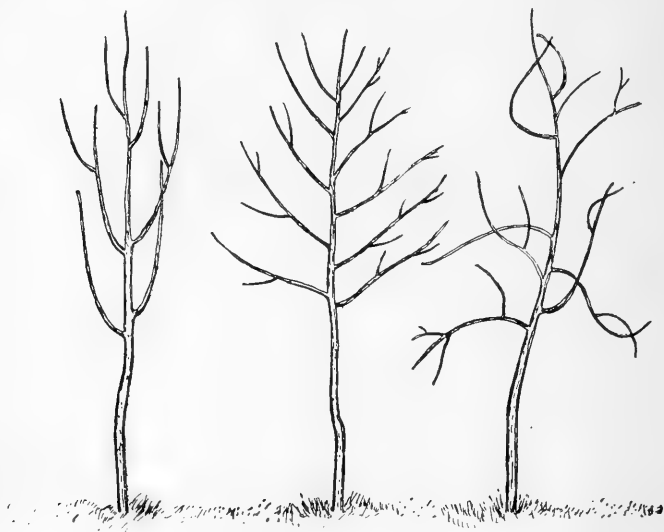


Fig. 7.— Young apple trees of different forms.

(c) The difference in the habits of trees can be easily seen in any orchard of many varieties. The upright form of the Tetofsky apple is in marked contrast with the spreading form of the Roxbury Russet. The spreading form of the Wild Goose plum is very different from that of the Lombard. A person who is very familiar with the appearance of certain varieties of pears or apples can easily separate them from other kinds by the appearance of the tree even when devoid of foliage. From this the impression should not be taken that all fruit trees may be distinguished from each other by their forms, color of bark and other characteristics, for while a person of much experience in this line may thus distinguish many kinds, it is quite out of the question to separate the members of all our long lists of fruits in this way.

Planting the Orchard.

There are a number of systems of setting trees. The ones most generally used are the square, quincunx and hexagonal systems. The lay of the land and the size of the orchard will influence to some extent the choice of a system. Trees are more often set too close than too far apart. This, in fact, is the danger in using fillers. (The use of fillers is discussed on page 46.) One does not like to remove a tree, once it is grown, even though it is injuring other trees.

It is always important that the rows run straight both ways since the orchard looks better and is cared for more easily. The first thing to do is to establish a base line and work from this. It is usually safer to have a surveyor establish this line than to trust to a road or fence unless the road is known to be on the proper line. Having the base given, it is an easy matter to establish the two perpendiculars to this and the fourth side parallel to the base. This gives the outside trees of the orchard. Then, by using the outside trees as sight stakes the other rows may be made straight both ways. If the land is laid off with a marker one way and a plow the other, the trees are quite easily put where they belong by sighting to the trees set at the ends of the rows.

Square System.—Of the systems named above the square system is the most often used. It does not permit of so many trees per acre, but is easily laid out, permits of easy cultivation and allows systematic thinning of trees later in its life when the trees crowd.

P	P	P	P	F	P	F	P
			F	F	F	F	F
P	P	P	P	P	P	F	P
			F	F	F	F	F
P	P	P	P	F	P	F	P

Square System

Square System with Fillers

Quincunx System.—This system permits of planting many more trees per acre than the square system. It also permits the use of fillers and provides for a well laid out orchard when the fillers are cut out.

P		P		P
	P		P	
P		P		P
	P		P	
P		P		P

Quincunx System

P	F	P	F	P
F	P	F	P	F
P	F	P	F	P
F	P	F	P	F
P	F	P	F	P

Quincunx System with Fillers

Hexagonal System.—About 15 per cent more trees are used in planting by the hexagonal than by the square system. It has the advantage of distributing the trees more evenly over the ground than the other systems. Its disadvantage is that cultivation is much more difficult. It does not permit of any satisfactory method of thinning out the trees without leaving too large gaps.

P		P		P
	P		P	
P		P		P
	P		P	
P		P		P

Hexagonal System

P	F	P	F	P	F
	F		F		F
F	P	F	P	F	P
	F		F		F
P	F	P	F	P	F

Hexagonal System with Fillers

Digging the Holes.

(a) In digging the holes make them large enough to receive the roots without crowding and deep enough as a rule to bring the union of the stock and cion well below the surface. Trees should generally be planted a little deeper, say from four to

eight inches, than they grew in the nursery. In severe locations and on gravelly soils they are frequently planted a foot deeper to protect from frost injury.

(b) In the case of fruit trees of best planting out size, if the land has been properly plowed and furrowed out only a little digging will be required.

(c) In digging holes in shallow soil put the surface and subsoils separate and then use the surface soil to cover the roots and put the subsoil on top.

(d) Firm the soil around the roots of the trees until it is solid. For this purpose it is a good plan to use a packer of wood such as is used to firm the soil around posts. This is especially important on dry soils.

Pruning the Trees.

(a) Trees may be left until after they are set out before pruning but sometimes it may effect quite a saving in freight to prune the trees before they are shipped from the nursery.

(b) Severe pruning is often needed for young trees as much depends upon the forming of the tree when young. The subject of pruning is more fully discussed in Chapter IV.

(c) Perhaps no question is more important than that of deciding at what height the trees should branch out. This will depend much on location. Trees with long trunks certainly tend to make cultivation methods easy and in very favorable sections they may be safely thus trained. In the Middle states and the Pacific coast states, best results have come from allowing the branches of trees to start within two feet of or close to the ground and thus the trunk is protected against sunscald and other climatic troubles. Fruit may be harvested more easily and cheaply from trees with low, open heads.

(d) It is generally advisable to shorten the roots of ordinary two-year-old apple and pear trees and vigorous one-year-old plum and peach trees to about eight inches, where there are several roots, as such treatment facilitates planting and does not injure the trees. Larger trees should have their roots shortened in the same proportion and the ragged ends of roots should always be cut off before planting. Such pruning as this may easily be done with a sharp hatchet on a block.

Cultivation of Fruit Plantations.

In a state of nature, as in our primeval forests and groves, where trees do well, they generally have the surface soil about their roots covered with a loose accumulation of vegetable mould that is shaded from the sun and wind. The deeper soil is filled with roots more or less decayed and tending to keep the subsoil porous. This covering protects the soil from baking, drying out and becoming too compact and gives the conditions aimed at in the cultivation of the land. For this kind of treatment, there must be a great accumulation of vegetable mould, which is incompatible with the light and air needed for the production of cultivated fruit and with the opportunity to get at the trees from all sides for gathering the fruit and for giving the protection that the trees need from noxious insects and diseases. The nearest approach to nature's method of cultivation is accomplished by mulching the orchard, which is sometimes done to advantage.

The reasons for proper cultivation are: (a) To give our favorite plants all the light, air and soil that they can use to advantage by destroying all competitors in the shape of weeds which would ordinarily make their struggle for existence more severe. (b) To protect from drought by keeping the top soil loose. In this way evaporation is prevented and the moisture saved in the soil for the use of the roots. Soil that is compact will transmit water upward to the surface by capillary attraction where it can evaporate, but when the surface soil is loose evaporation is prevented and the water thus transmitted from the subsoil is retained near the surface. This is one of the chief reasons for the cultivation of the soil. The extent of this protection is shown in the following table taken from "Soils and Fertilizers" by Professor Harry Snyder and giving the result of some examinations made in dry weather:

	Per cent of Water in Field.	
	With Shallow Surface Cultivation.	Without Cultivation.
Soil depth 3 to 9 inches.....	14.21	8.02
Soil depth 9 to 15 inches.....	17.21	12.38

(c) The cultivation of the soil also sets plant food free. It opens the soil up so that the air can get in and assist in the development of the plant food locked up in an insoluble form. This is an important function of tillage. The soil should be regarded as a great laboratory in which many complex organic and inorganic changes are continually taking place.

Humus is the decayed organic matter found in soils. It much resembles common charcoal in its physical properties, has great affinity for water and holds fertilizing agents in the soil. Humus makes the soil porous so that the air can readily penetrate it and also assists in chemical changes. Since it keeps the soil porous it prevents it from baking hard, thus protecting it from drought. It is largely on account of these qualities of humus that stable manure, a large per cent of which is humus, is often so much more effective than commercial fertilizers. The plowing in of green crops adds humus to the soil. The continued cultivation of the soil sometimes affects it injuriously by oxidizing all the humus and leaving it in such a condition that it washes badly and will not hold moisture. A good illustration of this change is shown in the fact that newly cleared land will seldom wash badly until the decayed organic matter in the soil has become so thoroughly oxidized that the humus no longer holds the soil together. After this organic matter has disappeared clay soils lose their loose, porous texture and become hard, compact and liable to wash.

The value of humus in the soil is well illustrated by experiments at the Minnesota Experiment Station. Corn, grown continuously for six years on the same field, yielded an average of 21.4 bushels per acre, while corn in a three-rotation, including wheat and clover, yielded 47.1 bushels per acre. As the plot producing corn continuously has sufficient plant food to mature a normal crop annually, the low yield can only be accounted for by the poor physical condition of the soil produced through the depletion of the humus by frequent cultivation.

Growing fruit trees in sod is a practice not to be generally recommended, but where the soil conditions are especially favorable it may sometimes be done to good advantage. In locations where trees are especially liable to injury from drought it is a

poor practice. In the retentive soils of Minnesota, Wisconsin, Iowa and elsewhere, apples may be grown to great perfection by spading up the soil about the tree for a distance of three or four feet from the trunk each spring and later in the season mowing the grass and weeds and putting them around the trees. However, such locations are exceptional and the great truth remains that, in general, orchards which are kept in sod are seldom profitable. When orchards are in a stiff sod the rain water is prevented from soaking into the land because an old sod on steep hillsides sheds water readily. The grass roots also carry up large amounts of water from the soil, which is evaporated and lost.

Mulching.—Growing trees and other plants by mulching may sometimes be successfully practiced. Some of the points to be considered in this connection are:

a—There is a great difference in the protective values of different kinds of mulch. A covering of coarse weeds may afford little protection, while a mulch of hard-wood sawdust would give excellent results.

b—Trees that are grown by mulching generally do best when the soil about them is worked in the spring before the mulch is applied.

c—A mulch may often be used to advantage close to trees where the soil near them is not easily cultivated. In such cases it is a good plan to protect the tree trunks with galvanized iron wire netting from injuries by mice which are especially attracted by the mulch.

d—Raspberries, blackberries, currants and gooseberries may be grown by a system of mulching without cultivation but it is seldom desirable to grow them in this way.

e—While the cultivation of the soil is not as successful in the conservation of moisture as mulching, yet when the best cultivation is practiced it is far better than mulching as commonly done.

f—Mulching fruit plants the year around without spring working of the soil tends to encourage a development of large surface roots which may later be winter-killed. Large surface roots also interfere with cultivation when mulching is discontinued,

although the risk of permanent injury from this source is much less than is generally supposed.

g—Mulching sometimes causes great danger by fire.

h—The mulch about plants may harbor insects, such as curculio, etc., which might injure the trees. These are most easily kept in check by clean cultivation; but where fruit trees are mulched, pasturing hogs in the orchard will greatly help in checking the spread of such insects as remain in the fruit after it falls.

Cover crops is a term used in connection with the growing of crops in orchards. In a general way, the best fruit growers are a unit in believing in the importance of clean cultivation for orchards. However, as we have already noted, this is often impractical on steep hillsides liable to wash badly. Clean cultivation also leads finally to a poor condition of the soil which can only be fully remedied by the addition of humus. This humus may be added by the application of coarse stable litter or other organic matter directly to the land. In this case the humus is confined almost entirely to the few upper inches and is not distributed throughout the soil as it is by the growth of clover or similar crops. The decaying roots of a cover crop leave humus both in the sub-soil and in the surface soil, thus rendering the whole mass more porous.

Still other advantages of cover crops are (a) they protect the soil to some extent from deep and sudden freezing and thawing; (b) they prevent the snow from blowing away in the winter; (c) such cover crops as clover and peas not only improve the physical conditions of soils on which they grow, but actually leave them richer in nitrogen. On this account plants of this class are especially desirable for orchards. (d) They are sometimes helpful in checking the production of the wood in late summer by using up some of the plant food and moisture in the soil. This checking of late growth in the fall ripens up the wood earlier, leaving the tree in better shape to stand the winter.

How to combine the advantages of cover crops and cultivation is often an important question for orchardists. In many fruit sections, this may be done by the cultivation of the soil during the summer and seeding down to some cover crop in the

late summer or early autumn. This may be a crop that will kill out in winter or that will live over and be allowed to grow on the land until late in spring, when it is turned under. Occasionally it may be a good plan to seed an orchard down to clover for a year or two in order to increase the humus in the soil; as, for instance, in the case of soils on steep hillsides where the humus is nearly exhausted. For this purpose the land should preferably be plowed in late autumn and the clover seed sown in early spring without any nurse crop.

Examples of practical use of cover crops.—Cover crops are of various kinds, among which may be mentioned the following:

(a) Peach growers of Michigan and apple growers and nurserymen in Minnesota use oats in their orchards, sown from the first to the middle of August, to protect the roots from severe freezing. Such a cover holds the leaves in autumn and the snows in winter, thus preventing frequent freezing and thawing as well as deep freezing of the ground.

(b) Crimson clover is an excellent cover crop for parts of New York State and south to Alabama. It should be sown in late summer or early autumn in New York but later in Alabama where it grows all winter.

(c) Buckwheat is a good cover crop for steep slopes or other places where it may be desirable to use a cover crop in summer. It shades the ground and aids it in holding moisture thus preventing the soil from drying out.

(d) Vetches and cowpeas may sometimes be used to advantage for a cover crop and should be sown in early spring. The cowpea is the great cover crop of the Southern states.

(e) The soy bean is a good cover crop. It is sown in mid-summer in rows.

(f) The velvet bean and beggar weed are great cover crops for the extreme Southern states.

(g) Mammoth clover and alfalfa may be used as cover crops if plowed under the second or third year. They should be sown in orchards without a nurse crop in the early spring. Sometimes they are sown in the orchard, leaving a space of four feet for cultivation by the side of the rows of trees.

Amount of seed of cover crops to sow per acre.—The following table shows the number of pounds of seed required per acre

to obtain a good stand of the cover crops generally used in this country:

Nitrogen Collectors.	Nitrogen Consumers.
Alfalfa40 lbs.	Rape 9 lbs.
Hairy Vetch40 lbs.	Turnip 2 lbs.
Cowpeas90 lbs.	Rye 30 lbs.
Soy Beans90 lbs.	Oats 2 bu.
Velvet Beans25 lbs.	Barley 1¾ bu.
Mammoth Clover20 lbs.	Buckwheat ¾ bu.
Crimson Clover20 lbs.	Corn ½ bu.
Sweet Clover15 lbs.	

Crops in the orchard.—The question of cropping the orchard is an important one. As a rule this should never be done, yet it may often happen that while the trees are young, before they need all the space between them, some other crop can be grown on the land to advantage. In such a case, the soil must be manured or it may run down so much that the fruit crop will not be profitable. The best test to apply to this is to see that the young trees make a reasonable growth of wood each year and, with this accomplished, there is no danger in cropping the orchard.

A cover crop may permit a fair growth of wood but will so rob the soil of moisture late in the summer that the fruit will fail to fill out properly.

The small grains are especially objectionable in the orchard because they do not permit the cultivation of the soil nor shade it sufficiently to keep it from baking. These crops also take much plant food from the soil.

Potatoes and corn require the cultivation of the soil in summer and consequently are among the best to grow in the orchard. In the orchard preference should be given to those crops that do not require the cultivation of the soil in late summer or early autumn, since cultivation seems to encourage late growth of wood. If the orchard is to be cropped care should be taken that the fertility of the soil is not impaired thereby, and ordinarily it will be necessary to add manure to replace the plant food removed.

Small fruits of various kinds may be used in orchards but must be removed when the trees get large enough to need all the land. It may often be a help to an apple orchard to have the tree trunks shaded by small fruits, such as raspberries and currants.

Planting with fillers is the name given to the system of planting whereby an extra number of trees are set out with the purpose of cutting them out as soon as they get large enough to crowd the trees that are to grow to maturity. Good examples of this practice are found in the planting of peaches or plums in the intervals between apples, or in planting twice as many peaches or plum trees on the land as can grow to maturity, the intention in each case being to cut out one-half of them as soon as the trees begin to crowd. This is not a bad practice when well carried out but in the hands of the average fruit grower the thinning process is seldom begun soon enough. This may result in serious injury and is always harmful.

Fruit Crops and Plant Food.

The most important factor in the growing of a fruit or other agricultural crop is the proper preparation of the soil. This should be attended to before anything is attempted in the way of fertilization of the land. Get the soil into the best physical condition and then manure* may be used to best advantage. In the case of orchards in new forest land it is poor practice to plant until the stumps and trash are well subdued, except where mulching is to be practiced, since the soil can be cleaned most economically before the trees are planted out.

All agricultural soils contain plant food in two forms:

(a) Where the soil is rich in plant food which is easily available to the roots of plants and which they can absorb readily. This is the condition of the soils in new fruit growing sections where the land has not yet been cropped extensively. Such soils may also contain a large amount of plant food which is not readily available.

(b) Soils also contain plant food in a form which is not readily available to the roots of crops. This is the condition of

*As here used, the term "manure" includes both animal manures and commercial fertilizers.

the largest amount of plant food in all soils and especially so in the case of soils that have been poorly tilled for long periods.

Each year a portion of the insoluble plant food in the soil is made soluble or put into such a condition that the roots of plants can use it. In the soils of the older sections the soluble plant food is largely used up and sometimes only the amount that is set free each year is available to the plants. It is this store of food that we should aim to supplement by the manures which we apply to the soil.

There are some new soils so rich in plant food that nothing is gained by manuring them. In fact, fruit trees on such soils are occasionally damaged by the use of manures which encourages a late growth in autumn, but such cases are rare. Practically all our fruit lands, especially those in the older fruit growing sections, are greatly improved by the addition of manures. This is especially true of bearing orchards.

In manuring the orchard the object is to get the maximum crop. The average crop or one just below the average is seldom profitable, being generally inferior in quality as well as in quantity. It comes in competition with the crops of all the poorest fruit growers and is sold only to people of small means.

The application of manure is for the purpose of getting the most profitable crop. It matters not how much money we put into our land providing we can take it out with a good profit. In other words, expensive manuring may be most profitable. It is the best grower that gets the profitable crop. Manure will not take the place of good tillage, insect protection and other similar factors, but the well fed plant, like the well fed animal, will overcome adverse conditions under which the weak, under-fed individual will succumb.

The elements that enter into the composition of fruit crops are the same as those that compose our farm crops. They differ largely in the relative proportions in which they enter various crops, but as our information about the composition of the soils in which our plants grow is indefinite, and as we use manures to supplement the plant food in the soil, we need not be particular about the exact proportions in which we apply it. Each grower should study his own soil conditions and the effects of different manures on it in order to get the best results.

The chemical elements composing our fruit and agricultural crops are oxygen, hydrogen, nitrogen, phosphorous, sulfur, iron, potassium, sodium, calcium, magnesium, chlorin and silicon. Nitrogen, potassium and phosphorous are the elements commonly lacking in the soil and it is these that we look for in the so-called commercial fertilizers and manures. These elements each act differently in affecting vegetation. To be used by the plants they must be soluble in the soil solutions. Soil that has an excess of soluble nitrogen in it encourages a vigorous, soft growth of wood and a dark green color in the leaves. Often such plants are unproductive, but when they bear fruit it is generally large in size. On such land trees are liable to grow late in autumn and as a consequence winter-kill. For peaches, such soil is more injurious than for apples and other hardy crops. Nitrogen encourages a growth of wood rather than fruit. Large amounts of potash and phosphoric acid in the soil cause a firm, solid growth of wood, early maturity of plant, high color and extreme fruitfulness but do not increase the size of the fruit like nitrogen. Potash and phosphoric acid, with the proper proportions of nitrogen, give the best results, all of these elements being necessary for healthy plant growth.

Amount of plant food in a crop of apples.—It is interesting to note the amount of nitrogen, potash and phosphoric acid taken from the land by a crop of seventy-five barrels of apples—that number being used as it represents a good average crop of apples per acre.

TABLE SHOWING THE CHEMICAL COMPOSITION OF 75 BARRELS OF APPLES.

Water	Dry Matter	Nitrogen	Phos. Acid	Potash
9563 lbs.	1687 lbs.	4.5 lbs.	2.25 lbs.	11.25 lbs.
or 85%	or 15%	or .04 %	or .02%	or .1%

To raise this crop of apples there are perhaps 50 trees, each one of which is fifteen years old and in its branches, trunk and roots, there are 400 pounds of wood of which 40% is water. It is probably fair to assume that the weight of the new growth of wood of a thrifty apple tree at fifteen years of age is twenty pounds per year, from which the amount of plant food used for the production of wood each year can be readily computed. It is also safe to assume that the amount of plant food yearly set

free in the soil is sufficient to take care of this growth of wood. The leaves are returned to the soil and hence the material in them does not have to be supplied to the soil. Therefore, if we supply enough plant food to put back that taken away from the land in the crop, we will keep our land in good condition. There is nothing exact about such statements, as they may vary as much as different soils do from one another. The following table shows approximately the amount of plant food materials removed in one year from the soil of an acre of land fully stocked with thrifty trees. This includes the amount contained in the new wood, foliage and fruit:

PLANT FOOD REMOVED FROM THE SOIL BY ONE ACRE IN ORCHARD.

	Nitrogen	Phos. Acid	Potash	Lime	Magnesium
	lbs.	lbs.	lbs.	lbs.	lbs.
Apple	51.5	14	55	57	23
Peach	74.5	18	72	114	35
Pear	29.5	7	33	38	11
Plum	29.5	8.5	38	41	13

The following table shows the amount of nitrogen, phosphoric acid and potash found in a good crop of fruit grown on one acre:

PLANT FOOD OF MANURIAL VALUE REMOVED FROM THE LAND BY VARIOUS FRUIT CROPS.

Fruit	Pounds	Nitrogen	Phos. Acid	Potash
		lbs.	lbs.	lbs.
Apples	11,250	4.5	2.25	11.25
Pears	10,000	4	1	12
Plums	7,200	7	3.6	14.4
Peaches	4,950	4	2	9
Quinces	7,200	8	3.6	17.2
Raspberries	4,800	5.6	4.3	12
Blackberries	4,800	9.6	2.4	11
Strawberries	4,000	5.2	2	9.2
Currants	4,000	12	4.8	12
Gooseberries	4,000	6	2.8	8
Grapes	6,000	9	4.2	18

This manurial value may be applied to the land in many forms. Maynard gives the following formulas:

(a) For fruit trees over ten years of age (forty trees), varying in quantity according to the condition of the soil and crop, 250 to 500 pounds of fine ground bone, 100 to 300 pounds of sulfate of potash, 50 to 150 pounds of nitrate of soda.

(b) Unleached hardwood ashes at the rate of one to two tons per acre and 500 pounds of fine ground bone.

(c) 400 to 600 pounds of South Carolina rock, ground fine, 100 to 300 pounds of sulfate of potash, 100 to 300 pounds of nitrate of soda.

(d) Barnyard manure, 6 tons per acre.

No manure needed in some cases.—In the case of some new and extra fertile fruit soils there may be no apparent diminution of fertility of the soil for many years. Such soils may often be maintained in their best condition indefinitely without the addition of manures by the use of nitrogen-gathering cover crops, such as clover, vetches and peas.

Time to apply manures to fruit lands.—In the case of fresh animal manure not yet decayed, there is little loss ordinarily in applying it broadcast as soon as removed from the stables or yards. As a rule this is the most economical way to handle it and is the general practice among good farmers, fruit growers and gardeners. However, partly decomposed manures contain so much soluble plant food that the loss might be very serious were the manure applied to the surface of frozen ground. Such manure is most economically applied in the spring and at once covered by a light plowing or harrowing. Such manure should generally be covered at once after applying and not allowed to dry out on the surface of the soil.

It is generally best to apply commercial manures to fruit plantations in the early spring or early summer. This is especially true of such soluble, quick acting fertilizers as nitrate of soda and muriate of potash. These may be applied broadcast to the soil about the trees. The surface covered should generally be fully as large as the diameter of the top of the tree but in the case of upright trees a larger surface should be covered. When the land is well stocked with mature trees the manure should always be applied to the whole surface of the soil.

Irrigation of Fruit Crops.—In some fruit sections special care must be taken to provide for the proper irrigation of all crops, while in others water need only be applied in very dry seasons. It is always advisable, if it can be arranged at a reasonable cost, to provide water for such crops as strawberries and blackberries, so that it may be used when needed. In some seasons a failure of the strawberry or raspberry crop may be averted by applying water at the right time.

In arid regions where crop growth depends on irrigation a careful study must be made of the needs of the crop and the soil, and the time and manner of applying water. Outside of the irrigated districts thorough cultivation of a crop is better than irrigation, unless water is absolutely needed. Cultivation should always follow irrigation where possible.

QUESTIONS—CHAPTER III.

1. How are varieties of fruits adapted to different districts?
2. How may the varieties be classified in regard to their adaptation?
3. What general principles should the fruit growers follow in selecting varieties for planting?
4. How and when should land be prepared before planting fruit trees?
5. When is the best time for planting?
6. How should the fruit grower select his nursery stock in reference to the hardness, age and shape of the trees?
7. What methods may be followed in setting out the trees?
8. How should the holes be dug for the trees?
9. What pruning do the young trees need when set out?
10. What treatment does the soil need in a fruit orchard?
11. What are the reasons for cultivation of the soil?
12. What is humus? Oh what value is it in the soil?
13. How may fruit trees be grown in sod?
14. What are the advantages of a mulch to a fruit crop? What are the disadvantages?
15. What is a cover crop? What are the advantages of a cover crop?
16. How may the advantages of cover crops be combined with cultivation?
17. What field crops are used as cover crops for the orchard?
18. How much seed should be sown per acre in order to get a good cover crop?
19. Is it practicable to raise garden crops in the orchard? What crops are best to grow?
20. How is the orchard planted with fillers?
21. What is the best way to get new fruit growing land into the best physical condition?
22. In what two forms is plant food found in the soil?
23. What is the result of a soil too rich in plant food for fruit growing?
24. What is the purpose of applying manures to the land?
25. What are the elements that enter into the composition of the fruit crop?

26. What effect does an excess of nitrogen in the soil have upon fruit crops?

27. What effect does an excess of potash and phosphoric acid in the soil have upon the fruit crops?

28. How is the plant food taken from the soil by the plants returned to it naturally?

29. What are some of the formulas for combining and applying different fertilizers to the soil?

30. When should manures be applied to fruit lands?

31. What is the general practice of applying manures to the land?

32. When should commercial fertilizers be applied and how?

33. When is a supply of water for irrigation desirable?

CHAPTER IV.

PRUNING.

Careful watching, pruning and care are necessary in the handling of a fruit plantation if the best results are to be obtained. The day is past when the successful orchardist can afford to set his trees and let nature take care of them. He must spray and prune. Under natural conditions nature prunes surplus branches and trees, but when those trees are grown in an orchard and plenty of room is given for growth and development certain shaping and training must be given to get symmetrical and useful trees.

Reasons for Pruning.—Trees are pruned for a variety of reasons, among which are the following:

(1) To remove dead and diseased wood. Nearly all trees have dead and diseased limbs some time during the year, which must be removed in order to keep the tree healthy.

(2) To allow sunlight and air to get into the branches and aid in keeping the tree healthy. If the branches grow too thick the fruit in the tree will not color up as it should.

(3) To aid in the production of first class fruit. Too much wood will form on a tree, thus causing the tree to bear too heavily and consequently produce small, poorly-colored fruit.

(4) To secure shape and size that will enable spraying, cultivating and picking to be easily and economically done.

(5) To protect the tree from injurious winds and injuries resulting from climatic conditions, as sunscald, sleet storms, etc.

(6) To rebuild and give more vigor to weak trees or weak limbs. It is often best to replace trees of this sort with new ones.

(7) To remove bruised or injured branches or roots.

(8) To restore the balance between roots and top in the case of setting out young trees.

The effect of pruning and the necessity for pruning depend upon climatic conditions to some extent. In a humid district

the tree should perhaps be more open than in a dryer district to permit more sunlight to enter the top of the tree.

Too open a head in some districts might lead to sunscald of tree and fruits. In the irrigated districts much extra wood is cut out and still the fruits of the trees must not be exposed too much. In many districts it is well to prune very little other than to remove dead wood and interlocking branches.

Pruning the Young Tree.—Pruning should commence with the setting of the young tree. When it is received from the nursery all bruised roots should be shortened with a sharp knife. The top should be cut back to correspond to the amount the root has been shortened.

If the climatic conditions are moist and the soil rich, not as much wood will need to be removed as in a dry season when the soil and atmosphere are dry. Some growers even advocate very severe root and top pruning as is given by those who follow the Stringfellow method. This system is probably too severe for general planting.

Start the Head Low.—If a tree is properly handled from the time it is planted little heavy pruning will be needed. Heavy pruning is always objectionable since the wounds do not heal over as readily as the small ones and are thus more apt to cause permanent injury to the trees. Any branches that interlock or that are giving the tree an unbalanced appearance should be taken out. It is generally conceded that a low-headed tree is the best type to grow because the spraying and picking of the fruit may be more easily and economically done and there is less danger from storms. The head should be started from 18 to 24 inches from the ground. If properly handled this will permit of easy cultivation. Too many branches should not be allowed to make up the head or it will become crowded. Three or four are plenty and with careful attention will form a symmetrical head.

When to Prune.—Small limbs may be taken off at any time of the year. Large limbs should be taken when the tree is dormant. The best time is in late winter just before growth starts. There is less danger of the wound drying out and cracking if done then than if done early in the fall. Pruning is usually

done at any time during the winter when there is no frost in the wood. Pruning tools will break much easier when the wood is frosty. The winter is often the slack season in fruit districts and the work can be done cheaper then. Some pruning may be

done at the end of the growing season in late summer, but this is apt to start a late fall growth which is objectionable in the colder districts.

Cut Close and Clean.—

First, make a study of the tree to be pruned and then follow some definite plan to train that tree. The best orchardist obtainable should do the work. All cuts

should be made with sharp tools and close to the shoulder. Stubs should never be left as they will not heal over and only cause decay in the tree. In making the cut, if it be a large limb, saw from the bottom up a short distance, then take the saw out and saw down so as to meet the under cut. This will prevent the limb splitting off and causing serious injury to the tree. Always make a clean sharp cut. It will heal much quicker than a rough, bruised or jagged one.

Paint the Cut.—It is a good plan to apply a thick white lead paint to any wounds over an inch in diameter as this keeps the wood from drying out. Paint only the wounded part. Grafting

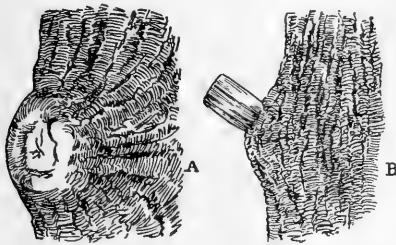


Fig. 8.—Effect of pruning. a.—Scar from a limb properly removed, after two years. b.—Stub left from careless pruning.

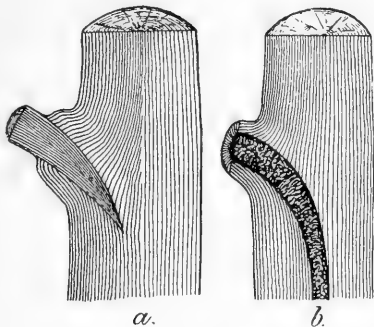


Fig. 9.—Result of cutting too far from trunk. a.—Section showing stub. b.—Decay from long stub penetrating heart of tree.

wax is an especially good material to use, but is too expensive for ordinary use where many limbs are to be painted.

Tools.—Good tools kept in good condition are essential for good pruning work.

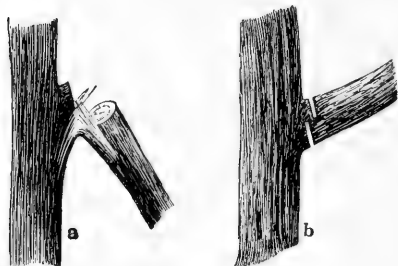


Fig. 10.—Methods of cutting. a.—Split from removal of limb cut from above. b.—Proper method of removing limb.

The common ax and bucksaw do not come under this head. A good saw, light and heavy shears, tree pruner for heading in limbs, ladder and heavy knife are all the tools actually needed in the work.

The common two-edged pruning saw is the one most often used. The swivel saw is much handier, however. The heavy long-handled shears often take the place of the saw, but unless the pruner is careful in handling them stubs will be left on the tree.

Forming the Apple Tree.

—Figure 13 shows the different steps in formative pruning, starting, as is done in some parts of the country, with the one-year-old tree. The numeral 1 represents a tree set; 1a shows it cut back to 18 to 24 inches from the ground and the side branches cut off. This will force out a number of side buds into strong branches. If all of these are allowed to remain we have a tree similar to 2 the second year. These should be thinned to three or four, as shown in 2a. There

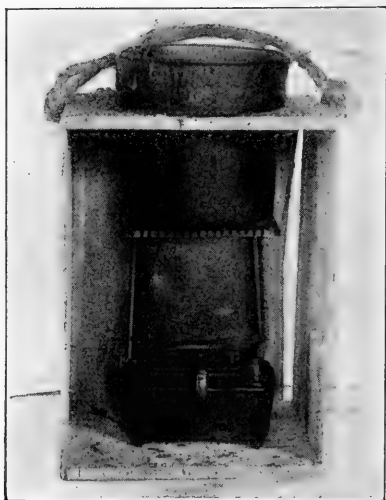


Fig. 11.—Handy method of heating grafting wax to paint wounds.

should be at least three or four inches between each branch to prevent the development of crotches, which are especially objectionable in apple trees. The arrangement around the trunk is shown in figure 14; *a*, the first year's growth; *b*, the second year's growth.

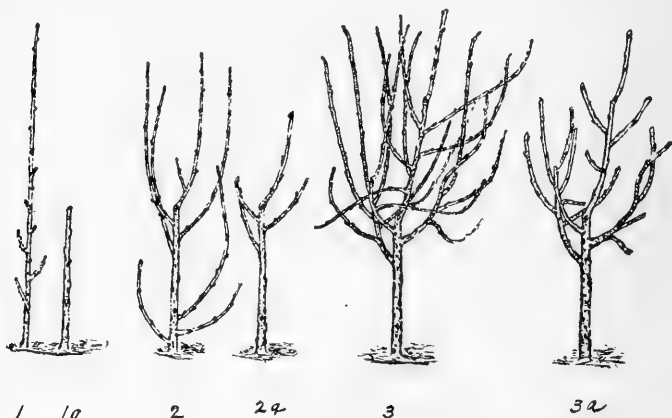


Fig. 13.—Forms of tree before and after pruning. 1 and 1a, at planting time; 2 and 2a, at beginning of second year; 3 and 3a, beginning of third year.

In the second year these scaffold branches should be cut back to one-half or two-thirds their length (figs. 13-2a and 14-a). This will cause two or three strong laterals to develop from near the extremity of each stub.

With the third season, the laterals which have developed from the previous season's cutting back will again need to be headed in about one-half their growth. Shoots which are growing inward, and those tending to cross or rub, should be removed or corrected. The regulation of a shoot is governed by the position on the tree. Note the designated ones and the position of the buds in figure 14, and the suggestions brought out in figure 13, 3 and 3a.

How to Make the Cuts.—In all formative pruning the cuts are made slanting and just back of the bud which has been grown on the proper side of the branch to throw the resulting shoot in the desired direction. The uppermost bud left on the

stub usually throws the strongest branch. In many instances an otherwise dormant bud can be found to throw a strong shoot to fill up an open space in the top by cutting a notch in the main branch just above the bud in question.



Fig. 14.—a, Diagram showing limbs of tree at beginning of second year's growth; b, branches pruned before third year's growth starts.

The method of cutting back to a bud is shown in figure 15; *a* and *b* are cut too far above the bud and will leave an excess of dead wood to be pinched off or covered over by the growing callous; *c* is cut too close to the base of the bud, a proceeding that is liable to cause the bud to be killed by drying; *d* shows about the right position for making the cut. Fig. 13, 1 and 1a, show a properly set one-year-old tree and the same tree pruned to start the head about 18 inches high; in 2 this tree is shown after a summer's thrifty growth, while 2a shows the same tree pruned to form the head; 3 suggests the growth that might result the ensuing season and 3a embodies some suggestions for cutting back to form a desirable head.

It should always be borne in mind that that pruning is best which is moderate. The severe cutting back of a tree once or twice in its life-time, as is so often the practice, can scarcely help but have serious results. Pruning should be done yearly from the time the tree is set until it is mature; it will then never be necessary to remove any great amount of wood at one time.

Espalier or Cordon.—The espalier method of training and pruning is followed in Europe very largely with the apple, pear and peach. It can be used there to advantage since labor is cheap and land is high in price. In America skilled labor is too expensive to use on this work and with our abundance of land the method would be of no value except for ornamental purposes. Espalier training consists of forming the tree into various grotesque shapes, or in training it flat along the side of a building

or fence. It is a common method of growing the pear in England on the south side of buildings.

Renewing Old Trees.—This is a difficult matter and the best method is probably to cut out the trees entirely or else to cut back the tops in winter very severely and train the new growth the same as young trees are handled. If the varieties are not good, top-working with better varieties may often be done to advantage.

Trimnings.—All trimmings from the orchard should be burned at once to prevent the spread of insects or disease that may be on them.

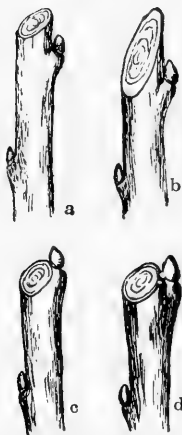


Fig. 15.—Methods of removing buds. a and b, stubs too long; c, cut too close to bud; d, proper method of cutting.

QUESTIONS—CHAPTER IV.

1. What are the principal reasons for pruning orchard trees?
2. When is an open headed tree objectionable?
3. When is an open head desirable?
4. When should the work of pruning commence? How severe should the early pruning be?
5. Why is a low head desirable? How far from the ground should it be to the first branches?
6. When should pruning be done?
7. Describe the method of making cuts in removing small and large limbs.
8. What is the danger if a long stub is left?
9. Why should the larger wounds be painted?
10. What tools are ordinarily used in pruning?
11. What is a desirable form for the young tree?
12. How may the growth of the tree be influenced by pruning to certain buds?
13. How may old trees be renewed?

CHAPTER V.

ORCHARD PROTECTION.

Throughout the whole life of fruit plants there is danger of injury from a variety of causes. At no time can we say that our fruit plants are safe, and we must be continually on the lookout to head off some injury. Among the more common of these injuries may be mentioned the following: sunscald, winter killing of the twigs, roots and fruit buds; injuries from birds and live stock, from wind, rain and frost in the growing season, from ice on the branches in winter, from girdling by mice and rabbits, from label wires, injuries from cultivation and from insects and diseases.



Fig.16.—Apple tree injured by sunscald.

the time when the branches are not protected by leaves. The encouraging of branches on the south side of the tree to protect the trunk from the sun, and the inclining of the trees to the southwest, are also remedies.

This injury is most liable to occur during severe droughts and in the early spring or late winter before growth has fairly started. It is supposed to be caused by the warm sun of the

Sunscald is the name given to the condition of the bark of trees which probably comes as a result of exposure to the sun under certain peculiar conditions. Its effect is usually to kill the bark on the south and southwest sides of the tree; later on, this bark peels off, leaving the wood exposed which soon decays and permanent injuries result. It is found that anything which shades the trunk will prevent this, hence one of the common remedies is to shade the trunk with burlap, corn stalks or similar material, especially during the

middle of the day starting active life in the portion of the trunk exposed to its direct rays. Later, when a cold spell comes, the protoplasm is destroyed and the soluble compounds formed by the renewal of active life are decomposed. The trees most liable



Fig. 17.—Apple trees in trial orchard protected from sunscald by corn stalks.

to this injury are those that are newly set and weak, those with smooth bark such as Hard Maple and Basswood, those trees with the trunks inclining to the northeast and those on dry land.

The philosophy of this disease should come in for more than passing notice. It is well known that one branch or portion of a dormant plant may start into growth independent of the condition of the rest of the plant. Thus a branch from a grape vine



Fig.18.—Apple tree with trunk protected by boxing. Such treatment protects from sunscald, from severe freezing, and from cultivation injuries.

or other plant, brought through an opening into the greenhouse in winter, will soon start into growth while the rest of the vine is frozen out doors. So the portion of the trunk of an apple

tree that is exposed to the direct rays of the midday sun may start into growth independently of the rest of the tree.

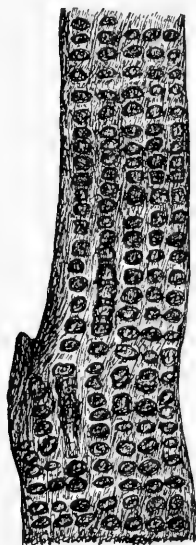


Fig.19.—Bark of apple tree injured by the sap-sucker woodpecker (yellow belly sap-sucker).

Injuries from birds.—Birds are often very injurious by eating cherries, raspberries and some other fruits. At times they become so exceedingly injurious that it may be necessary to use the shot gun, but as a rule the birds that commit these depredations are very helpful in destroying large numbers of injurious insects and the toll they take in fruit is not more than they are justly entitled to. The Yellow-belly Sapsucker is a bird that often girdles the larger branches of our choicest trees. He should be destroyed. Partridges and perhaps quail will sometimes eat the buds of our fruit trees in winter. They may be kept off by giving them a shock of grain to work on instead.

Injuries to trees by cattle.—In remote sections deer will browse the twigs off fruit trees and break them down. Farm stock is also occasionally injurious in the same way. Reasonable precautions will prevent this.

Injuries from wind.—Wind often causes much injury to trees heavily loaded with fruit by shaking off the fruit or even break-

ing the trees. The remedy is the use of windbreaks, the supporting of branches by stakes or by tying one branch to another on the opposite side of the tree. Attention to these precautions will often prevent serious injury. Young trees in exposed places are often injured by being blown about. This is the case for the first year with trees that are newly set and especially those that are set out in autumn and not properly staked or laid down. Such trees are liable to be blown about very much in windy spring weather when the ground is soft, and the tree is then easily loosened and killed. Autumn-set trees should always be staked if they are large enough to take the wind; a

pile of soil about a foot high around them will often be very helpful in holding them in place. In staking, the method of tying the tree so that it will not be scraped by the stake is very important. It would be better not to use stakes at all than not to tie the tree to them properly. It is generally best to tie trees to two stakes, using one on each opposite side.

Mice and rabbits.—Mice and rabbits eat the bark off the trees and where this injury is not more than three or four inches wide and only extends around a portion of the tree, it will often heal over in one or two seasons. But it will be greatly hastened in healing by covering the wound with grafting wax or, better yet, piling up the soil over it if near the ground. When the injury extends completely around the tree and is wide, the tree may be saved by setting some cions in the live bark, above and below the wound, which will carry over the sap until the wound is covered. In such a case, however, the wound should be entirely covered with grafting wax or clay after the cions are put in.

Cultivation injuries.—Cultivation is frequently done in such a rough way that it results in serious injuries. These can be largely prevented by the use of narrower singletrees and by protecting the ends with leather, or, better yet, using leather traces that go completely around the end of the singletree, so that when a tree is struck it is not injured. The best way of treating wounds of this kind is by covering them with grafting wax or grafting clay and then covering the whole with burlap.

Root galls result from the presence of low forms of life known as Nematodes and possibly also from a bacterial disease. Their life history is not well known. They are often exceedingly injurious but some of them do little harm. Prevention is better than cure and it is a good plan to refuse to receive nursery stock having such blemishes. They are sometimes prevented by using stocks that are resistant to such injuries.

Winter killing may be confined to the twigs and roots or flower buds of fruit trees. Any of these injuries may occur in deep valleys, when comparative immunity is secured on the higher land.

Winter injury to twigs and trunks.—This is due to the use of



Fig.20.—Twigs of young cherry trees that have been pulled out by settling of snow crust which had piled in over them.

varieties too tender for the locality and the most successful remedy is to secure hardier sorts if possible. But this is not always possible and the varieties grown may be most profitable if the trunk is protected in winter. Thus, in northern Minnesota the best authorities recommend that the trunks of young apple trees be surrounded with a box six inches square up to the branches and that the same be filled with soil

to furnish protection against winter injury. It is well known that even though the smaller branches may be seriously injured in the winter, they stand a good chance of recovering, providing the trunk is vigorous and uninjured. Such protection also prevents scald, injuries from mice and other animals. In Florida some of the orange growers protect their tree trunks by piling up the soil about them as far as the branches.

Winter injury to the buds of fruit trees.—This is a common source of loss to growers of cherries and peaches at the North. The fruit buds of these trees are liable to start a little in warm winter days and then to be killed by a low temperature, although the leaf buds may not be injured at all. Various remedies have been tried for this, among the most successful of which is the bending of the trees to the ground in autumn and covering with corn stalks. The tops are sometimes tied together and covered with corn stalks or matting in winter. Experiments have also been made in covering the trees with various paint compounds for the purpose of giving an extra covering to the buds, but without good results. One of the most

ingenious ways of furnishing protection to peach buds has been tried by Prof. Whitten of the Missouri Experiment Station who worked on the well known principle that dark colors absorb

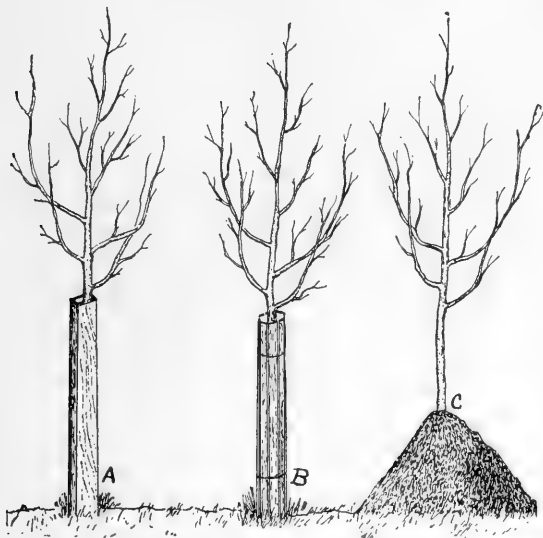


Fig. 21.—Protection of young trees. a.—Trunk protected by wooden box. b.—Trunk protected by lath screen. c.—Trunk protected against mice by mound of earth.

more heat than the lighter ones. He found that light colored peach twigs were slower about starting into growth and conceived the idea of spraying peach trees with lime wash to prevent their starting on mild days in winter. He claims to have been very successful in this practice.

The roots of fruit trees may be seriously injured in winter.—This may result from the use of a root stock too tender for the section in which the tree is grown. For instance, in Iowa, North Dakota, South Dakota and Minnesota the best root to use for the plum is the *Prunus americana*, but when they are scarce the nurserymen there often use the Mariana, Myrobalan or even

the peach for stocks. The plum takes well on these and they are commonly used in milder sections, but with such roots, trees are often injured or killed out entirely in severe winters in those sections. The same is true of some other trees. It is important to have them on hardy roots in order to prevent root killing.

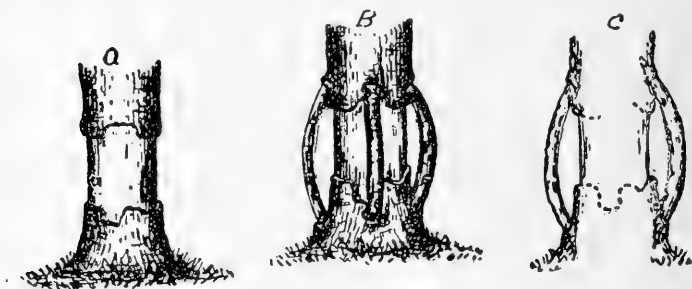


Fig. 22.—Tree gnawed by mice and the wounds bridged over with cions.

Heavy mulching about the roots of trees that are on tender roots will often make them safe against winter injury. Deep planting of trees on tender roots bring the roots deep in the ground where they are not injured and the cion above will generally send out hardy roots. As stated above, it is not uncommon to have the tender stocks on which trees are worked killed out, and if the cion has rooted the effect is seen in a weakened growth until a new root system has formed. If there are no roots from the cion the tree dies.

Protection from frost.—Freezing affects different plants in various ways. We can therefore divide plants into two classes:

(a) **Frost tender plants**, such as the asparagus, ash, oak, spruce and various other plants whose young foliage is easily injured by severe frosts.

(b) **Frost hardy plants**, such as the apple, peach, willow, poplar and birch whose foliage is not destroyed by even a severe frost.

The flowers of many plants will stand a severe freeze without injury providing they are not open when it occurs. This is

the case with the apple, pear, strawberry and most cultivated northern fruits.

We also have fruit plants like that of the Buffalo Berry and Juneberry whose flowers are seldom injured by severe frosts, even if fully expanded at the time it occurs.

The pistils are the parts of flowers most easily injured.—Thus, in the strawberry, after a severe frost in flowering time, we will often find the pistils ruined but the stamens apparently uninjured.

When injurious frosts are most likely to occur.—Injurious frosts are most likely to occur in places where the air is still, especially in low spots where the air is not only still but where the cold air from the surrounding elevations drains in. If the air moves rapidly, the warm air is mixed with the cold air and does not separate. Such frosty places are evident at the time of the first severe autumn frosts, especially if this comes early. It will then be seen that the frosty air fills certain hollows, as water might fill it. In such places, often called warm sheltered nooks, winter killing is frequently serious. A windbreak may also make a frost pocket on the side hill by interfering with the free circulation of the air.

The locations where injurious frosts are least likely to occur and hence afford the best location for fruit growing are high elevations tipping to the north or east where growth is rather backward in spring. Other locations that are comparatively exempt from injurious frosts are such as are near lakes or streams which tend to produce an equable climate.

Foretelling of frosts.—Frosts may be foretold some hours in advance by means of the wet and dry-bulb thermometers, the readings of which are compared. The difference between the readings is due to the evaporation from the wet bulb thermometer which produces a degree of cold in a direct ratio according to the dryness of the air. If the air is very dry, the wet bulb thermometer may record ten or fifteen degrees lower than the dry bulb. If the air is saturated with moisture they will read exactly alike. The basis for the calculation is the fact that we seldom have injurious early autumn or late spring frosts after the dew begins to fall. By referring the difference

between the readings of the two thermometers to a table, the dew point may be determined and if it is several degrees above the freezing point, no injurious frost need be expected.



Fig. 23.—Psyrometer for foretelling frosts.

The psychrometer is an instrument made up of a wet and dry-bulb thermometer attached to a board or frame for determining the humidity of the air. One adapted for this purpose may be purchased at a reasonable price from instrument dealers or it may be made as follows: For the frame, take a board eighteen inches long, two inches wide and one-half inch thick with a hole bored in one end to hang the apparatus up with when not in use. Get two all-glass thermometers with cylinder bulbs and the degrees Fahrenheit engraved on the stem. Cover the bulb of one thermometer with a thin piece of cotton cloth, fastening it securely by a thread. When the cloth covering is wet with water and exposed to evaporation in the air it constitutes the wet bulb thermometer; the other thermometer has no covering on its bulb, is not wet at any time and constitutes the dry bulb thermometer.

The following extract from Bulletin No. 23 of the Weather Bureau, U. S. Department of Agriculture, entitled "Frost," explains the method of using a psychrometer to foretell frost.

To make an observation.—The bulb of the so-called wet bulb thermometer is thoroughly saturated with water by soaking it in a small cup or wide mouthed bottle until the covering is thoroughly wet. The thermometers are then whirled rapidly for fifteen or twenty seconds, stopped and quickly read. A mental note of the reading is made when they are again whirled and read. Subtract the reading of the wet thermometer from that of the dry. Find this difference in the column at the side of the following dew point table. Follow the horizontal line under this figure until it intersects the column under the reading of the dry bulb thermometer at the top of the column to the right. The number at the intersection is the dew point

reading. If this comes above thirty-two degrees there is no danger of a frost, but if below there is danger, although frost may not occur owing to wind, clouds or other phenomena.

DEW-POINT TABLE.

Difference of reading of dry and wet bulbs.	Temperature of Air in Degrees (Fahrenheit).													
	15	20	25	30	35	40	45	50	55	60	65	70		
1	11	16	22	27	32	38	43	48	53	58	63	69		
2	6	12	18	24	30	35	41	46	52	57	62	67		
3		7	14	21	27	33	39	44	50	55	60	66		
4		1	10	17	24	30	36	42	48	53	59	64		
5			4	13	20	27	33	40	46	51	57	62		
6				7	16	24	30	37	43	49	55	61		
7				1	11	20	27	34	41	47	53	59		
8					5	16	24	31	39	45	51	57		
9						11	20	28	36	43	49	55		
10						4	16	25	33	40	47	53		
11							11	21	30	38	45	51		
12							4	17	27	35	42	49		
13								11	23	32	40	47		
14								5	18	28	37	45		
15									12	24	34	42		

First Example.

Dry bulb thermometer 60 degrees
 Wet bulb thermometer 47 degrees

Difference 13 degrees
 Dew point from table 32. degrees
 Probably no frost.

Second Example.

Dry bulb thermometer 47 degrees
 Wet bulb thermometer 39 degrees

Difference 8 degrees
 Dew point from table, between 24° and 31° or 27 degrees
 Probably a severe frost.

Protection from injurious spring and autumn frosts may be given in various ways according to circumstances:

(a) By covering up the whole plant and thus retarding its period of bloom until danger of frost is past, as may be done with strawberries and other small fruit. For this purpose they may be covered with earth or mulch. Peach trees are sometimes covered with corn stalks or hay to retard flowering. They

may also be laid on the ground and successfully carried through the winter when covered with corn stalks.

(b) By smudges which make a cloud of smoke over the land and thus prevent evaporation. This is effective when there is sufficient wind to spread the smoke. The material used for this purpose is wet straw, tar, resin, etc., or a combination of such material. It may be carried about the orchard on a stone boat or the smudges may be located in various places.

(c) By heating the air directly by means of fires, as is done in parts of Florida where wood is piled ready to be set on fire whenever frost threatens.

(d) By cultivating the land; moist soil is exposed, which furnishes considerable protection by the evaporation of the moisture from the freshly exposed soil.

(e) By spraying the plants; the air is brought near to dew point and also warmed. In order to make this effective the spraying must be repeated during the night when frost is expected.

(f) By irrigating the land; the air is brought near to dew point and it is also warmed. This is frequently resorted to in the case of cranberries.

(g) By covering with tents, as practiced in Florida and other places and even by using stoves in tents.

(h) Covering the flowers with straw mulch at night is practicable in the case of strawberries. Where the mulch is kept between the rows to protect the fruit from dirt, it may be thrown over the plants when frost threatens the flowers. If the weather continues cold, it may remain on the plants for a few days without injury, otherwise it should be promptly removed.

Protection against frost.—In the Yearbook of the United States Department of Agriculture for 1907, G. H. Powell has the following to say in regard to frost protection in California, which is of very general application:

“There are few districts in the citrus belt of California that may not be visited by frost in December, January, or February. The prevention of injury by frost may be influenced to a large extent by the location of groves on lands over which there is a sufficient air drainage. The new groves established during

the past few years have been located on the higher lands with this factor prominently in view. To protect them against the extreme cold, many of the groves on the lower lands are equipped with wicker coal baskets, briquets of shavings, crude oil, and asphaltum, or sheet-iron stoves in which the same material is burned. Oil smudges (in tin receptacles) or other materials, which are located at definite intervals in the spaces between the trees, are sometimes burned. It is a common practice, also, to run the water in the irrigation furrows between the trees on cold nights, in order to make use of the latent heat in the water

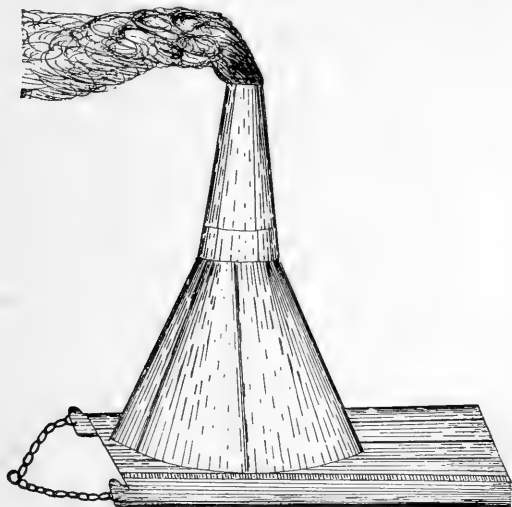


Fig. 24.—Form of smudger for use in protecting orchards from frosts. It is used with a protected stone boat.

as a means of frost protection. The materials employed in this protection against frost injury are used to cause a circulation of air over the grove in order to mix together the strata of different temperatures or for the production of a cloud of smoke over the grove in the morning in order to exclude the direct sunlight and thereby prevent the rapid thawing of the fruit when it has been frozen during the preceding night. It is the rapid thawing, rather than the freezing, of the tissues, that causes most of the injury to citrus fruits that have been subjected to ordinary frost temperatures.

"A general idea of the operation of frost fighting may be gained from a brief description of the work observed in a grove on a cold night. There were twenty-five perforated sheet-iron stoves scattered over each acre of grove, one stove being placed in the center of the square between four trees. These stoves were filled with a prepared mixture of shavings, asphaltum, and crude oil. When it was determined to light the fires a force of men appeared, each one carrying a can of oil and a torch. A small quantity of oil was poured over the smudging material and was then quickly lighted with the torch. As soon as all the fires were burning, the men returned home, except one man to about 5 acres, who kept the fires replenished and in good, burning condition.

"Just how much benefit is derived from these various devices it is difficult to estimate, as the experience of the growers is conflicting and the experiments that have been conducted have not always been comprehensive. There seems to be no doubt, however, that the judicious use of the various devices used in frost protection has been of great commercial value. One who has had an experience of many years and who has large financial interests involved writes:

"We have been able to protect against the severest cold we have had since we secured the coal baskets. Several times the temperature has been around 24° or 25° until we got our coal baskets under way, but we were usually able to make a change of from 3° to 5° when our baskets were lighted and were giving off a good heat."

"Aside from the injury to the fruit and the young wood by frost, continued cold weather causes the wood of the lemon trees to mature and the fruit to develop a coarse, rough texture and to ripen prematurely."

QUESTIONS—CHAPTER V.

1. What is sunscald and how can it be prevented?
2. What injuries to trees are caused by birds? By cattle? By wind? By mice and rabbits? By cultivation?
3. What are root galls?
4. What effect does winter injury have upon orchard trees?
5. How may twigs, trunks, roots and buds be protected from winter injury?
6. Into what classes may plants be divided, considering their susceptibility to frosts?
7. When are injurious frosts most likely to occur?
8. By what means can frosts be foretold? Explain each.
9. In what ways may trees be protected from frosts?

CHAPTER VI.

INSECTS INJURIOUS TO FRUITS.

The work of the fruit grower is not only one of tillage, pruning and fertilizing the crop, but he must be ever on the watch to ward off or kill the insects and diseases that injure or destroy his crop. None of these treatments can be neglected with impunity, yet if the crop has good cultivation and manuring it will overcome insect injuries and adverse conditions much better than if neglected. However, spraying will not take the place of manuring, nor manuring of spraying.

The great growth and wide specializing in fruit growing has led to the increase of troublesome pests. In some sections where the natural food of the native insects has been destroyed by cleaning the land, they have attacked the introduced plants. Then, too, new and exceedingly injurious insects and diseases have been introduced from other countries and have spread rapidly within recent years and these often need extremely drastic measures for their prevention. Good illustrations of the latter are peach yellows and root galls among diseases, and San Jose scale, Gypsy and Brown Tail moths among insects. By the introduction of insects and diseases some of the old standard varieties have been driven out of cultivation, even in sections where they formerly grew, or else can now only be grown when they are given much more care than was formerly necessary. The presence of these pests and the discovery of methods of checking their injuries has worked for the interests of the careful, painstaking grower who now has a decided advantage over the slovenly cultivator. In other words, it takes more brains and application to raise fruit now than formerly.

Comparative exemption from pests is often the case in new fruit areas but this exemption seldom lasts more than a few years, as is shown by the history of the new fruit areas in the Pacific Coast states where exceptional immunity from insect pests was enjoyed for many years, which might have been continued indefinitely had there been a suitable inspection law

properly enforced. The codlin moth and the plum curculio and other insect pests have come in and are now extremely troublesome and much care is required to hold them in check.

State Inspection.—Much has been said in favor of and against State Inspection laws for the prevention and suppression of insects and diseases. They have accomplished much good in some sections although they have been unquestionably used at times to restrict trade between the states. One of the greatest things that they have accomplished has been to cause people to think about insect pests and diseases and to impress upon them the importance of subduing them.

Laws for the suppression of noxious insects and diseases vary much in the different states but there is a tendency today for all the states to bring their laws to the same standard. These laws generally provide for the appointment of a state entomologist who is required to inspect all nurseries in his state and to furnish a suitable certificate if he finds them worthy. There is also a rule providing that no nursery stock shall be shipped from one state to another without a copy of this, or a similar certificate, being attached to the parcel containing it and that badly infested nurseries and orchards must be properly treated. Suitable penalties are provided for those avoiding the provisions of the law. In a few of the states and Canada the law requires that all nursery stock must be fumigated at the destination before its delivery to consignee. It would be hard to say now just what is a fair law for all concerned, and it ought perhaps to vary in different sections of the country according to crops and climate. A national law is needed to regulate interstate commerce in nursery stock, fruit and other products that might carry noxious insects and diseases from one state to another. The intelligent fruit grower should be familiar with the life habits of the insects in which he is most interested and should not work blindly by "Rule of Thumb."

Insects.—Noxious insects are held in check in various ways and from this standpoint we conveniently class them in groups:

Chewing insects.—Examples of these are grasshoppers, caterpillars, beetles and their grubs, etc. These are quite easily reached by arsenical and other poisons which may be placed

on their food. The great problem in dealing with this class is to find something which will hold the poison on the leaves for a reasonable length of time and will at the same time prevent the arsenical poisons from burning the leaves. This is particularly true of plants belonging to the plum family, including plums, peaches and apricots, which are easily injured by arsenious acid even when present in such small quantities that it would not be injurious to the foliage of apple, pear, currant or gooseberry. This burning is especially bad when its application is followed by several days of bright, dry weather. Another important problem which we have not solved is how to apply these poisons so that they will not wash off from the leaves. Among the insecticides commonly used for this class of insects are Paris Green, arsenate of lead and hellebore. Some of the chewing insects may be destroyed by the acrid or oily applications which are commonly used for the destruction of sucking insects, such as tobacco water and kerosene emulsion.

Insects that work in the wood of the tree belong to the class of chewing insects. These vary in their habits and nearly as various are the remedies used against them; each must be considered in the light of its life history. When borers are in their holes and can be reached easily by gas fumes, perhaps as satisfactory a remedy as any is to squirt a small amount of carbon bisulfide into their holes with a common oil dropper and stop up the holes with a little putty. In the case of borers that tunnel just under the bark, the location of which can be seen by the discoloration of the surface bark (as with the borer of the peach), the best remedy is probably to look over the trees in the early spring and again in the late summer and dig them out with a sharp knife.

Sucking Insects.—Examples of this class of insects are plant lice, scale insects and chinch bugs. These do not chew, but their food is the juice of plants. They obtain it by sucking. As they do not bite they cannot be destroyed by internal poisons, such as arsenic and hellebore, but they must be reached by something that will affect their respiratory organs. All such insects breathe through small pores in their sides and may be destroyed by a covering of a film of oil or soap (whale-oil soap

and kerosene emulsion). The bodies of leaf lice, which form a considerable portion of this class of insects, are covered with a thin skin and are injured or killed by astringent solutions, such as tobacco water, and also by hot water. Fumigating with hydrocyanic acid gas in case of scale or other sucking insects is a good remedy. Fumigating with tobacco smoke will kill most kinds of leaf lice. In fact, it would seem that fumigation, being so sure a remedy, is destined to be more largely used in the future. The use of strong compounds, when trees are dormant, for the destruction of scale insects, must continue to gain in popularity. Among the best of the compounds used for this purpose are the lime and sulfur mixture and the soluble oil preparations.

Insects that attach themselves to roots generally are of the sucking class and are extremely difficult to destroy. Among the worst of these pests is the woolly aphis or root louse of the apple, and the phylloxera or root louse of the grape, the latter having been extremely injurious to the roots of the European Wine Grape in France. In the case of the woolly aphis the trouble is largely avoided by planting trees that are known to be exempt from it. If the trees are once well started there is little danger of injury, since the pest is seldom harmful to large trees. Fumigation of stock insures the removal of the root louse. In the case of the phylloxera on the European Wine Grape the only satisfactory remedy has been to graft on the roots of some resistant stock such as the American Frost Grape (*Vitis riparia*). So common has this practice become in Europe that the result is the European wine industry stands on American roots.

Beneficial insects.—In a state of nature, each species of the animal kingdom is held in check so there is a nicely balanced relation between them, but occasionally even in nature some one species becomes too numerous and breaks the bounds that are ordinarily strong enough to hold it. Among the natural agencies that destroy insects may be mentioned heavy rains, sudden changes to a freezing temperature, winds, predaceous and parasitic insects, and fungus and bacterial diseases.

Parasites.—A most important factor in checking the spread

of insects is the numerous parasites to which they are subject. These may be either animal or vegetable. Any one who has had much experience in gardening may have seen many instances of the increase of animal parasites until certain kinds of insects were no longer injurious. This is common in the case of the cabbage worm, the tent caterpillar, grasshoppers and many others.

Animal Parasites.—The most common of animal parasites that destroy insects are small wasps and some two-winged flies which deposit their eggs in or on the eggs and larvae of the injurious insects on which the growing wasps feed. These destroy enormous numbers of insects and should be regarded as among the greatest aids to the fruit grower.

Among vegetable parasites that destroy insects may be mentioned the diseases which destroy the chinch bugs, and which the states of Kansas, Nebraska and Minnesota attempted to introduce on a large scale for the subjugation of this pest. Another instance is the disease which often destroys cabbage worms and even house flies. A good illustration of this occurred recently in the experience of a Minnesota gardener. He found the Cabbage *Plusia* getting very numerous in his twenty acres of cabbages and got a spraying outfit to kill them with, but had hardly started when he found the worms dying naturally, as the result of a fungous disease. He put up the machine and the disease successfully did the work for him.

Predaceous insects search out and destroy their prey. In this class of insects may be included the Preying Mantis, Tiger beetles, ladybugs and some wasps and dragon flies.

The Cottony Cushion Scale was first noticed in California in 1872 and was greatly feared on account of its spreading so rapidly and protecting itself from insecticides by excreting a waxy substance which completely covered the insect. The pest was finally destroyed by a lady bird (lady bug) imported from Australia.

Insects Injurious to the Apple.

Affecting the Fruit:

Codlin Moth (*Carpocapsa pomonella*).—The Codlin Moth is the common cause of wormy apples and makes the infested

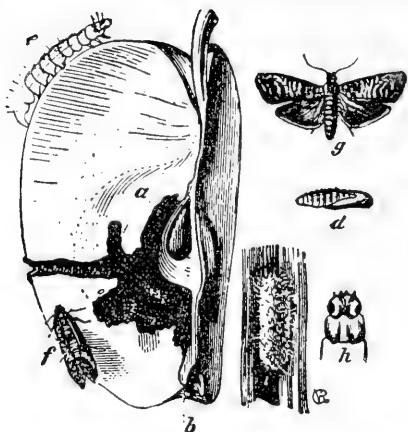


Fig. 25.—Injury caused by the larva of the Codlin Moth.

fruit ripen prematurely and fall to the ground. The moths deposit their eggs in the calyx (or eye) of the apple just as the blossoms fall. On hatching, the worm eats into the fruit where it lives until it is ready to change to the moth stage. It then leaves the fruit and spins a cocoon in which it undergoes its changes. There are two or more broods in a season. The worms that are in the late apples leave them in the winter and find

places to spin their cocoons nearby, which is often between the hoops and staves of the barrels holding the fruit.

Remedies.—The fallen fruit should be promptly gathered and destroyed. Keeping hogs in the orchard is very beneficial as they destroy the worm-infested fruit; but it should be remembered that when too much stock is pastured in the orchard and the grass becomes scarce, they are liable to bark the trees. If bands of burlap, or even paper, six inches wide, are fastened around the trunks



Fig. 26 —Flowers of the apple; the proper stage for spraying to control Codlin Moth.

not later than the first of June, many of the worms and chrysalides of this moth will be found under them and may be easily destroyed. The bands should be examined about once in ten days until the last of August.

The most common way of protecting against this insect is by spraying the trees just after the blossoms fall, when the apples still stand upright, with Paris Green and water at the rate of one pound to one hundred and sixty gallons. When the trees are sprayed to prevent scab, the Paris Green may be added to the Bordeaux mixture at the rate of one pound to one hundred and fifty gallons of the mixture.

Plum and Apple Curculio.—These are snout beetles which cut

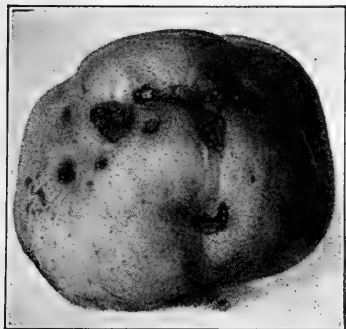


Fig. 27.—Showing the way in which apples are injured by the Plum Curculio.

small holes in the fruit as they feed, and also use the fruit as a place for laying their eggs. The latter soon hatch into a small grub which, at maturity, is about one-half inch long. The special injury to the fruit from this insect comes from the hard knots that form where it has been stung, which makes the apple gnarled and of poor quality.

Remedies.—These insects breed mostly in the wild plums, haws and wild crab apples, and destroying these generally results in lessening the damage to the apples in their vicinity. The windfalls should be destroyed, and pasturing hogs in the orchard is probably the easiest way to accomplish this. Clean culture has proven most satisfactory in ridding orchards of the curculio as they winter over in grass and rubbish. Spraying the fruit with Paris Green, lime and water, as recommended for the tent caterpillar, has sometimes proven satisfactory.

Affecting the foliage:

Tent Caterpillar (*Malacosoma americana*).—The characteristics of this insect are readily seen in Fig. 28. which shows the

caterpillars resting on the outside of the tent-like structure in which they live, and also a twig on which a bunch of eggs is fastened. The habit of this insect is about as follows: The eggs are laid on the smaller twigs of fruit trees in ring-like clusters during the first two weeks in July. Two or three hundred eggs are laid in each cluster and they are firmly cemented together. These hatch out early in the spring just as the leaves open. The young caterpillars soon commence to make a tent by extending sheets of silk web across the nearest forks of the twigs and this tent or nest is enlarged as more room is needed. It has holes in it through which the caterpillars enter and they re-

treat to the nest at night, in stormy weather and usually when not feeding. They generally come out of their nest once in the morning and once in the afternoon to feed. They are very voracious and soon strip the infested tree of its foliage. They change to moths in June and soon commence laying eggs. The eggs of the Western Tent caterpillar are not laid around the twig but in bunches

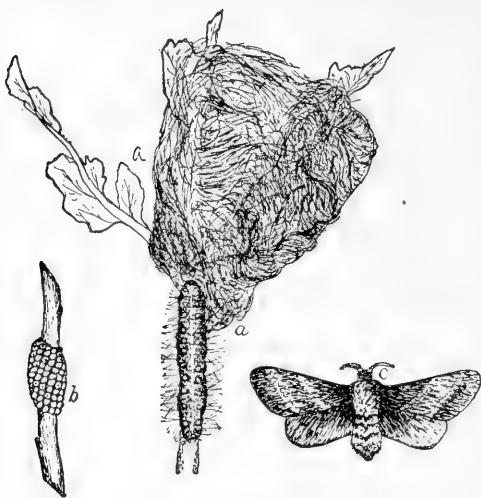


Fig. 28.—Tent Caterpillar. a.—Web house of tent caterpillar much reduced. Caterpillar nearly full size. b.—Eggs nearly natural size. c.—Moth natural size.

on the sides of the twigs.

Remedies.—The tents are readily seen. They should be gathered and destroyed early in the season when the worms are within them. The egg masses are also easily seen against a cloudy sky when the trees are leafless, and can be gathered and destroyed in winter or at any time before they hatch.

Fall Web Worm (*Hyphantria cunea*).—This is often mistaken for the Tent Caterpillar from which it is quite distinct. It appears later in the season, generally in July or later. Its webs are larger and loose or open and the caterpillars stay in them and feed. The web is extended to include other foliage as that enclosed is eaten. The remedies should be the same as in the case of the Tent Caterpillar.

Leaf Lice or Aphis (*Aphis mali*).—The leaves of the apple are frequently attacked by plant lice which, by sucking the sap, cause the leaves to curl up and assume a very unnatural appearance. They work almost entirely on the lower side of the leaf and are most abundant on the new and tender growth which generally becomes distorted as a result of such attacks.



Fig. 29.—Eggs of Plant Lice on twig of young apple tree.

Similar lice attack the foliage of the plum, currant and other plants. The eggs are laid on the branches of apple, plum and other trees in autumn. They are yellowish in color when first laid, but become a glossy black by winter. These hatch in the spring and locate themselves on the small, young growth and feed by sucking sap. All hatched at this time are females and reach maturity in ten or twelve days, when they commence to give birth to living young, producing about two daily for two or three weeks, when they die. The young ones soon commence to produce live young and their increase is very rapid, in fact so fast that the new growth is kept covered with them. As the season advances, some of the lice acquire wings and found new colonies on other trees. On the approach of cold weather males appear and the season closes with a stock of eggs for the continuation of the species.

Remedies.—The lice should be destroyed in the spring before they become numerous. The eggs hatch about the time the buds are bursting, and as soon as the lice appear, they should

be sprayed with strong soapsuds, kerosene emulsion or tobacco water. If the lice are allowed to get very numerous before spraying is commenced, the work will have to be repeated several times. Where trees are heavily infested, smoking may be the most desirable treatment. (See reference to this under the head of Insects Injurious to the Plum.)

Climbing Cut Worms (*Agrotis* sp.).—When the foliage or buds are being destroyed without any apparent cause, climbing cut worms should be searched for. If present they will be found in the day-time buried in the ground near the base of the trees and occasionally do much damage. They are closely allied to and resemble the common cut worms so well known to gardeners.

Remedies.—They may be destroyed by spraying the foliage as recommended for the Tent Caterpillar and by jarring the trees after dark and then gathering the worms.

Insects Attacking Trunks and Branches.

Flat Headed Apple Tree Borer (*Chrysobothris femorata*).—

This borer is quite abundant in some sections but generally does not cause serious losses here. It prefers

to work in trees that are newly transplanted, or weakened by some disease, making its borings in the trunks and larger branches and often completely girdling them. It is the larva of a beetle that is oblong, flattish in form and of a shining greenish-black color about three-eighths of an inch long. The beetles emerge from the borings in the trees in the early summer. They are very active in the middle of warm days and may be found in the hot sunshine running up and down the trunk of the tree, whence they fly quickly if an attempt is made to catch them. They lay their eggs, which are yellow, under loose scales on the bark or

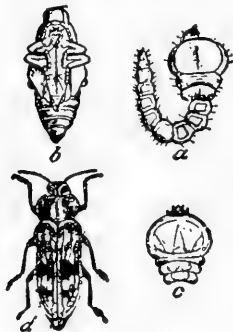


Fig. 30.—Flat headed Apple Tree Borer. a.—Borer full grown. b.—Pupa. c.—Reverse side of head. d.—Mature borer.

in cracks and crevices. The young soon hatch and eat their way through the bark, feeding on the sap wood. As the borer approaches maturity, it usually bores into the more solid wood

and finally out to the bark where it changes into the beetle form. This insect also attacks the pear, plum, peach and cherry.

Remedies.—All trees should be examined early in autumn; if there are borers present, they may be detected by the dry appearance of the bark or by the exudation of sap or sawdust-like castings. When such signs are seen the parts should be at once cut into with a knife and the borer destroyed. As a preventive measure there is perhaps nothing better than to coat the trunk and larger branches with a mixture of soft soap reduced

with a solution of washing soda to the consistency of a thick paint, and if a little carbolic acid is added, it will be even more repulsive to the beetles. This should be kept on the trees during the summer months when the insect is injurious.

Twig Borer (*Amphicerus bicaudatus*).—A dark colored, cylindrical, small beetle that bores into the twigs of the apple, grape and some other fruits. It is seldom extremely injurious.

Remedies.—The remedy is to cut out in early summer the infested twigs which contain the borers and to burn them.

Buffalo Tree Hopper (*Ceresa bubalus*).—An active, jumping, ridiculous looking creature about one-third of an inch long, re-



Fig. 31.—Buffalo Tree Hopper; showing scars on old wood as the result of its injuries; also mature insect.

sembling a beech nut more than any insect. Its eggs are laid in slits cut into the bark of apple trees by the female. Their presence seems to seriously injure the adjoining wood and bark and causes numerous irregular wounds which often seriously check growth and are sometimes taken for hail injuries. It feeds on the foliage when young, but does little injury in this stage.

Remedies.—The best treatment is to prune away and burn the infested wood in winter, but this is seldom entirely practicable and we have largely to depend on natural remedies and on high cultivation to enable the plant to resist the pest.

San Jose Scale (*Aspidiotus perniciosus*).—This is perhaps the most insidious and destructive of all our insect pests. In appearance, it is nearly circular, about one-sixteenth of an inch in diameter, dark brown in color, with a darker spot in the center. It lives on the bark of nearly all of our garden and lawn plants. It is a sucking insect and moves only when very young and then only for a short time, after which it becomes fixed in place. Several generations are produced each year. At the North many of the scales die in winter but those left breed so fast that they soon cover their host. It is probably spread to young trees by the feet of birds, etc. When this pest is discovered for the first time some good expert in such matters should be consulted.



Fig. 32 —
Oyster Shell
Bark louse
in place on
twig.

Remedies.—The best remedies now known are the lime and sulfur wash and some of the soluble oils specially prepared for this purpose, the formula for which will be found in the Appendix.

Scurfy Bark Louse (*Chionaspis furfurus*) affects the apple and pear. The life history of this insect is similar to that of other scale insects. The females are larger than the males, and oval; the males are very small and slender. A branch infested with this pest appears to be covered with whitish scurf or dandruff. It is seldom very injurious.

Remedies.—The remedies for the San Jose Scale are effective here but covering the branches with whitewash or lightly brushing them with kerosene oil is extremely satisfactory.

The Oyster-Shell Bark Louse (*Lepidosaphes uli*) is about the color of the bark on which it grows. It is very injurious where it occurs in great numbers. In appearance each scale is long and shaped somewhat like an oyster. Its life history

and remedies are much like those for other scales. It generally yields readily to the whitewash treatment, but where many trees are badly infested they should be treated with some of the soluble oils, or lime and sulfur wash should be used.

Woolly Apple Louse (*Schizoneura lanigera*); branch form.—When fully grown, this insect is dark colored and covered with a cottony coating. They may be found covering the new bark about wounds and in the axils of leaves and buds and they may cause serious wounds when neglected. It comes from small eggs laid near the base of the twigs.

Remedies.—They are easily destroyed by painting with kerosene. Where very numerous, it may be best to use whale oil soap mixture, on account of the danger to the tree from using kerosene.

Insects Attacking the Roots of the Apple.

Woolly Apple Louse (*Schizoneura lanigera*); root form.—This insect attacks the roots as well as the branches of the apple. On

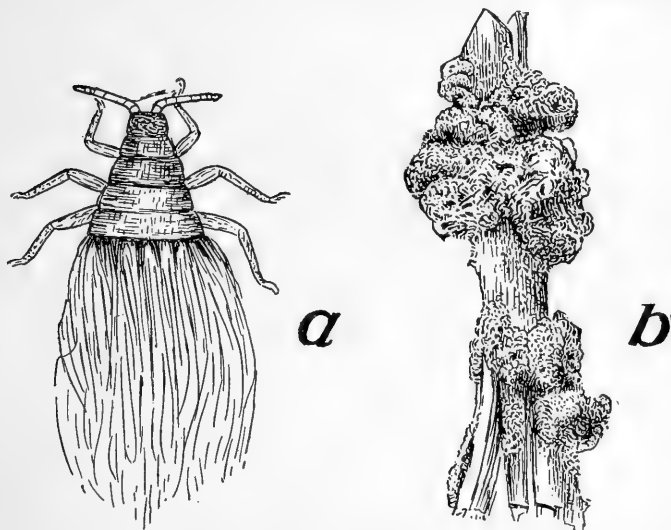


Fig. 33.—Woolly Aphis. a.—Mature insect. b.—Swellings on the root as a result of its injuries.

the roots it causes warty swellings and may kill the trees. It is one of the most dangerous of all insect pests affecting the apple.

Remedies.—The best remedies for it when occurring on the roots are as follows: Remove the earth about the crown for a distance of about two feet and put on from four to seven pounds of tobacco dust. Put back the soil and irrigate where practicable to do so. Removing the soil from about the roots and applying hot water has been satisfactorily practiced. Bisulfide of carbon poured into holes made with a bar about the trees has also been successfully used. In doing this, make the holes about ten inches deep near the infested roots and then pour three ounces of the bi-sulfide into each hole. Three or more holes should be made about each tree. Young trees are often destroyed by the woolly aphid but the old trees are seldom hurt by it.

Insects Injurious to the Pear.

Any of the foregoing insects referred to as attacking the apple may also attack the pear except the woolly aphid, and the same remedies should be used. In addition to these, the pear is attacked by the following insects:

Pear Tree Slug (*Eriocampa cerasi*).

—These slimy looking insects are hatched from eggs laid in the tissues of the leaves by a glossy, black fly soon after the leaves expand in spring. When first emerging from the egg they are white but soon become covered above with a slimy brown matter that oozes out of the skin. The slug, when

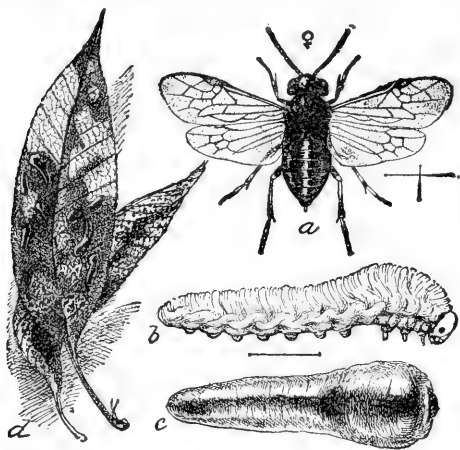


Fig. 34.—Pear Tree Slug. a.—Mature insect. b and c.—Larva, side and back view. d.—Worms feeding on leaves partly skeletonized by them.

mature, undergoes its changes in the ground where it also remains during the winter. There are several broods each season. The slugs eat off the green surface of the foliage, leaving it skeletonized. It attacks the cherry, plum and rose as well as the pear.

Remedies.—The remedies are the same as for any of the leaf-eating insects, Paris Green and Pyrethrum Powder being most commonly used. Dusting the leaves with air-slaked lime is also a good remedy.

The Pear Psylla (*Psylla pyricola*).—This is a minute insect that has occasionally done much injury to pear trees by sucking the sap. It is so small as to be seen with difficulty with the unaided eye. In severe attacks old trees put forth but little growth, new shoots often wither and drop in May, the leaves turn yellow and the fruit prematurely ripens in midsummer and falls off. Its presence is also indicated by the honey dew which is excreted by the insect in large quantities so as to cover the tree and even the vegetation under it. In this sweet solution a kind of fungus soon starts and smears the tree with a blackish coating.

The mature insects pass the winter hidden in crevices under the loosened bark on the trunks and limbs of pear trees. During warm days they crawl about. In the first warm days of spring the egg-laying season begins. The eggs are laid in creases in the bark and in the old leaf scars. In two or three weeks they hatch into what is known as "nymphs," which first locate along in the axils and petioles of the leaves. As these nymphs grow, they change their skin and in about one month become full grown with wings, and resemble the harvest fly in miniature. They can jump like a flea and fly away upon the slightest unusual jar.

Remedies.—There are several natural enemies that help to hold the pear psylla in check, among which are the lace winged fly and the red ladybug. The most effective treatment seems to be spraying in the spring with kerosene emulsion, applied with considerable force to destroy the young. The mature insect is not easily reached in this way.

Insects Injurious to the Peach.

Peach Twig Borer (*Anarsia lineatella*).—When the buds of the peach begin to open in the spring, a small, brownish larva

with a black head eats into the buds and destroys them. When the new shoots start, the borer eats into them causing them to wilt and decay. Many of the second brood of this borer eat into peaches, causing a gummy exudation and ruining them for market. The larvae that appear in the spring spent their winter in little excavations which they made in the fall in the bark of the trees.

Remedies.—Early in the spring, just before the buds open, spray the trees with lime and sulfur wash or with whale oil soap, in the proportion of one pound to two gallons of water. Fish oil soap, diluted once with water or kerosene emulsion, will doubtless do the work nearly or quite as well as the lime and sulfur wash. Many of the larvae may be caught under bandages used as for the Codlin Moth.

Peach Borer (*Sanninoidea exitiosa*).—The yellowish white borer commonly very destructive in peach trees is the larva of a wasp-like appearing moth that lays its eggs on the trunks

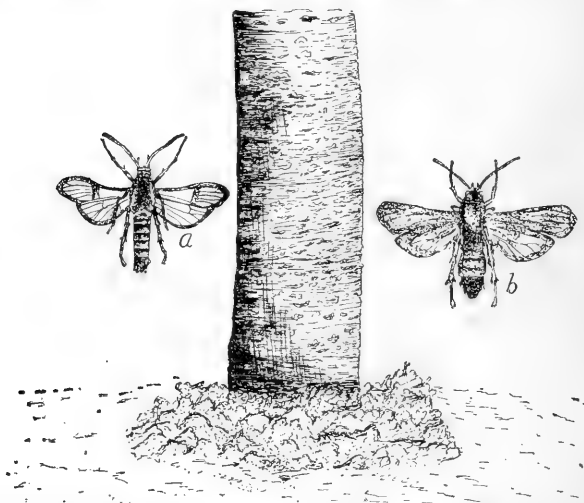


Fig. 35.—Peach borer; showing trunk of peach tree injured near surface of ground where gum and frass are mixed together. a.—Male. b.—Female.

and larger branches of peach trees from the middle to the last of summer in the North. The eggs soon hatch and the larva works into the trees, which exude a quantity of clear, jelly-like gum that is often mixed with borings. The borer lives in the tree about one year.

Remedies.—Carefully inspect the trees in autumn and spring, just below as well as above the ground, and remove all borers with a small pointed knife. Wrapping the trunks with stout paper or wire screen during the egg-laying period is recommended.

Other insects attacking the peach are several kinds of aphids and curculio. For each of these see similar heads included under "Insects injurious to the apple and plum."

Insects Injurious to the Plum.

Plum Curculio (*Conotrachelus nenuphar*).—This is the insect which causes the plums to prematurely ripen and drop to the



Fig. 36.—Plums injured by Curculio, showing scars, also enlarged curculio.

ground. It is not nearly so destructive to our native plums as to those of European origin (*Prunus domestica*). The latter are often so badly infested that none of the fruit comes to full maturity. While our native plums are stung just as much by the curculio as the European plum, but few of the eggs of the curculio develop into the grub in this fruit, probably on account of its rapid growth. This insect is a small, rough, grayish or blackish beetle, about one-fifth of an inch long, with a black shining lump on the middle of each wing and behind this a more or less distinct band of a dull yellow color with some whitish marks about the body and with a rather short snout. The female lays her eggs in the young, green fruit shortly after it is formed. Then she cuts a circle around the portion of the fruit in which the eggs are laid to prevent it

from growing. The eggs hatch in a few days and the larva works around the outside of the stone. This causes the fruit to become diseased and it falls prematurely to the ground. Within the plum the growth of the larva is completed. It then goes into the ground where it transforms to a beetle, which soon escapes.

Remedies.—Recent investigations seem to show that clean cultivation and burning of any grassy areas near by, in which the beetles can winter over, is most desirable in checking the spread of this pest. When the curculio gets alarmed it draws itself together and falls to the ground. Advantage is taken of this peculiarity to catch and destroy it. A sheet is spread under the tree whose branches are suddenly jarred, when the beetles, which fall on the sheet, may be gathered and destroyed. As it is important to catch as many beetles as possible before any mischief has been done, jarring should begin while the trees are in blossom and should be continued every morning until they are gone. If the insects are abundant this will generally take about three weeks. It will be found that where hens with their broods of chickens are enclosed within the plum orchard, they will devour a large number of the larvae of the curculio. If hogs are kept in the same enclosure as the plum trees, they will pick up the fallen fruit and so destroy a great many of the larvae and assist very much in reducing the injury from this cause.

Plum Gouger (*Coccotorus scutellaris*).—The plum gouger is a snout beetle somewhat resembling the curculio, but readily distinguished from it by a little careful examination. It is about five-sixteenths of an inch long. The head and wing cases are brown with a leaden grey tinge, the latter with whitish and black spots scattered irregularly over their surface. It appears in the spring about the same time as the curculio, but instead of working around the stone it eats through the soft shell and lives within the stone where it undergoes its changes and emerges a perfect beetle. Both sexes of the Plum Gouger bore cylindrical holes in the fruit for food. These cause the fruit to become knotty and worthless but it does not prevent their remaining on the tree until maturity. This insect does not cut

a flat or half circle around the hole in which the egg is placed, as is so characteristic of the curculio.

Remedies.—The remedies recommended for the curculio are also best for preventing the work of this insect.

The Plum Leaf Aphis (*Aphis prunifolii*) commonly called "leaf lice," is frequently troublesome and occasionally appears in such large numbers as to seriously check the growth of the trees.

The life history of this insect is the same as for the apple leaf aphis, which see.



Fig. 37.—Hoop tent ready to put over a tree.

Remedies.—Tobacco water, kerosene emulsion and similar materials often hardly appear to have any effect when the lice are very abundant, as the leaves curl up and protect the lice, so that they are not easily reached and the waxy covering of the



Fig. 33.—Hoop tent in place over tree.

lice sheds water. At such times it will be found that tobacco smoke is a most valuable and certain remedy. In applying it, a tent made of unbleached cotton, large enough to cover the

tree should be used. The best form for this tent is bag shaped, and large enough to easily take in the tree. The tent should be fastened at the bottom to a hoop made of gas pipe. In operating the hoop tent the hoop is lifted up on its edge close to the tree and gradually lifted over it, the slender, long, side branches being pushed up under the tent. When the tree is finally enclosed, tobacco smoke is applied until the tent is filled with smoke so thick that the hand cannot be seen before the face; it is allowed to thus remain for fifteen minutes, which is long enough to kill all the lice. There is no danger of injuring the tree if the tobacco does not flame up. To prevent this, the tobacco used should be dampened. The most convenient form of tobacco to use is leaf stems which come from cigar factories and can be obtained at a very low price.

A tent that will answer the purpose very well may be made out of two large pieces of cotton cloth supported on a light wooden frame. Where the trees are so very large that they require a tent more than 14 feet in diameter, a piece of one-inch rope will be found to work better than a gas pipe hoop to hold the bottom of the tent.

Other insects injurious to the plum include the peach borer, leaf slug and flat headed borer which are described elsewhere.

Insects Injurious to the Cherry.

The insects injurious to the cherry are about the same as those injurious to the plum and include borers, curculio and aphid. The cherry is also commonly injured by the leaf slug which attacks the pear. These insects may be found under their respective heads.

Insects Injurious to the Grape.

Grape Vine Leaf Hoppers (*Erythroneura vitis*).—These are small, grayish insects that sometimes appear on our grape vines in countless numbers. When abundant, if disturbed on a hot, dry day, they appear in clouds, make a short flight and quickly settle on the vines again. They breed most rapidly in hot, summer weather and do most injury to varieties having no down on the under side of the leaves, such as the Clinton and Beta, but may destroy the foliage of any kind. They are sucking insects and cause the leaves to turn yellow and even finally dry up.

Remedies.—By taking advantage of the fact that the insects are dumpish early in the morning and may be easily jarred to the ground, large numbers may be destroyed by shaking the vines after first laying down strips of cloth covered with coal tar or similar material that will catch them. Perhaps the best remedy consists in making two frames four feet square out of common lath and covering them with cloth coated with fresh coal tar. Two men are required to use these, who place the frames opposite one another on each side of the rows, and as near as practicable at the bottom, at the same time gently jarring the vines by striking downwards, with a few light branches, on each side. In this way large numbers of the insects can be caught, and if this method is persistently used this pest may be kept in check.

The Grape Phylloxera (*Phylloxera vastatrix*) or root louse, is an American insect that is frequently found on the roots or leaves of American vines. On the roots its presence results in the formation of swellings or knotty excrescences. It occasionally appears on the leaves of some species that have thin foliage such as those of the *Riparia* class, where it forms many galls on the under side of the leaves which sometimes become so abundant as to seriously check the growth of vines. This leaf form is seldom very troublesome and is not necessary for the propagation of the species. It spreads by winged forms that occur on the roots or leaves and may travel through or over the land for considerable distances. On the American vines its presence does not necessarily cause death or seriously check their growth, but European vines succumb very quickly to its attacks and it has been the principal cause of the inability of growing European grapes successfully in this country. The importation of this insect into Europe and its spread there threatened to destroy the vine industry of many sections.

Remedies.—The danger from this insect has there been largely overcome by grafting the European kinds on native American species which are resistant to this pest; the native *V. riparia* (our River Bank grape) is commonly used. Immense quantities of wood of this species have been sent to Europe for this purpose. The Phylloxera is a native of America east of the Rocky Mountains

and is not found on the Pacific coast, but it has been introduced into California and foresighted growers there are practicing grafting their vines on resistant roots. Bi-sulfate of carbon placed in the ground about the roots is a good remedy. Probably the best treatment for the leaf form is to pick and destroy the infested foliage.

The Rose Chafer or Rose Bug (*Macrodactylus subspinosus*) eats roses, the flowers of the grape, and, when very abundant, many other garden plants. It is a beetle with long, hairy legs which is rather slow in its movements. It is especially injurious by reason of its eating the flowers of grapes.

Remedies.—Where they are very abundant, insecticides are too slow in acting to do much good and all remedies fail. Where not unusually abundant, they may be kept in check by picking. Covering the flowers with bags has also been resorted to with excellent results. Bordeaux mixture seems to be distasteful to

them and spraying with this material will often largely prevent their ravages as well as check fungus diseases.

Other insects injurious to the grape are the Snowy Tree Cricket and occasionally some scale insects and leaf eating insects.

Insects Injurious to the Currant and Gooseberry.

The Currant Worm (*Nematus ventricosus*) is the most troublesome insect that at-



Fig. 39.—Currant Worm. Eggs of worm on under side of midribs; holes in leaves gnawed by young larva.

attacks the currant and gooseberry. The female lays her eggs in rows on the veins on the under side of the leaves quite early in the season. They are white in color

and about one-twentieth of an inch long. These eggs hatch in about ten days. The young worms feed in companies, at first eating small holes in the leaves, but later on they destroy all the green tissue in the leaf and then spread in all directions over the bush, eating the foliage. They will frequently strip a bush of its foliage in a few days time if left to themselves. When full grown they are three-quarters of an inch long. There are two broods of these worms; the first appearing before or about the time the fruit is ripe and the second, two or three weeks later. The mature insect is a fly, somewhat resembling the house fly.



Fig. 40.—Currant Worm at work.

Remedies.—Powdered hellebore, mixed with its bulk of flour, may be dusted on the plants when the foliage is wet or it may be used at the rate of one ounce of hellebore to a gallon of water and be sprayed on the foliage. Used in either way it is a very cheap, effective and easily applied remedy. But hellebore is



Fig. 41.—Currant Borer in its tunnel in the center of the cane, where pith has been eaten out.

quite poisonous and is not safe to use when the fruit is ripe, although no danger will exist if several days should elapse after the application before the fruit is gathered. A light shower after the hellebore is applied will remove all danger from it. Pyrethrum insect powder is a good, safe and effective remedy when applied just at night, but it is very expensive and difficult to obtain of good quality. Paris Green and arsenate of lead make efficient remedies when properly applied and are most commonly used.

Where these insects have made their appearance, the first indication of them should be watched for in following years and great care taken to destroy the first brood each season. It is a good plan to begin spraying early, even if no worms are seen. Growers of this fruit should be very particular not to neglect the bushes after the crop is gathered, for it is very important for the next year's crop that they should make a good growth of wood, and neglecting them at this time often al-

lows a crop of worms to mature and cause more extensive injury the following year. The fly seems to prefer the foliage of native varieties of gooseberries, such as the Houghton seedling, for its eggs and a few of these bushes may be planted among the currants, when most of the worms can be destroyed on them as soon as the eggs hatch.

Imported Currant Borer (*Sesia tipuliformis*).—In many sections this insect in its larva state causes great injury to the stems of the currant and gooseberry by so weakening them that

they break off when loaded with fruit or by making them sickly. The female lays her eggs in the stems early in the summer. In a few days the eggs hatch into little white grubs, which work into the pith of the stem, where they make their burrows and live until the following season. They then finish their transformation and appear as wasp-like moths and the females shortly commence to lay eggs. This insect infests chiefly the red and white currant, but it also attacks the black currant and often the gooseberry.

Remedies.—The infested stems should be cut out in the autumn or very early in the spring and burned at once. If the growers in any vicinity will follow this method in united effort they can keep this insect in subjection.

Lice (*Aphis ribis*) are frequently very abundant on the foliage of currants and gooseberries, where they cause the leaves to curl up and become distorted, thus checking their growth but seldom causing serious injury. The life history of this insect is about the same as for the apple leaf louse.

Remedies.—They may be destroyed by spraying the foliage with tobacco water, soap suds water, or kerosene emulsion. In fighting these insects, it is very important to commence as soon as the first of them are seen as they often increase with great rapidity. On account of the position of the leaves these lice are very difficult to get at with a spray, and on their first appearance the infested foliage should be destroyed. It is sometimes most practicable to apply tobacco water by dipping the affected branches into the emulsion or into tobacco water.

Insects Injurious to the Raspberry and Blackberry.

Raspberry Flat Headed Borer (*Agrilus ruficollis*).—The perfect form of this insect is a beetle which lays its eggs in the growing canes sometime during the summer. Where the eggs are laid, peculiar gall-like swellings may occur, having many rough slits in them; but this is not always the case, for sometimes canes may be killed by the insect and no swellings at all appear on the canes. The eggs hatch into little yellowish-white larvae, having flattened bodies, brown jaws and tails furnished with two dark brown horns. One swelling may contain many larvae. When full grown the larva is from one-half to

three-fourths of an inch long, and by burrowing in the wood frequently girdles the canes. The perfect beetles emerge about the time that the plants are in full blossom.

Remedies.—As the insects winter over in the canes, they may be destroyed by cutting and burning all the infested wood some time during the winter.

Snowy Tree Cricket (*Oecanthus niveus*).—This insect does not feed on the raspberry plant in any way but it is injurious on account of its peculiar habit of puncturing the canes with lines of little holes in which it deposits eggs. If this work does not kill the canes, it so weakens them that when they start in the spring they are very apt to break off as soon as the foliage is expanded. The eggs, which are laid in autumn, are yellow and about one-eighth of an inch long. They are not readily seen when laid, but by the latter part of winter the infested canes take on an unhealthy appearance by which they may be readily located. This insect feeds upon leaf lice and is thus beneficial to some extent, but it causes so much injury by laying its eggs in raspberry, grape and other plants with pithy wood that it should

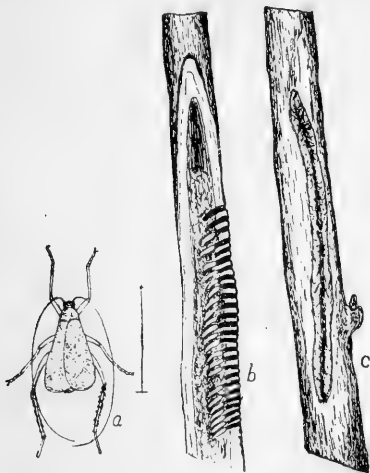


Fig. 42.—Snowy Tree Cricket. a.—Mature insect. b.—Infested raspberry cane with portion removed to show how eggs are placed in cane. c.—Showing injury to cane as it ordinarily appears.

be destroyed as nearly as possible.

Remedy.—The only remedy is to cut out and burn the infected wood before the eggs hatch.

Insects Injurious to the Strawberry.

Leaf Roller (*Ancylis comptana*).—This insect is injurious in its larva stage when it is about one-half an inch long and a very active worm. It will be found nicely encased in a straw-

berry leaf that it has drawn together by silken bands and of which it is devouring the green surface. When abundant, this insect may do very much damage. It changes to a small rust colored moth with white markings on the wings at maturity. It has at least two broods. It winters over in the pupa state in the ground near the plants.

Remedies.—The larvae are not easily reached with any insecticide as they are protected by the folded leaf. The first brood is rather difficult to destroy without injuring the fruit. Since the second brood does not appear until July, they may be destroyed by mowing off and burning the foliage of the plants or by scattering straw and burning it. Where there are but a few infected leaves, they should be crushed in the hand. A few trials will show the best method of crushing the worm inside. Arsenical sprays are also used but the insect is so well protected that this remedy is seldom satisfactory.

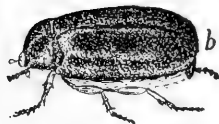


Fig. 43.—a.—White Grub. b.—Its mature form, known commonly as June beetle.

White Grub (*Lachnosterna* sp.).—This is the common white grub found in sod land. It is the larvae of the June beetle and is sometimes exceedingly destructive, when plants are set out on land that has recently been in sod, by eating the roots of the newly set plants. On land that has been cultivated for two years it is seldom troublesome. It lives several years in the ground before emerging as the full grown June bug. It may be avoided by not planting on land that was the preceding year in sod.

Strawberry Weevil (*Anthonomus signatus*).—This appears as a small, blackish beetle with gray pubescence when the strawberry flower buds are well developed and lays an egg in each, afterward puncturing the flower stock below the bud, so as to check development. The larva feeds upon the pollen in the unopened bud, and changes to beetle stage in midsummer. It also attacks a number of other flowers in the same way. Occasionally it is very troublesome to the strawberry for a number of years; then its injury stops suddenly for no apparent reason. Only staminate or pollen varieties are attacked.

Remedies.—The best way of avoiding injury from this insect is by planting chiefly the pistillate sorts, as these are not affected. In a small way, the rows of staminate plants may be protected by mosquito netting or other covering until the buds are ready to open. The application of insecticides for the prevention of injury by this insect have not been especially successful.

QUESTIONS—CHAPTER VI.

Insects.

1. What care should the fruit grower take in suppressing insects and diseases?
2. How have insects and diseases been introduced into the fruit growing sections?
3. What effect do they have upon the fruit grower's work?
4. What sections are usually exempt from insects and diseases?
- Example.
5. What are the advantages and disadvantages of State Inspection?
6. What do the State Inspection laws provide for?
7. What would be the benefit of a national law?
8. Into what groups may the destructive insects be classified?
9. What are the habits of each?
10. What are the remedies best adapted to each group?
11. Into what groups may the beneficial insects and parasites be classified?
12. What are the habits of each?
13. What is the history of the cottony cushion scale in California?
14. What insects are injurious to the apple?
15. What is the life history of the Codlin Moth?
16. What injuries do they cause?
17. What are the best remedies for this insect?
18. How does the curculio injure the apple?
19. What is the remedy for it?
20. What insects injure the foliage of the apple?
21. What is the life history of the Tent Caterpillar?
22. What are the remedies for the Caterpillar?
23. How do the Tent Caterpillar and fall web worm differ in their habits?
24. What remedy should be used for them?
25. What injury does the climbing cut worm cause on the apple tree?
26. How may it be destroyed?
27. What insects injure the trunks and branches of the trees?
28. What is the life history of the flat headed apple tree borer?
29. What harm does it do?
30. What remedy is used as a preventive for the injuries caused?
31. What injury is caused by the twig borer? The buffalo tree hopper?
32. What is the remedy for the twig borer?
33. What is the life history of the San Jose scale?
34. What injury does it cause?
35. What is the remedy for the San Jose scale?
36. What injury is caused by the scurfy bark louse?

37. What is the remedy for it?
 38. What is the life history of the oyster shell bark louse?
 39. What is the injury caused by and the remedy for the same?
 40. What is the injury caused by the branch form of the woolly aphid and remedy for it?
 41. What injury does the woolly aphid cause on the roots of apple trees?
 42. What is the best remedy for it?
 43. What insects are injurious to the pear tree?
 44. What injury does the slug cause?
 45. How are its ravages prevented?
 46. How does the pear psylla injure the trees?
 47. What is its life history?
 48. What remedy should be applied?
 49. What insects are injurious to the peach?
 50. What harm does the twig borer cause?
 51. What is the best remedy for it?
 52. What injury is caused by the peach borer?
 53. What is the remedy for it?
 54. How does the plum curculio affect the plum?
 55. What is the remedy?
- Take up the other insects discussed in the same way as the foregoing.

CHAPTER VII.

DISEASES INJURIOUS TO FRUITS.

The diseases which the fruit grower has to combat are numerous. No portion of the plant is exempt from their ravages. Some diseases are perhaps not due to a special growth in the tissues, but result from some physiological weakness of the plant, due probably to unfavorable surroundings. Such troubles can be stopped only by doing away with the cause, and practically the only method of preventing them is by improved cultural conditions, as is the case with Peach Yellows.

The great majority of plant diseases are what are known as fungus diseases. These are propagated by small bodies or spores, given off in various ways, which act as seeds in starting new growths. The life habits of these diseases are extremely variable and often very complex. Some of them live one generation on one plant and the next generation on some very different plant. For instance, the Apple Rust (*Gymnosporangium*) lives one stage on the foliage of the apple and the next on the Red Cedar, where it develops the cedar apples that produce the scarlet, gelatinous fruiting bodies commonly seen on Cedar trees in early summer. This disease may be largely avoided by destroying the Red Cedar in the vicinity of orchards.

The remedies commonly used for plant diseases are to cover the susceptible portions of the plant with some antiseptic covering. Such materials are generally termed fungicides. The active fungicidal principle in most of those in common use is some salt of copper, so combined as not to injure the foliage. The most generally useful fungicide is Bordeaux mixture, which is a combination of the salts of copper with lime and water. This material* is adapted for use in diluted form when the tree is in leaf, or when of increased strength, for use when the tree is bare of foliage. Sulfate of copper solution is a valuable fungicide for use when trees are dormant, but is very injurious to young

*Formulas for insecticides and fungicides will be found in the Appendix.

vegetation. Potassium sulfide and other forms of sulfur are used alone or in combination as fungicides. As noxious diseases and insects are present on many plants at the same time, it is a common and good practice to use an application that shall combine the advantages of fungicide and insecticide. A good illustration of this is Bordeaux mixture to which has been added a small amount of Paris Green. Such a mixture is an effective remedy for apple trees that are affected with scab and the Codlin Moth. A very complete list of fungicides and recipes for them will be found in the Appendix.

Diseases of the Apple.

Apple Blight, Fire Blight (*Bacillus amylovorus*).—This is the disease that commonly kills the twigs and branches and occasionally injures the trunks of apple, pear and quince trees. Its cause is a bacterial disease which gains entrance to the tree through wounds or through the flowers. The germs are carried by insects to the flower. The insects are attracted by the dark, mucilaginous fluid that oozes out of the diseased wood in the spring and which is swimming with bacteria. From the flowers and other centers of infection the disease spreads through the whole plant. This is the disease which so commonly kills the young growth of apples in June.

Remedies.—Some varieties are quite subject to it, while others are only slightly, if at all, affected with it; hence it may be avoided by selecting resistant sorts. When it appears the best treatment is to remove and burn the infected parts, cutting considerably below where the disease appears. The disease may be carried in pruning implements from a diseased to a healthy tree. It may be well under some conditions to disinfect pruning tools by the use of kerosene or in other ways so as not to spread the disease by them.

Bitter Rot (*Glomerella rufomaculans*).—The summer spore stage of this fungus does serious injury to the apple in some sections. It attacks apples before they are ripe and also apples in storage. The spots which appear become sunken, are soft and have a bitter taste. On the surfaces of these spots the spores issue in long, gelatinous, cylindrical masses. These are washed apart by rain water and spread the infection. The

winter spores are produced on the branches in canker spots from which come the new sources of spring infection.

Remedies.—Remove and burn all canker spots found on the trees each year, as these are the sources of infection. Destroy the diseased fruit. Spraying with Bordeaux mixture and later, when the fruit begins to ripen, with a copper carbonate solution will hold the disease in check.



Fig. 44.—Bitter rot of apple. Branch infested with canker of bitter rot.

Black Rot (*Sphaeropsis malorum*) is a common source of trouble. It especially attacks the summer apples at the time of ripening and the other kinds in storage. This fungus also occurs on the branches and leaves of apples.

Remedies are the same as for Bitter Rot.

Root Galls, in the shape of roundish swellings, are sometimes found on the roots of apples and other trees. Stocks thus affected should be regarded with suspicion, although some of these galls do not appear to be seriously injurious.

Leaf Rust (*Gymnosporangium macropus*) and (*G. globosum*).—This disease causes serious injury to the foliage of apples and pears so that the foliage and fruit crops are destroyed. This fungus causes yellow blotches on the leaves, and later, cluster cups with thorn-like tops appear on the under side of the leaves. One stage of this disease lives on the Red Cedar, where it produces Cedar apples from which in the spring come the bright scarlet, gelatinous, honey-like masses. The spores from the Red

Cedar form grow on the apple and those from the apple on the Cedar.

Remedies.—Spraying with Bordeaux mixture is one remedy. The best remedy, however, is to remove the Cedar apples in winter or to destroy the Cedar trees.

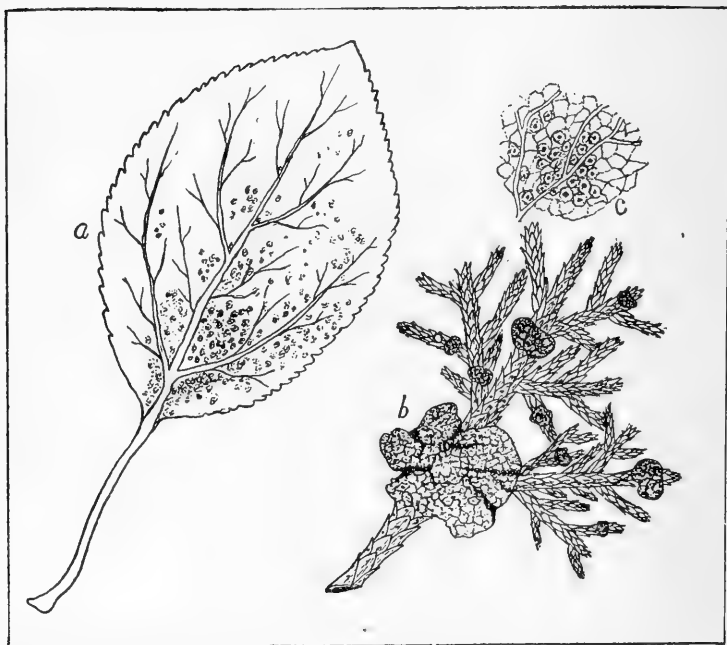


Fig. 45.—Leaf rust of apples. a.—Apple leaf infested with the rust disease. b.—Twig of red cedar showing old and young cedar apples. c.—Portion of the tissue of the infested apple leaves enlarged.

Apple Scab (*Venturia pomi*).—A very serious disease of the apple. It attacks and kills the foliage and causes black, scab-like spots on the fruit, and also attacks the young growth occasionally. The sources of infection are the fallen leaves on which the fungus matures its spores in early spring in time to infect the unfolding leaves.

Remedy.—Spraying with Bordeaux mixture is the only known satisfactory remedy. Several sprayings are usually necessary where this disease is well established. A winter spray with strong Bordeaux mixture before the buds open is recommended, followed by two or three sprayings after growth has started, at intervals of from two to three weeks. Good ventilation and proper spacing of trees aid very materially in avoiding conditions favorable to fungus growth. Burning or plowing under the diseased leaves which have fallen will also aid in stamping out this disease.

Powdery Mildew (*Podosphaera leucotricha*).—This mildew seldom injures apples except young plants in seedling beds

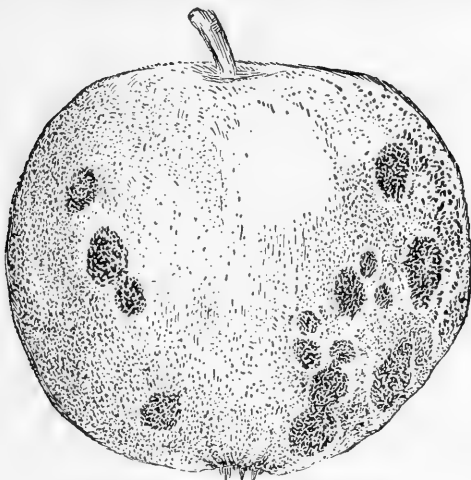


Fig. 46.—Apple infested with scab.

or nursery rows. It is most injurious to seedlings in their first year, especially when severely crowded.

Remedy.—This disease may be prevented by spraying with Bordeaux mixture, commencing in the early summer and repeating at intervals of about two weeks.

Fruit Scald.—This occurs most commonly on apples that are kept in cold storage. Some varieties with tender skins

may be injured in piles in the orchard. The scald shows as large brownish or black blotches on the fruit. Some varieties are much subject to it while others are quite exempt. The subject is not well understood, but varieties liable to this trouble should be stored where they will have free circulation of air.

Spraying Injuries.—In spraying plants it is not uncommon to cause them some little injury. This often shows in the russeted appearance of the fruit or foliage. It may be due to the use of chemicals of unknown purity or to the unusual susceptibility of the plant. Carelessness in making Bordeaux mixture is often the cause of spraying injury. These injuries may sometimes be so serious that they kill the foliage. As a rule, however, the earliest spraying on the young leaves does not seem to cause injury so frequently as later sprayings.

Frost Injuries.—Apples and pears are sometimes slightly injured by frost soon after the flowers open, and in such cases there will often be a russeted ring around the fruit or on one side.

Sunscald.—This is a name given to a condition of trees when the bark becomes dead on the southern or southwest side of trees. It is a very serious cause of loss of trees in some sections and in such places all trees should be protected against it. For description of this trouble see chapter on Protection.

Diseases of the Pear.

The pear is injured by about the same diseases as the apple. It is especially subject to fire blight, scab and rust, which are more fully mentioned under apple. It is also injured by leaf blight (see Quince) and leaf spot, for which Bordeaux mixture is the best remedy.

Diseases of the Quince.

The quince is subject to Brown Rot, Leaf Spot, Rusts, Scab, Fire Blight, and it is also subject to the following:

Leaf Blight (*Entomosporium maculatum*).—This trouble affects the leaves and in bad cases may entirely defoliate the plants. On the fruit, the fungus produces black areas. On pears, it may cause the fruit to turn black in places, grow one-sided and crack open.

Remedy.—The remedy for this is Bordeaux mixture applied just before the flowers open in the spring and two to four applications of it later at intervals of about two weeks.

Black Rot (*Sphaeropsis malorum*).—This disease often causes serious rotting of the quince just before maturity. It generally starts from the calyx end. The remedy is a preventive, and consists of spraying with Bordeaux mixture.

Diseases of the Plum.

Plum Pocket (*Exoascus pruni*).—This is a name given to certain peculiar deformities which occasionally take the place of plums on the trees. They consist merely of a thin shell with no evidence whatever of seed. They appear in early summer, and some seasons this disease is very abundant and then for a number of years it may scarcely appear at all. It is due to the presence of a parasitic fungus which attacks the young

fruit, and by growing within it causes the peculiar development which finally results in the formation of the so-called pocket. This, or a similar fungus, may also attack the foliage and cause irregular swellings and distortion.



Fig. 47.—Leaf curl of plums involving twig and foliage.

Remedies.—It will sometimes be found that a single tree will be troubled with this fungus for a series of years and it will not spread much. When this is the case such trees should be destroyed, as they are likely to be centers of in-

fection, and the diseased fruit should be picked and destroyed. Some varieties are more subject to its attack than others.

The leaf curl of peaches is caused by a fungus similar to that which causes plum pockets and recent experiments show that this disease may be kept in check by spraying with thick Bordeaux mixture or a solution of sulfate of copper just be-

fore the buds open. Later, sprayings of Bordeaux mixture may be necessary if the weather is rainy. The object of these sprayings is to kill the spores of the disease which are found on the bark.

Black Knot or Wart of the Plum (*Plowrightia morbosa*).—

This manifests itself by wart-like or knot-like growths appearing on the smaller limbs as well as on the larger branches and



Fig. 48.—Plum pockets as they appear on the tree.

sometimes even on the trunks. In sections of the country where the European Plum (*Prunus domestica*) is grown this is one of the most serious obstacles to its successful cultivation. Our native plums are not often destroyed by it, but it sometimes causes serious injury to

them. This knotlike growth is spongy and of a black color. Upon examining it with a microscope it is found that the surface has many little cavities that contain the spores by which the disease spreads. Spores escape from the knots during the late winter or early spring.

Remedies.—Upon their first appearance these swellings should be removed and burned, if they are on the smaller branches where it is practicable to get them off. If on the trunk or larger branches where the branch cannot be cut off, they should be cut out as much as possible and painted with thick Bordeaux mixture. Where trees are badly infested they should be removed entirely. This same disease also grows on the wild choke cherry and black cherry and, if abundant on them, their removal will make the extermination of the disease easier in the nearby plum orchard.

Brown Rot of the Plum (*Sclerotinia fructigena*) is a common and serious cause of loss. See Brown Rot under the head of peach.

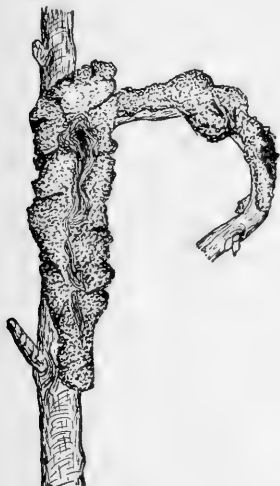


Fig. 49.—Black knot of plum.

Shot Hole Disease.—This may be caused by any of the several fungi or even by spraying injuries. Any of these causes may destroy the foliage in spots; after the deadened tissue drops out the shot-hole appearance is produced.

Crown Gall is the name given to a morbid growth which generally takes place near the surface of the ground. It is of a spongy nature and often spherical in form. The same disease or class of diseases also attacks the peach, raspberry, blackberry, apple and other trees. It is most commonly injurious to trees growing in the nursery. All stocks showing it should be regarded with suspicion.

Scab of plums (*Cladosporium carpophyllum*) causes dark, hard spots in the skin of the fruit. It may be prevented by spraying with weak Bordeaux mixture.

Diseases of the Peach.

Brown Rot (*Sclerotinia fructigena*).—This disease principally attacks peaches about the time the fruit begins to ripen and often spreads rapidly. It also causes decay in the fruit after it is picked, and is likewise one of the most injurious foes of plums and cherries, as well as of the peach, while apples, pears and quinces are sometimes injured by it. It sometimes destroys the young growth. If the diseased fruit is allowed to remain on the tree it dries up and does not fall off. The fungus passes the winter in the diseased branches and also in the dried fruit. In the spring these send out spores which start new centers of infection.

Remedies.—The diseased dried fruit should be removed

from the trees and ground and destroyed by burying deeply or burning. During the ripening season all rotting fruit should

be gathered promptly and burned. Where the fruit sets thick, thinning is of much assistance in keeping the disease in check. Spraying has not generally proven successful, on account of the rapidity of the spread of the disease when once started and because of the liability of the foliage to injury from the spraying solutions. It is probably desirable to use Bordeaux mixture on the trees in the spring before



Fig. 50 —Brown rot; half grown plums rotting with this disease.

the leaves open, and then apply two or three sprayings of potassium sulfide about picking time.

Crown Gall or Foot Rot.—This disease or class of diseases affects the peach in much the same way as the plum. In the case of the peach, however, the wood is made weaker and the trees are broken off at the surface of the ground. It is thought by some that it is the result of too much moisture, and the organism to which it is ascribed (*Dendrophagus gubosus*) comes in later as a saprophyte. There is no known remedy. Diseased trees seldom amount to much and the best treatment is probably to remove and burn them.

Leaf Curl (*Exoascus deformans*).—This disease appears soon after the leaves come out. It causes them to become distorted and swollen and later those that are infected the worst fall off, leaving the tree nearly or quite bare of foliage. The remedy for it is spraying with Bordeaux mixture about two weeks before the buds begin to swell in the spring. In wet springs a second application of one-half strength can be used to advantage. Where the trees are sprayed with lime and sulfur in winter for scale, the disease is held in check. A weak solution

of copper sulfate, containing one pound to twenty-five gallons, applied in the spring about two weeks before the buds open, is effective.

Scab (*Cladosporium carpophyllum*).—This fungus occurs on the fruit, leaves and twigs. On the fruit it makes black spots which may unite and involve a large part of the surface in a black scab, disfiguring the fruit and causing it to become one-sided. The mycelium lives over winter on the infected twigs. Winter or early spring sprayings are recommended for the Peach Scab.

Yellows.—This disease is now considered due to some derangement of the plant functions. It is evidently contagious. The disease is not easily distinguished from troubles due to other causes and weak trees may present symptoms closely resembling those that are infected with Yellows. Its symptoms are a general premature ripening of the fruit, which becomes streaked with red, or spotted, and is of a poor quality; a premature development of the winter buds, giving rise to excessive branching on new shoots resembling "witches brooms", the formation of water sprouts, and finally a scanty, yellowish development of the foliage.

Peach Rosette.—This disease is very similar to the Yellows. It is distinguished by the peculiar rosette arrangement of the diseased water sprouts which spring from the branches. It generally causes the death of the tree in one season. No remedy is known except to dig out and burn all affected trees at once.

Remedies.—The best treatment is to grub out and burn the diseased trees. A rigid enforcement of such treatment would probably keep it in check, as this seems to be a fair lesson to draw from the wide experience of the state of Michigan in combatting this trouble.

Diseases of the Cherry.

The cherry is subject to the following diseases:—Black Knot, Brown Rot, Leaf Curl, Leaf Spot and Powdery Mildew. These are all discussed under Plum and Peach. The remedies for these is Bordeaux mixture.

Diseases of the Grape.

Anthracnose (*Sphaceloma ampelinum*).—This rot may attack the twigs, fruit or leaves. On the fruit it forms small, dark

spots with bright borders and is called bird's-eye rot. The diseased wood should be removed. When vines are sprayed with Bordeaux mixture for other diseases, this is held in check, and it is seldom abundant enough to warrant spraying for it alone.

Black Rot (*Guignardia bidwellii*).—One of the most com-

mon of injurious diseases affecting the grape. It sometimes attacks the leaves, but is most common on the fruit, which causes it to rot, turn black, and finally dry up. The disease breeds in the mummified fruits and in the diseased leaves of the Ampelopsis as well as of the grape.



Fig. 51.—Black rot of the grape, showing infested fruit rotted and dried.

Remedies.—The dried grapes should be removed and burned. Spraying with Bordeaux mixture is probably the most certain remedy and if persistently followed up year after year will be found quite effective. The fruit should be kept covered with it until it begins to color, after which ammoniacal carbonate of copper should be used. If Bordeaux mixture was used up to ripening time the fruit would look dirty. Bagging the fruit is commonly a satisfactory remedy, provided the bags are put out as

soon as the fruit is set. To spray effectively with Bordeaux mixture will generally take three or four applications, according to the weather. It is sometimes washed off before it is dry, when it should be applied again. Some vineyardists are getting good results by using a solution of copper sulfate (1 lb. to 25 gals. of water) just before growth starts.

Downy Mildew (*Plasmopara viticola*).—This fungus may attack the young wood, flowers or fruit, or all these at the same time. When it attacks the foliage it appears as greenish yellow, or brownish, irregular spots on the upper surface, with corresponding spots of whitish, frost-like mildew on the under side. The effect of this is to have the leaves dry up and fall

off, frequently when the fruit is quite green, which, consequently, does not ripen. But, besides the loss of fruit from this disease, the wood is often left in a very poor, immature state, and the whole plant so seriously weakened that it will not produce a full crop of fruit for several years. It frequently acts in this manner on the Delaware, while it seldom injures the fruit of that variety. On some other varieties the fruit is more susceptible than the foliage and it produces brown rot of the berries, which may cause severe loss in some season. In this case the first perceptible effect of the disease is when a purplish spot appears on the side of the berry. Later, the fruit is covered with a white mould, then it turns brown, and later on becomes soft and wrinkled.

Remedies.—Spraying as recommended for Black Rot.

Powdery Mildew (*Uncinula necator*).—This mildew forms a superficial, cobweb-like growth on the leaves and new growth, and occasionally on the fruit. The remedies are the same as for Downy Mildew. It is also recommended to spray the vines in the winter with copper sulfate solution to destroy the winter spores. Flowers of sulfur has also been used successfully against this disease.

Preventives of grape diseases.—Every effort should be made to keep fungus diseases from getting a hold of the plant. It has been found that where the vines are closely shut in, so that there is but little circulation of air and the water does not quickly dry off the foliage, or where the soil is wet and cold, the vines are very liable to become diseased. On this account, where a vineyard is subject to such troubles, the first thing to do is to remedy, as far as is practicable, anything that obstructs free circulation of air through it. If the land is moist and cold it should be underdrained. For brown and black rot of the fruit early bagging of the clusters will be found quite effective. But after these things are done, disease may gain a foothold and cause serious injury to weak varieties; hence spraying may be necessary. Some varieties are uniformly healthy in some locations, while others are very susceptible to disease. Yet these latter are often the most profitable kinds to grow for marketing purposes.

Diseases of the Strawberry.

Leaf Spot, Rust or Sunburn (*Sphaerella fragariae*) is a disease which lives in the tissues of the leaves and stem. In the early spring small purple or red spots appear on the new leaves. About the time the plants are exhausted by fruiting, or perhaps, before the fruit is fairly ripe, these spots increase rapidly in size and in a few days what was a promising strawberry bed is dried up and worthless.



Fig. 52 —Rust or leaf spot of strawberries.

Many varieties that are hardy otherwise have foliage that is susceptible to this disease, and some kinds should not be planted unless some fungicide is used to protect them from it. Our growers at present prefer to obviate the necessity of using fungicides by planting only those varieties that are very robust and healthy. However, it may be desirable to grow some varieties with weak foliage. In such a case the newly set plants should be sprayed three or more times the first season, commencing as soon as the young plants are well established and twice the following spring, with Bordeaux mixture or some other fungicide, beginning as soon as the leaves appear. To do this requires no more labor or expense than it does to spray for the potato bug the same number of times, and the grower will be well repaid in the increased crop. Highly cultivated plants are less liable to disease than those that are neglected.

Diseases of the Blackberry.

The Crown Gall occasionally attacks blackberry canes near the surface of the ground, causing irregular swellings. It has



Fig. 53.—Crown or root gall of blackberries.

not generally proven seriously injurious, but undoubtedly, the part of wisdom would be to avoid setting new plantations from a field so infested. The diseased canes should be gathered and burned.

Leaf Spot (*Septoria rubi*).—This disease produces dark colored spots on the foliage, which are sometimes very abundant. Spraying with Bordeaux mixture is the best remedy.

Orange Rust.—The blackberry is also injured by the orange rust, which is referred to under the head of Raspberry.

Diseases of the Raspberry.

Leaf Curl.—This name is indicative of one of the early stages of the disease. The leaves curl up, and though they may remain green all through the season, the plants make a poor, weak growth. The fruit is dull in color, small in size and rather bitter in taste. Later the plants kill out, and any healthy sets with which they may be replaced soon succumb to the trouble. This disease spreads very slowly and, as a rule, at the beginning there are only a few infected spots in a plantation, which slowly increase in size from year to year. The spread of the disease may be prevented to a great extent by pulling and burning the diseased plants as soon as they appear. In setting out a new plantation, use only land which has not been in raspberries for several years and take great care to have young, healthy sets. Do not accept plants from a weak plantation on any account.

Red Orange Rust (*Gymnoconia interstitialis*) is most harmful to the Black Cap raspberries, though it frequently injures blackberries, dewberries and allied plants. It produces a weak appearance in the canes and foliage, and in the latter



Fig. 54.—Cane rust on raspberries.

part of the summer the under side of the foliage becomes completely covered with a thick coating of orange colored spores, which easily rub off. One soon learns to know the plants that are diseased, even before the spores appear, and they should be pulled and burned at once. This is especially necessary with the black-cap varieties; but even with these, if the affected plants are destroyed, the disease may generally be kept in check until a new plantation can be well started, and sometimes assiduous attention to pulling and burning results in stamping out the disease.

Crown Gall is sometimes injurious to the raspberry the same as to the blackberry, but it is seldom very injurious at the North. In selecting new sets care should be taken to avoid those from infested fields.

Cane Rust or Anthracnose (*Gloesporium necator*) manifests itself on the raspberry by small purplish spots, which may spread and form whitish patches with purplish edges. The tissue is killed out under the spots. It affects raspberries generally, but the purple and cap varieties are most liable to its injury.

Remedy.—The best treatment is to spray the canes before the leaves start with thick Bordeaux mixture. The badly diseased canes should be cut out at pruning time and only resistant varieties planted. Spray the new growth in the spring once or twice. There is a great difference in the power of different varieties to resist this disease.

Diseases of the Gooseberry and Currant.

Mildew (*Sphaerotheca morsuvae*) is the worst disease of the gooseberry. It attacks the foliage which, as a result, becomes covered with a whitish mould. Later the leaves dry up

and drop off and the wood fails to mature. In bad cases the berries become discolored and perhaps ruined. As a rule, this disease does not cause serious injury in good locations in this section; but in wet seasons, or on wet land in any season, or where there is a poor circulation of air it may be very destructive.

Remedies.—These should be preventives largely, and consist of allowing plenty of room between the plants for a good circulation of air and keeping them in as vigorous a state of health as possible by manuring and cultivating. If the disease makes its appearance in the face of these precautions, recourse should be had to the following remedy, which is very satisfactory: Spray the plants in the spring as soon as the young leaves begin to unfold, and repeat it as often as once in eighteen or twenty days, except in times of heavy rains when it must be done oftener. For this purpose use liver of sulfur (Potassium sulfide) dissolved in water at the rate of one-half ounce to the gallon.

Leaf Spot (*Septoria ribes*).—Both currant and gooseberry are injured by what is termed leaf spot, which causes deadened spots in the foliage. It may be prevented by spraying with Bordeaux mixture before the fruit begins to color and again after the fruit is picked.

QUESTIONS—CHAPTER VII.

Diseases.

1. What portions of the plant are most susceptible to disease?
2. How are the majority of plant diseases propagated?
3. What is meant by the alternation of generations?
4. How are plant diseases generally treated?
5. Describe the injury caused by the following diseases of the plum and give remedy for each: Plum Pocket, Leaf Curl, Black Rot, Brown Rot, Shot Hole Fungus, Crown Gall.
6. What diseases are injurious to the pear?
7. Describe the injury caused by the following diseases of the apple and give remedy for each: Apple Blight, Bitter Rot, Black Rot, Crown Gall, Leaf Rust, Apple Scab, Powdery Mildew, Fruit Scald.
8. How does spraying sometimes injure the trees?
9. How does frost affect the trees?
10. What is sunscald and how does it injure the trees?
11. How may it be remedied?
12. Describe the injury caused by the following diseases of the peach and give remedy for each: Brown Rot, Crown Gall, Leaf Scald, Scab, Yellows.

13. Describe the injury caused by the following diseases of the grape and give remedy for each: Anthracnose, Black Rot, Downy Mildew, Powdery Mildew.

14. What are some general preventives for diseases of the grape?

15. How does rust or sunburn affect the foliage of the strawberry?

16. What is the remedy for it?

17. Describe the injury caused by the following diseases of the blackberry and give remedy for each: Crown Gall, Leaf Spot, Orange Rust.

18. Describe the injury caused by the following diseases of the raspberry and give remedy for each: Leaf Curl, Orange Rust, Crown Gall, Anthracnose.

19. What diseases affect the cherry?

20. What diseases affect the quince?

21. Describe the injury caused by the following diseases of the quince and give remedy for each: Leaf Blight, Black Rot.

22. Describe the injury caused by the following diseases of the gooseberry and currant and give remedy for each: Mildew and Leaf Spot.

Take up the other diseases discussed in the same way as the foregoing.

CHAPTER VIII.

SPRAYING AND SPRAYING APPARATUS.

The methods of spraying of plants naturally divide themselves into two groups, (1) dust spraying and (2) liquid spraying.

Dust and Liquid Spraying Compared.—In a general way it may safely be stated that insecticides and fungicides applied in the dust form to trees are not as efficient as when applied in the liquid form, and the difference in efficiency is enough to make it worth the extra trouble necessary to employ the liquid form under all ordinary circumstances.

The principal difficulty with the dust spray is in getting it to stick to the foliage and fruit. It should be applied while the foliage is damp. This may be soon after a rain, or while the foliage is damp with dew. Advantage cannot often be taken of the former condition; hence one must usually rely on getting the dust spray on very early in the morning or occasionally late in the evening. In either case it will be out of the regular working hours and therefore disagreeable. The wind also interferes much more with the application of dust sprays than with liquid sprays. This difficulty, however, is helped by the fact that in the early morning, when the dust spray must usually be applied, there is seldom much wind during the summer months. Another reason for the comparative inefficiency of dust sprays—and this applies especially to the application of dry Bordeaux mixture—is that the dry form can never be obtained in as finely divided condition, whether prepared at home or in the factory, as good home-made liquid sprays. This means that an equal or even greater quantity of the dust form cannot be as thoroughly distributed over a given amount of leaf surface as can the liquid form, and hence will leave more unprotected spots, through which disease or insect pests may enter. The great advantage in favor of dust sprays is the comparative cheapness of their application because large quantities of water do not need to be hauled around in order to apply the spraying material, but, as previously stated, this

is not enough to make up for the difference in efficiency. However, it may become of much importance in the case of hilly land. Here the light dust spray outfits can be used when it would be impossible to get around with a barrel of liquid spray, or, much less, with the large wagon outfits.

Liquid Spraying Outfits. Pressure.—The important point in the application of liquid sprays is to get a high pressure. This should not be less than 75 pounds on an ordinary pressure gauge. For high trees better work will be accomplished with a pressure of 125 pounds. It is not usually advisable to use a pressure of over 125 pounds, because it is too hard on the machinery and apparatus in general. The higher the pressure it is practicable to maintain, however, the more efficient will be the application of the spray. This should be applied

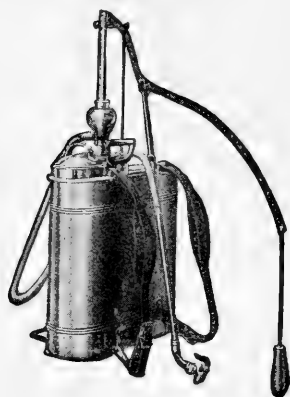


Fig. 55.—Knapsack sprayer.

in the finest mist-like form possible, and a good pressure is necessary to accomplish this. A fine mist will float among the foliage like a fog if there is not too stiff a breeze, and will cover both sides of the leaves and fruit much better than could possibly be the case with a spray of drops such as comes from an ordinary nozzle under low pressure.

Agitation in Barrel Outfits.—

The movement of the barrel while in use is often sufficient to keep well made Bordeaux and other light sprays from settling, but with

the heavier sprays, like Paris Green and lime-sulfur wash, some provision for agitation is necessary. Probably the best way to provide for this agitation is to have a paddle attached to the pump near the bottom of the barrel in such a manner that it will move with every stroke of the handle and thus keep the liquid stirred up and prevent settling. Another method of providing for agitation, known as "jet agitation," is to leave a small hole in the bottom of the cylinder, through which a part of

the liquid is forced out with each stroke. This method works quite well while the pump is new and the packing tight, but as the pump becomes worn it will usually be found that all of the liquid which the cylinder will handle will be needed in order to maintain sufficient pressure. Moreover, the hole through which the jet escapes wears larger in time and thus further helps to decrease the efficiency of the pump.

Agitation in Tank Outfits.—All tank outfits should be equipped for agitation for all kinds of spraying compounds. It is, however, desirable not to have the agitation too violent, because with some spraying compounds, especially with the lime-sulfur wash, there may be considerable sediment which, while small enough to pass through the strainer on the suction hose



Fig. 56.—Plum leaf covered with arsenate of lead after 10 days. Showing how well it sticks to the foliage.

and through the nozzle in small quantities, may in larger quantities cause considerable difficulty with these parts. The agitation should be just sufficient to keep the finer particles in suspension and still allow the coarse particles to settle. One way of providing agitation is to have the tank sectioned crosswise with partitions every two and a half or three feet, leaving a hole about a foot wide and six inches high through which the liquid will rush and cause a general stirring up every time the wagon is driven forward to another tree. This method does well with small to medium-sized trees with well made Bordeaux and the lighter spraying compounds but where they tend to settle rapidly, such agitation is seldom sufficient, and where the trees are so large that considerable periods occur between movements of the wagon it is entirely insufficient. Another objection to this method is that the partitions make it difficult

to clean out the tank and remove the coarse sediment which collects in the bottom. A better method of providing for agitation is by means of a rod running lengthwise of the tank, with perforated cross pieces about six or eight inches high, cut rounding to fit in the bottom of the tank, and twelve to sixteen inches wide, attached at every two and one-half or three feet. There are two methods of giving this apparatus the alternating backward and forward movement necessary for agitation. Probably the most common way is by means of a chain drive from one of the hind wheels of the wagon. This method, of course, supplies agitation only when the wagon is in motion and is therefore to some extent open to the same objections as the preceding method. It has the advantage, however, of giving



Fig. 57.—Barrel sprayer.

more thorough agitation while it is working and of being such a simple arrangement that it can easily be made, and there is little about it to get out of order. The other method of supplying the motion to the agitator is by having it connected with the pump. Up to the present time no really substantial method of connection has been devised, and little provision has been made for regulating the amount of agitation given. Usually this agitator gives more agitation than is needed. It will, however, probably be the best method when it has become perfected, because it is continuous. Provision is sometimes made for hand operation of the agitator by means of a handle fastened in the top of the tank.

The working parts of pumps and the lining of the bamboo spray poles should be of brass for most spraying compounds. If the parts are made of iron they are liable to ordinary rusting and to corrosion by Bordeaux mixture and similar com-

pounds. With the lime-sulfur wash iron parts last longer than brass parts, but any kind of metal will wear rapidly, since this compound contains much grit on account of the large quantities of lime used in making it.

Air Chamber.—All spray pumps should be provided with an air chamber of liberal size. This equalizes the pressure between the strokes of the pump, thus giving a more even flow of spray from the nozzle and easing the strain on the hose.

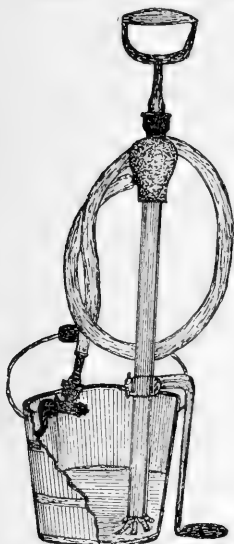


Fig. 58.—Bucket pump outfit.

Nozzles.—Most of the nozzles now in use have a chamber, known as the “eddy chamber,” underneath the nozzle-cap, with the entrance into the chamber so arranged that a rapid, whirling motion of the liquid results and causes the liquid, if under proper pressure, to break up and leave the nozzle in a very finely divided, mist-like condition. There are a number of types of nozzles, but the amateur will probably have the best success by using nozzles of the Vermorel type. Where sufficient power is available, as with gasoline engines, two or more poles may be run from one pump, each pole bearing from two to four nozzles.

Clogging of the nozzle may result from several causes. The most common is improper straining. The spraying mixtures should always be strained, when run into the spraying barrel or tank, through as fine a mesh as possible.

For lime-sulfur wash about twenty meshes per inch must be used because a smaller mesh fills up badly. For most other sprays a mesh as small as twenty-five per inch should be used if possible. A much finer mesh can be used when the strainer is made with the wire mesh on the sides as well as on the bottom because this allows the liquid to continue to pass through the strainer when the bottom has been covered with sediment, as frequently occurs with lime-sulfur wash. The mesh should be of brass or copper. Whenever burlap is used for holding the dissolving

blue vitriol, it should be of a good, firm grade. If it is flimsy, much fiber may leave the burlap and ultimately get into the nozzles and clog them. Wood fiber, becoming loose from the inside of the spray tank, will also frequently cause clogging of the nozzle. A high pressure will drive much sediment through the nozzles that otherwise would clog them.

Hose.—The hose must be strong and durable in order to avoid delays from breakage and disagreeable leakages. Three-ply three-eighth inch is most commonly used. One extensive fruit grower in the East uses seven-ply three-eighth inch hose. It is not advisable to use a larger hose because it does not stand the pressure so well and is heavier to drag around from tree to tree in spraying.

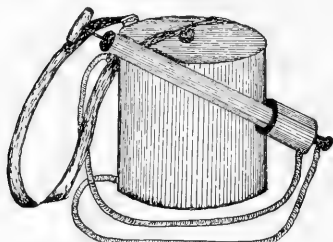


Fig. 59.—Inexpensive compressed air sprayer for spraying currants, potatoes, cabbages, etc.

Thoroughness of work is essential to real success in spraying. The man who goes about his trees in a "hit or miss" fashion, leaving a branch unsprayed here and the center of the tree unsprayed there, is the one who finds that spraying does not pay. An apple that is not completely covered with a coat of poison is not completely protected from the second brood of the codlin

moth larvae. Every inch of twig and branch of a tree sprayed for the San Jose scale, that is not coated with the mixture, has just as many live scales on it as it had before the spraying outfit came by that tree, and hence remains unmolested as a source of infection on the new growth and of re-infection on the treated portions as soon as the coat of spray becomes ineffective. Many who begin to spray after an orchard is about full grown find that the trees are set too closely together. Enough space should be left between the rows to permit the ready passage of the spraying outfit at all times. It is impossible to do good work in spraying trees where one cannot get around conveniently with the spray pole. Moreover, in a closely set orchard, a horse pulling a barrel outfit on

a stone-boat will often not be able to get down the row, to say nothing of the impossibility of getting through with a power outfit.

Kinds of Spraying Outfits.—For spraying on a very small scale, the knapsack, bucket pump, and five-gallon compressed



Fig. 60.—One of the many types of sprayers with power from a gasoline engine.

air outfits are very serviceable. The cheapest and most generally useful spraying outfit on areas up to five acres is a first-class oil barrel set upright on a stone-boat with a good spray pump fastened on it. On larger areas up to 15 or 20 acres the wagon tank with a horizontal hand pump is more practicable, since it has greater capacity and efficiency. On areas of over twenty acres the air-cooled gasoline outfit will usually be a good investment. It relieves the laborious work of pumping by hand, and correspondingly reduces the working force necessary and gives a higher pressure. With a little mechanical ingenuity and care on the part of the operator it should be easily kept in good working order.

Another type of spraying outfit is what is known as the "gas sprayer." The spray mixture is run into a tight steel tank

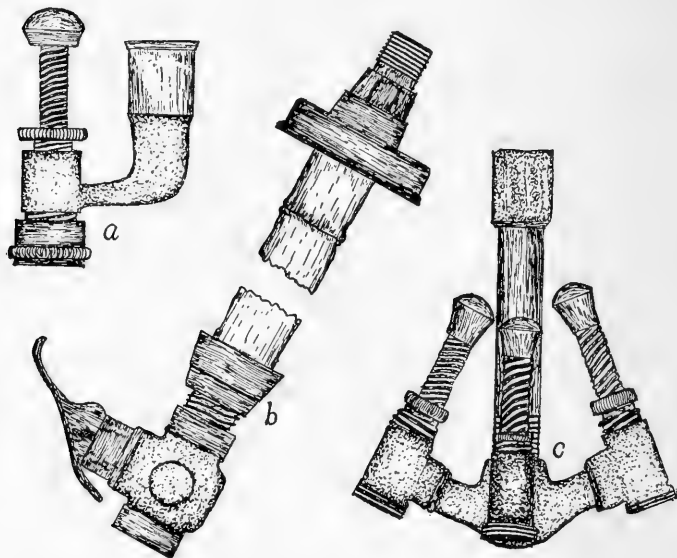


Fig. 61.—Forms of Vermorel Spray nozzles in common use. a.—Vermorel nozzle with an opening. c.—Vermorel nozzle with four openings. b.—The top and base of extension rod, showing a cap to keep the spray liquid off the hand.

of 50 to 250 gallons capacity. A carbon dioxide gas tank is connected with this and the gas released from it, according to the pressure desired, into the spray tank. This method has the advantage of being the most simple arrangement possible. It is, however, expensive, since the gas tanks must be sent back to headquarters to be refilled, involving considerable cost in freight in distant locations, as well as the cost of refilling. Injury has frequently resulted to trees sprayed with this type of sprayer, presumably because the carbon dioxide gas united with the "lime" in the Bordeaux mixture, leaving free copper sulfate which burned the foliage.

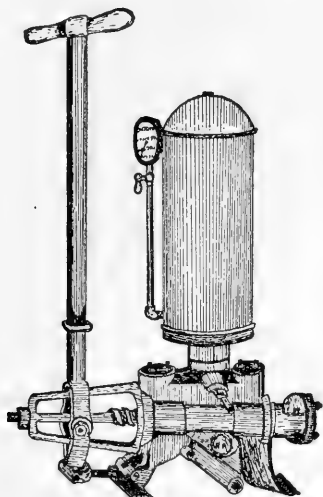


Fig. 62.—Spray pump with horizontal movement.

QUESTIONS—Chapter VIII.

Spraying and Spraying Apparatus.

1. What are the advantages and disadvantages of dust spraying?
2. What are the important things to be remembered for successful liquid spraying?
3. By what means can the spraying mixture be kept well mixed in the barrel spraying outfits? In the tank spraying outfits?
4. What materials should be used for making the working parts of spray pumps?
5. What causes the clogging of the nozzles and how may it be remedied?
6. What care should be taken in spraying the orchard?
7. What spraying outfits are best adapted to small areas? To large areas?

CHAPTER IX.

HARVESTING, MARKETING AND STORING FRUIT.

While good, sound business judgment is necessary throughout the whole round of successful fruit growing, it is especially important when the grower comes to picking and marketing. The successful fruit grower must not only study how to raise fruit and what kinds are needed in the markets of the world but he must learn the best way to market it so as to bring him the largest possible returns. Markets may easily be divided into small, local and large, and the methods of selling may vary greatly in different sections. The ways of doing business are much more uniform in the large markets, but there is much difference in this respect in different sections and the grower should study carefully the peculiarities of his markets.

Fruit growers may also be divided into classes, according as they retail or wholesale their products. Large fruit growers must be wholesalers, while many small growers can often, to advantage, work up a retail business. The methods of distributing fruit have become very much improved in recent years so that the prices are more uniform than formerly. This, to be sure, interferes with the high prices that occasionally prevailed in local markets under the old methods. On the other hand it makes less liable the glutting of the local market and the resultant low prices that were so troublesome formerly, so that the present conditions are probably better than the old for both the producer and the consumer.

Picking.—The marketing of fruit begins with the picking for it is the first step in selling it. No matter how carefully other details are attended to, the picking must be done right or the fruit will be of little value. Fruit allowed to become too ripe before picking, or roughly handled in picking, may be rendered unsalable. For best results, fruit to be marketed in fresh condition must be picked by hand.

The exact time to pick fruit can only be determined by

experience. A rule for this cannot be laid down for every class of fruits.

Time to Pick Fruit.—Strawberries are picked when they begin to turn red, and raspberries when the fruits part readily from the stem on which they grow; blackberries and dewberries as soon as well colored, although the flavor would generally be improved by allowing them to remain longer on the plants. Gooseberries are generally marketed green; currants are allowed to color, but are not allowed to ripen and are generally preferred for jelly-making when a few berries show some green color. Cherries are picked as soon as well colored. This will depend somewhat on the variety. Plums may be picked when they are well colored. The Japanese kinds color well after picking. Prunes are generally allowed to ripen on the

trees and are shaken off if to be used for drying. If to be shipped for use when fresh, they are picked as soon as well colored. Pears are usually picked as soon as full grown and are preferably ripened in the shade. For the distant market it is necessary that pears be shipped green and be allowed to ripen in transit. At Fresno, California, the season for Bartlett pears lasts two months, the first shipments beginning as soon as the fruit is large enough to sell. Peaches for the nearby market are picked as soon as they begin to show a slight softness and before they are mellow; for the distant market, they are picked quite green. Summer cooking apples are generally picked as soon as large enough to use, without regard to ripeness. All the summer apples that are to be shipped must be picked green

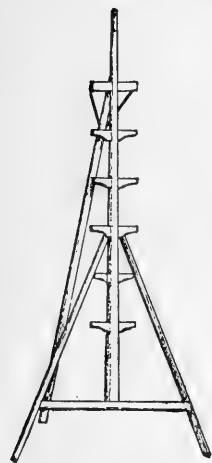


Fig. 63.—Ladder in common use for picking fruit.

as they are quite perishable when ripe. It may be best, however, to allow them to color a little. Late varieties are picked as soon as well colored and before severe frosts. Apples should always be picked earlier if they show by the windfalls that they are

ripening, as there is liable to be serious loss from this cause. **Winter apples** generally keep best if picked a little before they are fully colored, but while still firm and hard. **Grapes** should be picked when fully ripe, as they do not ripen after being picked.



Fig. 64.—Picking scene in an apple orchard. Note the low-headed trees, which make it possible to reach all the fruit from the ground or from short ladders. The pickers are equipped with canvas bags hung over the shoulders, in which the fruit is placed as picked. This leaves both hands free and allows rapid work. The fruit is taken to the packing shed in bushel baskets, and is then carefully packed in boxes or barrels.

The stems should be left on strawberries, plums, apples, pears, grapes, currants and cherries. If the stems are pulled out of the fruits, injuries are caused that encourage rotting.

Fruit should seldom be shipped in the same package that

it is picked in, but should be sorted into other suitable packages in a cool storehouse.

Local peddling is possible where the grower lives near his customers. In some sections the dealers have combined and secured legislation which has made this prohibitory; but where practicable, it is a very satisfactory way of disposing of the product so as to get the highest possible price. A variety of fruits are most easily disposed of in this way and under some conditions it is a good plan to combine the peddling of fruit with a vegetable business.

Commission Dealer.—The larger grower must find some party to sell his produce. It may be best for him to do this through the commission merchant. In any case, it should be understood that the larger grower has a decided advantage over the small grower as he is a bigger factor in the market and will receive more attention. It is most important to secure an honest and able commission dealer if the business is to be done in this way. The usual charge for handling fruit is 10% of the gross sales.

Associations of fruit growers, when well managed, offer the most satisfactory method of selling. Here the sales are made by an agent of the growers. Such an arrangement gives to a large number of small growers a power in the market equal to that of the big grower and shipper. It prevents their competing injuriously with one another in the local or distant market and reduces marketing to a simpler matter. The small grower can stay at home and look after the picking and packing, as he does not have to go to market when he sells through an association, and still he is a controlling factor in the market. Organizations of this kind should have correspondents over a large territory and they can often ignore the prices prevailing in the local markets.

Fruit Packages.

Packing.—The packages for fruits are many and various and the shipper should be familiar with them all. In some of the older fruit sections it is customary to have the packages for small fruit returned to the packer. As a rule this is a poor practice and results in the use of unsightly pack-

ages which hurt the sale of the fruit. The same is true of the practice of using dirty barrels for apples. The common experience of the larger fruit growers leads to a belief in the gift package for general marketing. In fact, for long distant shipments, the return package is out of the question, although it may do for some local markets. Every fruit shipper should occasionally visit the great markets and study this question of marketing

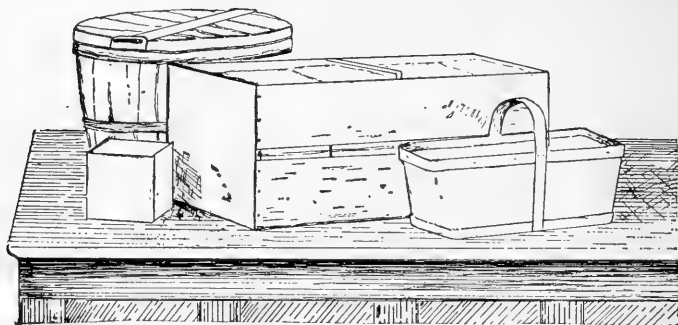


Fig. 65.—Fruit packages, showing bushel basket with cover, 32-quart gift package for berries and grape basket.

fruits at first hand. He will probably learn more about fruit packages in a single hour of inspection at such a place than in a week of studying such a subject in the small markets.

Uniform packages.—While there are a great variety of fruit packages in use in the different markets of this country, it is very desirable that the packages used for selling fruit in the same market be uniform. For instance, it is important to have all the so-called quart boxes, such as are commonly used for selling small fruit, of the same size, otherwise there will be lack of fair competition among growers, since many buyers do not properly distinguish between the standard package and one that is short. In some states, and notably in Canada, legislation has been invoked for this purpose and with good effect. These laws generally take the form of prohibiting any person from offering for sale any fruit package smaller than the prescribed size unless each package is plainly labeled that it is short in size. There is much more attention paid to this subject in America

than in Europe where comparatively little fruit is used and that generally marketed in a variety of packages.

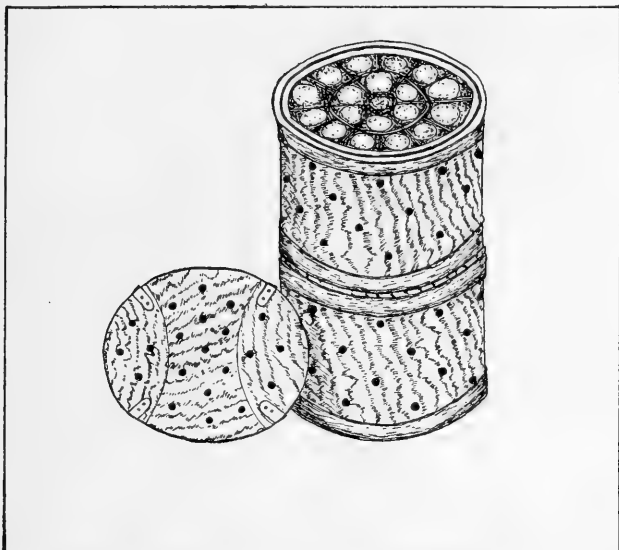


Fig. 66.—Fruit package with separate compartment for each fruit.

The following list shows some of the fruit packages that are prescribed by law:

Fruit Package Laws.

New York Small Fruit Package Law:

Quarts shall contain 67 cubic inches.

Pints shall contain $33\frac{1}{2}$ cubic inches.

$\frac{1}{2}$ Pint shall contain $16\frac{3}{4}$ cubic inches.

New York Apple, Pear, Quince and Potato Barrel Law:

Barrels shall contain 100 quarts of grain, dry measure.

Head diameter shall be $17\frac{1}{8}$ inches.

Stave length shall be $28\frac{1}{2}$ inches.

Bulge shall not be less than 64 inches, outside measurement.

Potatoes sold by weight shall weigh 174 pounds to the barrel.

Massachusetts Berry Basket Law:

Baskets shall be of the capacity of one quart, one pint, or one-half pint, Massachusetts standard dry measure.

New Jersey Peach Basket Law:

Peach baskets shall hold sixteen quarts, Winchester $\frac{1}{2}$ bu. measure.

Height of basket shall be $12\frac{1}{2}$ inches.

Width across top of basket shall be $13\frac{1}{2}$ inches.

Inside measurement shall contain 1075.1 cubic inches.

Missouri Apple Barrel Law:

Length of apple barrel shall be $28\frac{1}{2}$ inches.

Chimes shall be $\frac{3}{4}$ of an inch at the ends.

Diameter of heads shall be $17\frac{1}{4}$ inches.

Diameter of the center of the barrel, inside, shall be $20\frac{1}{2}$ inches.

Canadian Fruit Package Law:

Apples packed in Canada for export shall be packed in barrels.

Distance between the heads, inside measurement, shall be $26\frac{1}{4}$ inches.

Head diameter shall be 17 inches.

Middle diameter of barrel shall be $18\frac{1}{2}$ inches.

Canadian Fruit Baskets shall contain, when level full

a—Fifteen quarts or more.

b—Eleven quarts and be $5\frac{3}{4}$ inches deep, inside measurement.

c—Six and two-thirds quarts and be $4\frac{5}{8}$ in. deep, inside measurement.

d—Two and two-fifths quarts.

Michigan Peach Basket Law:

Peach basket shall contain 716 4-5 cubic inches or 1-3 bu.

Michigan Standard Barrel Law:

Barrel staves shall be 27 inches long.

Heads shall be $16\frac{1}{2}$ ins. in diameter.

Maine Barrel Law:

A barrel of potatoes shall weigh 165 pounds.

Tennessee Apple Barrel Law:

Apple barrels shall contain $2\frac{1}{2}$ bushels.

Wisconsin Apple Barrel Law:

Apple barrels shall contain 100 quarts, dry measure.

Florida Orange Box:

The standard orange box adopted by the Florida Fruit Exchange measures 12x12x26 $\frac{5}{8}$ inches.

Georgia Peach Crate:

The peach crate adopted by the Georgia Horticultural Society measures 8x12 $\frac{1}{2}$ x22 inches.

Raspberries, blackberries, currants, gooseberries, strawberries and small plums are generally shipped in boxes that are commonly called quarts and occasionally in pint boxes. There is quite a variety in the forms and sizes of boxes used for this purpose. In the Central states, almost without exception, the gift package is used and here the boxes are generally made of wood veneer, with the bottom raised about one-half inch and the corners ventilated. Cases usually contain sixteen or twenty-four pints or quarts. This makes a very satisfactory package in which fruit carries well.

Grapes are usually marketed in the so-called five or ten-pound veneer basket which usually contains either four or eight pounds. This basket has a wooden cover which is held down by wire. **Plums** are usually marketed in baskets containing about one-half peck each. In the Eastern states a package resembling the grape basket is often used, while in the Pacific Coast states a basket that fits into a case holding six or eight of them is a favorite. **Peaches** are shipped in much the same packages as plums although in Delaware round baskets are much used.

The bushel basket.—In some sections a favorite package for marketing **apples, pears and quinces** is the bushel basket with a cover. While this does very well for local use it is too wasteful of space in packing cars to warrant its general use. It is, however, a popular package with the purchaser as it is useful to him and he is willing to pay something for it, while the box package is regarded by the purchaser as being of no value.

The bushel box is the popular fruit package in many of the Western states and has given excellent returns. For fancy fruit, it is an excellent package, but for fruit of ordinary grades it is probably not as good as the barrel, as the cost of the pack-

age and packing is much more than where barrels are used. Much fancy fruit from the Western states is wrapped in paper before it is packed and is then put in the boxes in layers by hand. Of course such fruit ships and keeps better than fruit not so carefully handled. The box enables a better display to be made of the fruit and supplies a handy package for the retailer.

Methods of Packing.—There are two methods or styles of placing apples in these boxes in general use, known as the straight and diagonal packs. In the straight pack the apples are placed in straight rows, both lengthwise and across the box. The straight pack is not used where the diagonal can be used as the apples are more apt to be bruised in pressing and putting the cover on.

There are various ways of arranging the apples in the box in the straight pack as well as the other kinds. Some place the apple on the side, others with the stem up, and others with the stem down. Probably the best packs are those arranged with the stems to the outside in the top and bottom layers.

The term **tier** is used to designate the number of rows across the top and the number of rows deep. The number of rows across times the number of rows deep times the number of tiers long gives the number of apples in the box. The number of tiers, of course, depends on the size of the apples. The up-to-date packer now stamps either the number of tiers, or the number of apples contained in the box on the outside so that the buyer may know at a glance how many apples he has in the box.

Diagonal Pack.—In the diagonal or diamond pack the rows run diagonally with the edge of the box. Its advantage over other packs is that it accommodates sizes that do not work into the straight pack and also that in pressing the apples can adjust themselves to the spaces between the apples in the adjoining tiers. The diagonal pack contains the half tiers, such as three and one-half and four and one-half. These allow an easy pack for many apples that would not go in the straight pack.

The diagonal pack is started by putting in two or three apples in the lower left hand corner and then building the lower layer from these. Experience is needed before one can do this well.

Grading.—The apples should be graded by an experienced grader and placed on the packing table ready for the packer. A mechanical grader, as shown in the illustration, is useful until one is able to judge the size of an apple readily. The holes in the grading board may be of the following diameters: $2\frac{1}{4}$, $2\frac{1}{2}$,

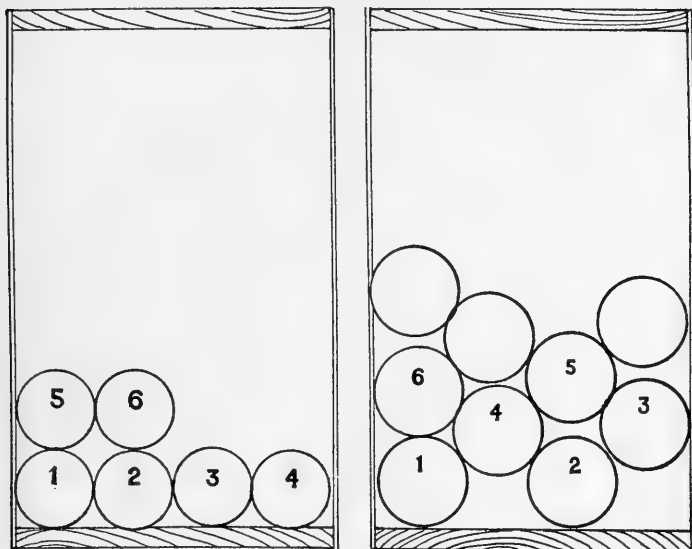


Fig. 67.—Methods of packing apples in boxes. Numbers show order in which first fruits are placed in the boxes. At left, 4 tier straight pack; at right, $3\frac{1}{2}$ tier diagonal pack.

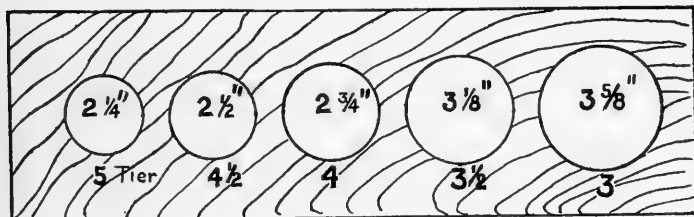


Fig. 68.—Handy board for grading apples into sizes for packing. The figures in the openings show the diameter of the holes in inches, while the figures below show the corresponding packs.

$2\frac{3}{4}$, $3\frac{1}{8}$ and $3\frac{5}{8}$ inches respectively. (This is for the standard apple box.) Apples which go through the $3\frac{5}{8}$ inch hole and over the $3\frac{1}{8}$ inch hole are $3\frac{1}{2}$ tier apples; through $3\frac{1}{8}$ and over the $2\frac{3}{4}$ inch are 4 tier; through $2\frac{3}{4}$ and over $2\frac{1}{2}$ inch are $4\frac{1}{2}$ tier, and through $2\frac{1}{2}$ and over $2\frac{1}{4}$ inch are 5 tier. If the use of the holes results in sizes averaging a trifle too small for a tight pack they can readily be cut a little larger.

In some local markets it is customary to sell a large amount of choice fruit in a return package which is not covered. Such boxes present a much improved appearance if the fruit is faced down and packed in layers. This is done by taking off the bot-

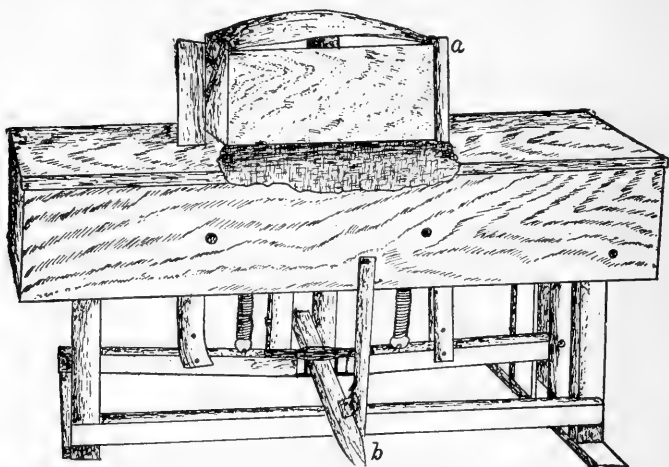


Fig. 69.—Fruit press for packing bushel boxes. a.—Box in place with cover ready for nailing. b.—Foot lever.

tom, placing the box, bottom end up, on a small shutter and then putting in the fruit in layers. The bottom boards are then nailed on and the box turned upright. A box packed in layers will hold considerably more than one in which the fruit is poured in.

In packing apples and pears in boxes for shipment to distant markets, some pressure must be applied to insure the fruit being solid and firm in the boxes. This is generally given by springing on the head boards, which leaves the top bulging.

When packed in a car, such packages should lie on their sides and be held in place by the use of strips of wood between each tier of boxes.

Fruit packing material is generally bought by the grower all cut out ready to put together. For many of the small packages, a wire stitching machine is used in putting them together. Barrels are generally bought in the crate and set up in a local

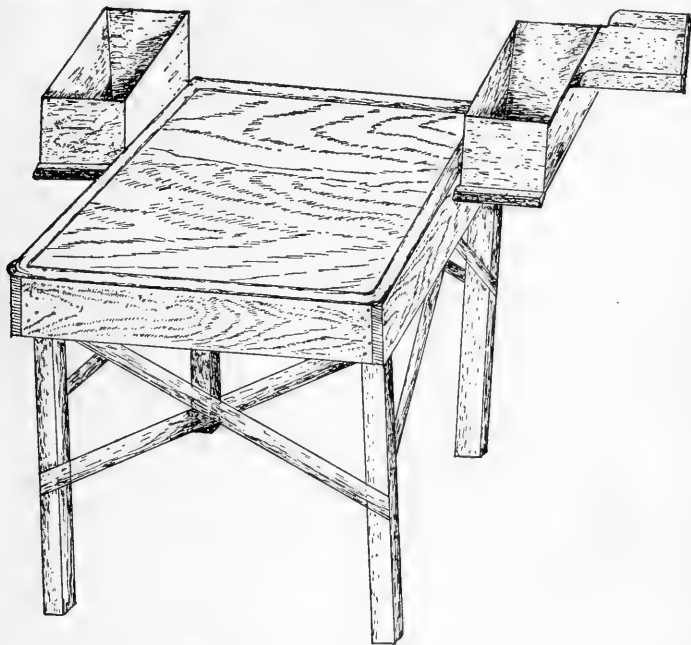


Fig. 70.—Sorting table for fruit packed in boxes.

cooper shop. Box material is generally handled in the same way. By purchasing it in this way and putting it together himself the grower can often utilize his spare labor to advantage.

Barrels are commonly used for marketing apples and sometimes for pears. This package is preferred for apples in most of the Eastern markets, and especially when the fruit is some-

what inferior in quality, or when low in price. It is probably best to always market the extra choice apples in boxes.

Formerly there was a great difference in the size of barrels used for packing apples and this fruit came to market in barrels holding scarcely two and a half bushels, while sugar barrels, which hold nearly four bushels, were occasionally used. This worked in various ways to make the marketing of apples a very loose matter. To help overcome this difficulty, the National Apple Shippers' association adopted a standard size for apple barrels. According to these requirements a standard barrel must have a head $17\frac{1}{8}$ inches in diameter; a stave $28\frac{1}{2}$ inches in length and a bulge of not less than 64 inches outside measurement. This size of barrel is by law the standard barrel in New York state for the marketing of apples, pears, quince and potatoes. The standard Missouri barrel is nearly identical.

How to pack a barrel of apples.—Select a clean barrel. If second hand barrels are to be used, such as flour barrels, they should be thoroughly cleaned by washing and rubbing. If this is not done, the fruit is apt to look dusty when opened which will detract from its sale. Under such conditions some packers follow the plan of lining the barrels with newspapers or other cheap paper which is an excellent plan. Ordinarily, new barrels are used. Sometimes a circular piece of paper is put on each end. The barrel being placed before the packer with the bottom out and the head down, the packer puts about a half bushel of apples in the bottom and proceeds to turn them so that the stem end faces the head, i. e. downwards. Two layers are generally faced in the case of fruit of first quality but for ordinary fruit, one layer of facing fruit is enough. When these are in, the barrel is filled by pouring in the sorted fruit from a basket that is put down in the barrel before it is emptied so as to avoid the least chance of bruising the fruit. For this purpose a half-bushel basket with a swinging bale is best. As each basketful is put in, the barrel is gently shaken so as to settle the fruit but not enough to bruise it. When the barrel is nearly full, a layer of apples is put on with the stem end up. This layer should stand up out of the barrel two inches or more. The chime hoops are then loosened a little and the outside one taken off, but not the

second hoop, as this would allow the barrel to spread too much. A head is then put on under a barrel press and is slowly forced into the barrel. While the pressure is being applied a few well directed strokes with a hammer directs the head into place, when the chime hoop is driven down and a few nails are put in to hold the head in place while the press is removed. The outside chime hoop is put on and nailed in place and then the lining hoops are nailed fast. The barrel is then turned over and stencilled on the end that was downward but is now the top.

A package thus packed opens up with a nice show of evenly packed apples and makes a good appearance. The necessity of pressing in the apples arises from the fact that otherwise the apples will shake in the barrel when it is moved and will bruise.



Fig. 71.—Packing presses for apples. a.—Foot press. b.—Screw press.

A properly packed barrel has no movement of its contents. There is considerable bruising of the fruit where the pressure is applied but such bruises are not often injurious.

Barrel press.

—There are several kinds of barrel presses in

common use. Presses illustrated in figure 71 are the forms commonly obtained from the implement dealers. Where such a press cannot be conveniently obtained, a very good one may be made by any blacksmith by using an ordinary bench screw for applying the pressure.

Grades of fruit.—For the most successful handling of fruit there is nothing more important than proper grading. Even grades of fruit that can be depended upon soon establish for a shipper a reputation that is of great advantage to him in marketing his product. The grades of fruit are variously designated. It is

generally customary to mark the choicest fruit with the words "Choice," "Select," or "Fancy," but other special marks are used. The next grading is generally "First Quality", "A-1," or "AA." The lower grade may be marked "A" or "2nds," or for the various grades one or more "X's" may be used. It is seldom that more than three grades are made. In seasons when prices are low it will often be found unprofitable to ship fruit of third quality.

Every shipper should put his name on his fruit package to indicate his responsibility for its contents. In this way a shipper's product comes to be known and fairly valued, which is an advantage to him as well as to the dealer and consumer.

For grading apples and pears, the Ontario Fruit Growers association has adopted the following standards which gives a good idea of what such grades should consist of:

1. X A No. 1. Sound apples or pears of uniformly large size and high color for the variety named; of normal form; at least ninety per cent. free from worm holes, scabs or other defects.

2. A No. 1. Sound apples or pears of nearly uniform size and good color for the variety named; of normal form; at least ninety per cent free from worm holes, scabs or other defects.

3. No. 1. Sound apples or pears of fairly uniform size; at least eighty per cent. free from worm holes, scabs or other defects.

4. No. 2. Apples or pears that are disqualified from being classed under any of the aforementioned grades, but which are useful for culinary purposes, and not less than two inches in diameter.

Storage and Storage Buildings.

It is a common fault, at least with growers of late keeping varieties of apples, that they are often too quick to sell their product and in consequence stand in their own light in the matter of getting the best returns from their labor. As a rule, it is unwise for the apple grower to sell late-keeping apples from the orchard. It is generally far better to wait until those who wish to rush their fruit to market have disposed of it before selling. If the grower sells his product as it is picked,

he has to look after his harvesting and marketing at the same time, which is apt to crowd him and his facilities to his disadvantage. Of course, in order to store fruit properly, the grower must study the keeping quality of his product and be equipped with cool storage so that he can hold it for at least a few weeks. Such facilities are an incentive to the grower to give extra attention to the fruit he raises, as only good fruit can be stored to advantage. The inferior fruit, if to be marketed at all, should generally be disposed of early.

Cold storage apparatus of the modern improved form is too expensive for general use by individual fruit growers and it

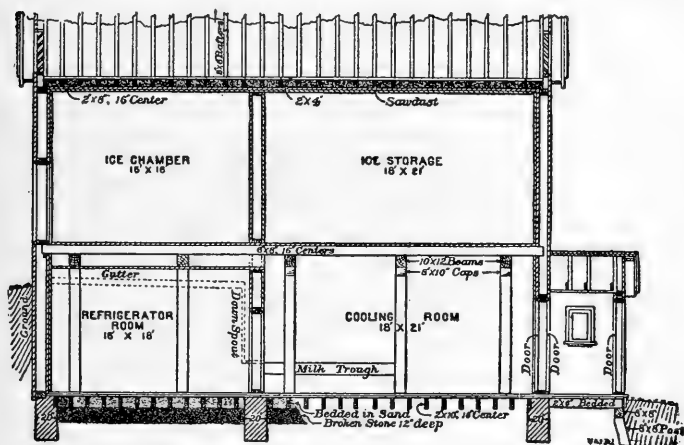


Fig. 72. —Kansas Cold Storage House; longitudinal section.

is a question whether it is not usually best, when fruit is to be stored for a considerable time, for the grower to patronize the owners of cold storage plants rather than build for his own use or, better yet, co-operate with others and erect a large, modern, fruit storage building.

Cooling rooms adapted to the storage of small fruit and other quickly perishable products, even for a short time, could be used to advantage on every fruit farm. These need not be expensive and often an old building may be refitted and made

to answer the purpose. The chief requirements are to arrange for thorough insulation against outside changes of temperature. This can be most satisfactorily arranged by the use of dead air spaces and building paper. There should be at least two well constructed dead air spaces about the storage room. These dead air spaces should be made in the floor and roof as well as in the walls. The windows, if such are found necessary, should consist of at least three sash set closely together so as to make two tight dead air spaces between.

It will be found that rooms above ground, surrounded by well made dead air spaces, are more satisfactory for cooling fruit than cellars even if the latter are provided with proper insulation. The cost of properly fitting up a cellar as a cooling room is nearly or quite as expensive as the fitting up of a similar space above ground and the wood and other materials used in its construction are short lived. The stone, cement or brick walls used ordinarily in cellars are good conductors of heat and among the poorest of materials for the walls of a storage room.

A fruit grower provided with a well insulated fruit room will often find it to his advantage to lower its temperature by the use of ice early in the season. Figs. 72 and 73 show a good method of constructing a fruit storage house large enough to hold a few carloads of apples, with provision for the use of ice for reducing the temperature. The building is designed to be located on a hillside of such a slope that the first floor will be on the level of the surface at one end and the second floor a few feet above the surface at the other. The building is 18 by 38 feet, interior measurement, two stories in height and divided into four rooms, two on each floor. On the second floor is the ice-storage room, 18 by 21 feet, in which the future supply of ice is stored, and the ice chamber, 15 by 16 feet, in which is held the ice that cools the refrigerating room directly below. A door in the ice chamber communicates with the outside. This is for the unloading of ice and is the only outside entrance into the second story. The refrigerating room is 16 by 18 feet, and is the compartment in which the temperature is to be reduced, and in which perishable products are to be stored. Leading

into this room is the cooling room, 18 by 21 feet, which is to be used as a general purpose storage cellar. A small entrance room protects the doorway into the cooling room. This is the only entrance to the ground floor.

The flooring is laid tight in the storage room and provided with a slope towards the center. A gutter catches the drainage and carries it into the gutter from the ice chamber. To prevent

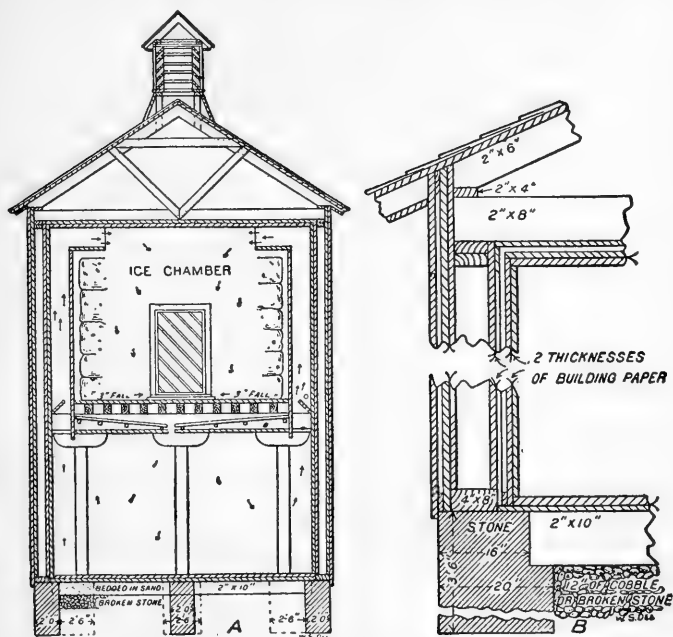


Fig. 73 —Kansas Cold Storage House. a.—Vertical section. b.—Details of construction.

leakage the floor of the storage room must have a sheet iron covering. The floor of the ice chamber is laid with 2 by 4-inch lumber with 1-inch space between. This provides for air circulation and water drainage. A sloping catch floor leads the water into the gutter which carries it down and out through the cooling room.

Cellars and caves may often be used to advantage for storing apples. Such storage is cheap and easily obtained. They are only useful for this purpose during cold weather. When properly handled apples keep well in them.

QUESTIONS—CHAPTER IX.

1. Why does so much depend upon the picking of the fruit for the market?
2. What effect does the wide distribution of fruit growing sections have upon the market?
3. What is the proper time for picking different fruits?
4. When is local peddling a success?
5. What is the relation of the commissioner to the fruit grower?
6. Of what value are fruit growers associations to the small fruit grower?
7. What is the advisability of using the return package?
8. Why is it necessary to have packages for selling the same kind of fruit uniform in size?
9. What are some of the packages prescribed by law?
10. How are small fruits generally marketed?
11. What is the standard marketing package for grapes?
12. How are plums and peaches marketed?
13. What is the popular package for apples, pears and quince?
14. How are ordinary grades packed? The fancy grades?
15. What is the size of the standard apple barrel?
16. How should a barrel be packed?
17. What is a barrel press?
18. What are the advantages of grading the fruit properly?
19. How should they be designated?
20. What are the Ontario Fruit Growers standards for grading apples and pears?
21. What are the advantages and disadvantages of a cold storage plant?
22. How may inexpensive cooling rooms be fitted up?
23. Why are cooling rooms above ground more satisfactory and economical than those in cellars?

CHAPTER X.

PROPAGATION OF FRUIT PLANTS.

Our cultivated fruits, with a few unimportant exceptions, do not come true from seed, and hence, must be increased by division. The various ways in which seed enters into the subject of the propagation of fruits are as follows:

Propagation by Seed.

(1). Seed is used for the growing of stocks on which to work (i. e., graft or bud) cultivated fruits such as apples, pears, plums, peaches and others.

(2). Seed is used for growing a few varieties of the peach and strawberry that come nearly true from seed, such as the Alpine and St. Anthony de Padua strawberries and, in the case of the peach, for a large number of varieties which come sufficiently true to name for home use.

Some of the conditions which influence germination of such seeds are as follows:

(a) Seeds of many species which ripen in the early summer, such as those of the strawberry, gooseberry and raspberry, if sown at once, will start quickly. Seedlings of such kinds should be wintered over in a cold frame, greenhouse or cold cellar. If the seed is dried it should be stratified towards the end of winter and frozen and sown in the spring. In the case of the raspberry and gooseberry, the seedlings are so small at the end of the first season, if the seed is sown as soon as ripe, that it is generally best to dry it and sow the following spring.

(b) Seeds that ripen in late summer should be stratified and sown the following spring.

(c) Stratification refers to the mixing of seeds with soil or other material and burying out of doors. It is a common and very safe way of keeping over winter such seeds as those of the peach, plum, apricot, nuts and many forest tree seeds. All of our hardy seeds may be treated in this way successfully. In practice the seeds are mixed generally in sand, but sometimes

leaf mold or fresh, moist leaves are used for this purpose. Where only small quantities are cared for, boxes are generally used, which are left out doors in winter; but where large quanti-

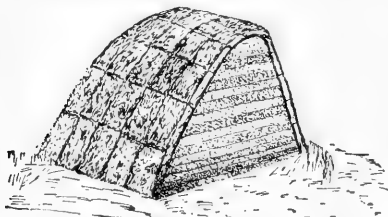


Fig. 74.—Seed stratified in pit and covered with sod.

ties of large seeds like those of the peach and black walnut are used, they are often mixed in pits on the surface of the ground and covered with sod.

Apple seed is generally kept dry during the winter and moistened and frozen in the spring before sowing, but may be stored over winter by stratification with excellent results. In the case of a few plants the seed will start at once if stratified. In such cases dry the seed and do not sow until spring. However, it is a good plan to mix it with damp sand in the latter part of winter for a few weeks, after which it may be frozen before being sown.

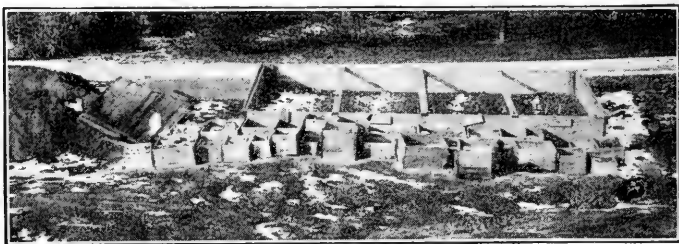


Fig. 75.—Boxes of stratified seeds at the Minnesota Experiment Station in Winter.

Propagation by Offsets.

(a) The strawberry and red raspberry, American plum, Morello cherry and some other fruits may be grown by taking off sprouts that come up from the roots. Such sprouts are termed "offsets," or suckers.

(b) Offsets are best removed in autumn or in the spring. In removing them, it is important to get a portion of the main

root from which they grow. In the case of the plum, two or three inches of the main root is sufficient.

Propagation by Layers.

(a) The easiest and best way of increasing many orna-

mental as well as fruit plants is by layering. Spring layers are made by laying down any portion of the plant in the spring.

(b) Summer layers are made in the summer, generally in July, from wood of the same season's growth.

(c) Mound layering is used for propagating the gooseberry, currant and quince.

(d) Layers may be made at any time, although roots may not form for a year or more.

(e) Layers should be taken up when well rooted and dormant. This is generally in the autumn of the first year or in the following spring.

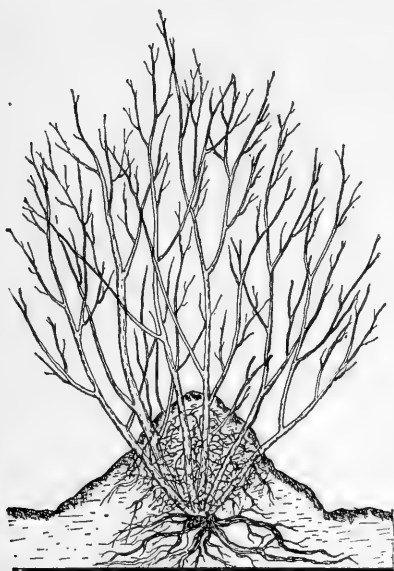


Fig. 76.—Gooseberry that has been mound layered.

(f) Layering is adapted to such fruits as the grape, currant, gooseberry and black raspberry.

Propagation by Cuttings.

(a) Various portions of plants may be used for propagating plants. Cuttings may be made of the ripened wood of the branches in the case of the gooseberry, currant, grape, quince and Kieffer pear.

(b) Cuttings may be made of the roots, as in the red raspberry, blackberry and some kinds of the Morello cherries and plums. Plants grown in this way from cuttings are generally better than those grown from sprouts.

(c) Cuttings may be made of the soft wood of the summer as in the grape, currant and gooseberry and, in the case of the strawberry, they may be made from the immature offsets. Soft wood cuttings need a frame or greenhouse for best results and should be treated similarly to geranium and coleus cuttings.

Size of Cuttings.

(a) The size of the cuttings used in propagation varies greatly. All that is absolutely necessary is to have one bud to each cutting and this will produce good results, providing it has the proper conditions of heat and moisture surrounding it. One-bud cuttings are sometimes used for the currant and grape with good results, but must have the best of care.

(b) Cuttings are generally made with more than one bud to encourage strong growth and to increase their chance of living.

Conditions Necessary for the Successful Growing of Hardwood Cuttings.

(a) The wood for ripe wood (hardwood) cuttings must be well matured and firm. Such wood, if well matured, has in it plenty of food to start the cuttings into growth.

(b) The wood should preferably be made up into cuttings in autumn or early winter if to go into the open ground. If not planted out at once they should be stored in a cold cellar, cave or pit outdoors. They will often be calloused by spring if thus treated. Cuttings may be of any length, from one bud, up. It is customary to make cuttings of currant and gooseberry about eight inches long.

Planting Cuttings.

(a) The soil for cuttings should be rich in plant food, compact enough to hold moisture but porous enough at the surface to prevent baking.

(b) Cuttings should generally be calloused before planting for best results, but set out before they show roots. It is generally best to get cuttings into the ground as soon as the spring weather permits, but do not plant out grape cuttings until they are calloused. Currant cuttings may be made up in early autumn or even in the last of August and set out at once, as when thus treated they will often be rooted by winter.

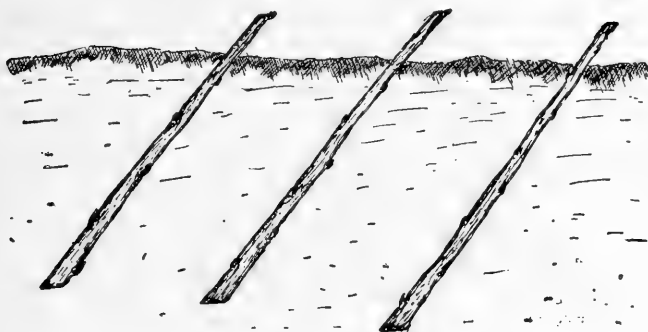


Fig. 77.—Cuttings properly planted out.

(c) Set cuttings deep so that the upper bud will come just at the surface of the ground. Do not have over one inch of long cuttings above ground.

(d) Set the cuttings slanting, i. e., at an angle of 45° or at half-pitch. This is preferred to setting straight, as they remain firm better when thus planted.

(e) In making cuttings, plan to have at least one bud within one inch of the top end.

The Solar Pit.—There are many trees that will not grow from cuttings unless they have their roots started a little before planting. This is most easily accomplished by what is known as “the solar pit”, which owes its success to the fact

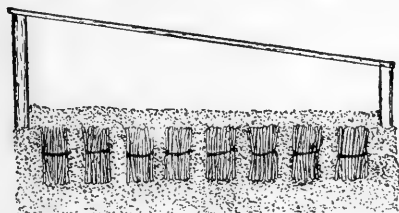


Fig. 78.—Solar pit with cuttings tied in bundles and buried.

that cuttings root first at the warmer end. It is made and used as follows: The bundles of cuttings are heeled-in as recommended. In the spring they are taken out and buried close together with the butt ends uppermost in a warm, sunny spot

and covered with about six inches of soil. A hotbed frame with sash is then put over them to warm the soil. Sometimes,

instead of using sash, the soil over the cuttings is covered with a foot or more of fermenting manure. In either case the soil is warmed and the formation of roots encouraged. In using the solar pit the rooting process should not be carried so far as to permit the roots to show plainly, as they are then liable to be broken off in planting, but the cuttings should be planted out as soon as they show signs of healing over on the butt end. This healing over process is called **callousing**, and in many plants necessarily precedes the formation of roots.

Graftage.

Graftage includes what is commonly called budding and grafting. Working is another term that includes the same. Most trees that graft easily will bud readily.

Limits of Graftage.—It is common to hear surprising stories about graftage. Quite recently a prominent grape grower referred to his efforts to graft the red currant on the red maple tree. Even Pliny says "Some apples are so red that they resemble blood, which is caused by their being grafted on a mulberry stock." But budding or grafting are never successful unless the cion and stock are nearly allied, and the closer the relationship between them, the more certain the success. Lindley says: "Varieties of the same species unite most freely; then species of the same genus; then genera of the same natural order, beyond which the power does not extend. For instance, pears work freely on pears, very well on quinces and mountain ash; less successfully on apples or thorns, and not at all upon plums or cherries; while the lilac will take on the ash, because of the near relationship between the two." But there are many exceptions to any rule that could be laid down concerning this matter. Some plants are increased most readily by budding, while others graft more easily than they are budded. The stone fruits are very easily budded and grafting them is often a much more uncertain process.

(b) Stock is the name applied to the part grafted on, be it large or small. The stock may consist of a cutting, a rooted layer, a tree or a seedling root and it may be worked when either dormant or growing.

(c) Cion is the name of the part inserted. It may con-

sist of one or more buds and be cut with or without wood. In budding, the term bud-stick is often used to take its place.

Budding.—In its broad sense the term graftage includes all there is of budding, which is simply grafting while the tree

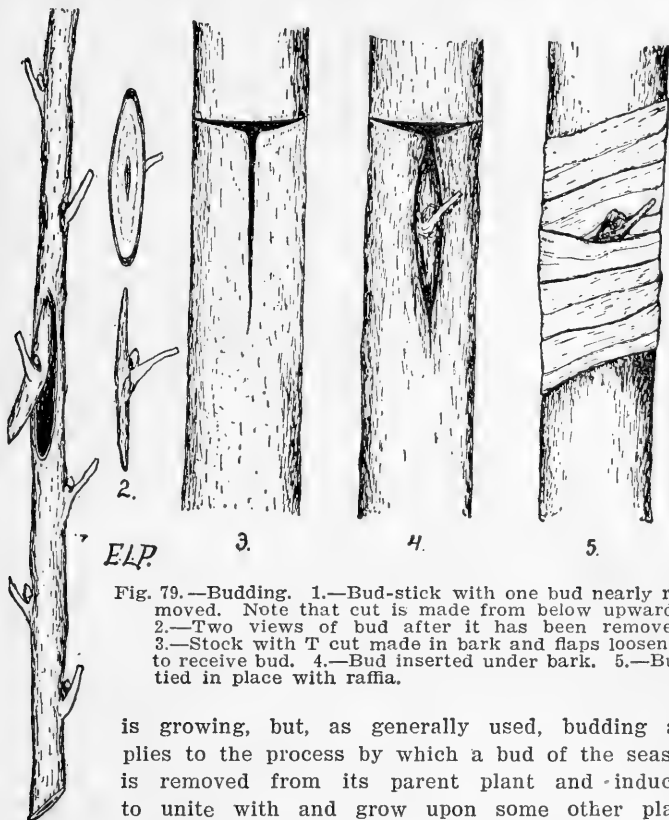


Fig. 79.—Budding. 1.—Bud-stick with one bud nearly removed. Note that cut is made from below upwards. 2.—Two views of bud after it has been removed. 3.—Stock with T cut made in bark and flaps loosened to receive bud. 4.—Bud inserted under bark. 5.—Bud tied in place with raffia.

is growing, but, as generally used, budding applies to the process by which a bud of the season is removed from its parent plant and induced to unite with and grow upon some other plant congenial to it. In the Northern states it is commonly practiced to propagate plums and other stone fruits, and apples and pears, all of which are readily increased in this way.

The varieties of some ornamental trees and plants may be propagated by budding, as, for instance, some varieties of elm, maple, poplar and birch. Most trees that graft readily will bud as readily, while others that will graft with difficulty will bud very easily. Budding is rather a simpler operation than grafting and easier for the beginner to perform successfully.

Stocks for budding are generally grown from seed and the buds are inserted in them when they are but a few years old, and as near the ground as possible. But budding may be done very successfully on any growing branch or stem where the bark is not too hard and still bends easily. It is often used to change the bearing qualities of fruit trees of small or medium size.

Bud-stick is the name given to the shoots from which the buds are taken. It is also referred to as the cion, but the cion proper is the piece which is inserted in the stock.

Time for Budding.—In a general way, budding may be done at any time when the bark will peel, providing the buds are sufficiently matured on the new growth of the season to insert them. The proper time will be influenced by the kind of stock used, the season, and sometimes by attacks of insects or diseases. For instance the native plum is generally budded to best advantage about the last of July, but should the stocks be attacked by some insect or disease that seriously injures the foliage in the middle of July, the growth of the stocks will soon be checked and the work must be performed at once or not at all. A period of severe drouth may check the growth, and in a similar way make early budding necessary. If the stocks are growing very fast, it is often best to delay the operation until the wood has become somewhat hardened, or else its rapid growth may cover up the inserted bud. If considerable pruning of the stocks is necessary to make a place for the bud, it should be done at least two weeks before budding is commenced, because the heavy pruning of any plant when in active growth results in a serious check to its parts. If done just when the buds are inserted, this may prevent the success of the operation. The ordinary season for budding in the North-

ern states is from the middle of July to the first of September, and the earliness or lateness at which a variety is most successfully budded depends on the condition of growth. The stock that stops growing early in the season is budded early, and those that grow until autumn are budded late. The conditions for success are:

1. The stock and cion must be perfectly healthy and free from insects. If either of them are weak or sickly, unsatisfactory results may be expected. To this end, everything necessary should be done to keep off insects and disease.

2. The buds should be well developed in the axils of the

leaves on the young shoots from which the buds are to be taken. It seldom happens that they are in this condition until the bud at the end is formed, but sometimes the buds in the center of the twigs will be large enough to grow, while those at the base and at the extreme tip are still quite small. If the buds are thought to be too immature, they may be readily developed by pinching off the

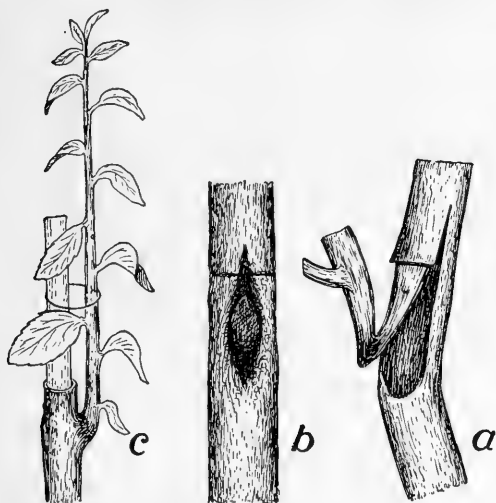


Fig. 80.—Showing method of cutting bud when the wood is to be removed from it. b.—Plum bud in the spring of the year before growth has commenced. c.—A shoot started from an inserted bud and tied to the stub of a stock. The dotted line b shows where the stock should be cut off after the bud is well started.

tips of the twigs. In ten or twelve days after such pinching, of even a very soft shoot, its buds will be fit for working.

3. The bark must separate easily from the wood on the stocks to be budded. This will take place only when they are growing rapidly.

4. A sharp, thin knife is absolutely necessary.

5. The work must be done rapidly, and the buds firmly and evenly tied into place. No wax is needed.

Necessary implements.—A common shoe knife, with the corners rounded off, makes a very cheap, and yet a most excellent budding knife. There are many specially designed forms of knives for this purpose and most of them have an ivory point or blade in the base of the handle for lifting the bark, but the rounded corner of the back of the shoe knife is just as good as the best ivory blade for raising the bark. A shoe knife costs not one-fourth as much as an ordinary budding knife and generally holds an edge better.

Besides a shoe knife, **tying material** is necessary. For this purpose basswood bark is perhaps the best, since it is but little affected by moisture, and if put on wet, remains tight and close. This tying material is prepared by soaking sections of the bark of the common basswood in water until the inner layers separate easily. The bark peels from the trees readily in June and July, and it requires about three weeks of soaking in stagnant water to get the fiber into the right condition. After the layers readily separate the bark should be stripped into pieces about one-fourth of an inch wide. If hard and stiff, it may be softened by rubbing and pounding. Cotton warp, corn husks or woolen yarn answer very well, and a tying material called raffia is now used more widely than any other material for budding. This is a long, grass-like material which is used for baskets and is made from the leaves of a palm known as *Raphia peduncula*. It should be made into thin, very narrow strips before being applied and should be put on dry.

The process of budding will be found illustrated in figs. 79 and 80, showing the successive stages in shield budding, which is the form generally used in this country. When everything is ready for the work, prepare a lot of bud-sticks as shown in fig. 79, by cutting off all but about one-half inch of the leaf

stalks. These sticks should be carefully protected from wilting, and it is customary to carry them in the field wrapped up in moist cloth or oiled paper. If it is necessary to store them after they are cut, they should be kept in a cool, moist place, in moss, sawdust, or cloths, but not in water. They are often kept for a week before using, but are preferably used as soon as possible after they are cut.

To insert the bud a smooth place is selected (on small stocks this should be about two inches from the ground) and on the north side if practicable, since buds are less liable to be injured by freezing on that side than on any other. A cross-cut should be made at this point, and from it a cut about $1\frac{1}{2}$ inches long, as shown at 3 in fig. 79; at the same time the bark should be raised to loosen it. A bud-stick is then taken and a bud cut off with the bark and a thin piece of the wood extending about one-half inch above and below the bud, as shown at 2 in fig. 79. The lower point of the bud (by which is meant the bark and wood cut off, as well as the bud) is now inserted under the bark at the cross-cut, and is gently pushed down by the leaf stock and knife blade. If the bark of the stock will not raise when the bud is thus pushed down, the stock is not in the best condition for budding and it will be necessary to raise the bark with the back of the knife blade, or with the ivory blade previously referred to, in order to let the bud come into its place. The sides of the bud should come under the bark, but if the wound is not large enough to admit quite all the bud, any small part that may project above the cross-cut should be cut off by again drawing the knife through the cross-cut. The bud must now be securely and firmly tied in place, taking care to draw it down evenly and firmly and to cover all the wounds with tying material as shown at 5 in fig. 79, but do not cover the bud itself. In less severe sections, the ties do not need such careful attention as here in the Northwestern states, where it is important to tie very carefully. After the bud is tied, the bands should be watched so that when the growth of the stock becomes so great that the bands are too tight for it—which is generally in about a week—they may

be loosened. When the bud is well united, the band should be cut off altogether. The buds will generally unite in about two weeks, but sometimes they will require a longer time, and it is often desirable to leave the ties on for some little time after this period. It is a bad practice to neglect the bands and allow them to severely cut into the stock.

The inserted buds should not start at all until the following spring. If they start into growth the season they are inserted, they are almost certain to be killed the following winter. If the bark of the inserted bud shrivels, or if it remains fresh and the bud falls off, the work is entirely lost, though the stocks that have missed one year may be budded the next, and even while loosening the bands it may not be too late to again bud those that have failed. To make the work more certain, two buds are often inserted in each stock, although only one is allowed to grow.

In the spring, the inserted bud will resemble fig. 80. Just as the top buds commence to swell, the budded stocks should be cut off at least one inch above the inserted bud, and sometimes seven or eight inches of the old stock is left above the bud to serve as a stake to support the shoot starting from the bud (fig. 80). All the shoots that come from the stock should be rubbed off so that all its strength will go into the inserted bud.

Late in the season the stock should be cut down to just above the bud, see the dotted line at *c* in figure 80. The growing shoot should be trained to a single stem if its stock is a low one, so as to make a straight tree. If the root is strong, the bud will make a growth of two to four feet the first year. Some kinds of trees readily take on an upright form, while others naturally grow very crooked and need special care to induce them to grow straight.

On the approach of winter it is a good plan to draw the earth up against the buds as a protection, but this cannot be done when the buds are more than two or three inches from the ground. If the buds are too high up to allow this earthing up from the ground, especially in the case of somewhat tender kinds, some growers put a very thin covering of grafting wax

around the bud, taking care not to cover the tip of the bud more than a very little. This covering is a protection against ice forming behind the bud and from sudden freezing and thawing in winter. However, with our hardy trees this precaution is unnecessary.

June Budding.—Many nurserymen offer what they call June-budded trees at low prices. These are often small trees that can be easily sent by mail and are made by an operation similar to common budding as described herewith except that the work is done in June and the inserted buds are forced into growth as soon as they adhere to the stock, by cutting off the latter. At the North they make only a small growth the season they are budded. The buds for this purpose may be hastened into maturing by pinching off the ends of the shoots to be used for bud-sticks. For ordinary purposes, nothing is gained by budding in June in the Northern states, for a plant budded there in August will make as large, if not a larger, growth and as straight a tree by the end of the following year than a June-budded tree of the same age will make in its two years of growth. However, at the South, where the growing season is longer, June budding is the favorite way of growing peaches and plums which there make a strong enough growth the first season. If they were treated in the common way as used at the North the trees would be too large for best results in transplanting.

The wood is sometimes removed from the bud after it is cut off. This practice is common in Europe, but in general practice in this country it is left on. However, care should be taken not to cut the bud very thick, or the large amount of wood in it will prevent its binding into place smoothly and evenly. When the wood is to be removed from the bud, the latter is cut off in a little different way from the method described. This method is illustrated at a figure 80. Two cuts are made and then by a dexterous twist, the bud and bark removed. It is then inserted as previously described.

Other forms of budding are used occasionally but in all of them the general principles are the same as those practiced in shield budding. Figure 81 shows a form of budding where-

in a circle of bark is taken out of the bud-stick and is inserted into a stock or branch of about the same size. These are unusual forms and only used for some special purpose. In budding on the branches of trees, it is generally best to insert the bud on the upper side, but the place for its insertion should be governed by the form of the tree. Budded trees are no better than grafted trees, but they may be as good, or perhaps worse, according to the way in which the work is done. If the buds and stocks are perfectly hardy, as, for instance, when our native plum seedlings are budded with similar kinds of improved quality, as with the DeSoto plum, or native seedlings, then the tree resulting is as good as if root grafted. But if the hardy kinds of apple are budded on ordinary seedlings which are not hardy, then there is a part of the tender seedling which is above ground and is liable to be killed out by cold.

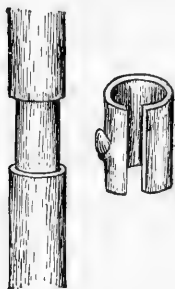


Fig. 81.—Method used in ring budding.

In this case, the resulting tree would be much improved if the seedling root had been grafted below ground instead of being budded above, so as to have the benefit of the protection the ground affords. On the other hand, where hardy trees are budded on the branches to change the bearing, the work is just as sure as if grafted. It is foolish, then, to pay more money for a budded than a grafted tree.

Grafting is distinguished from budding by being performed at a season of the year, generally in the spring, when vegetation is dormant—at least, when the plant operated upon is not in full leaf; but there are many exceptions to such a definition, and it might be better to include the two subjects of budding and grafting under the general head of graftage, as they are closely related.

Stock is the term used to indicate the plant grafted on, whether large or small.

Cion is the term used to express the part inserted, of whatever size or form it may consist. These should ordinarily be of the new, well ripened growth of the season. If cions are

to be used in the spring they should generally be cut late in the fall, as some kinds are liable to be injured by the winter. However, a spring-cut cion may often be used successfully, but it is not safe to trust them if, when cut open, the heart wood appears dark colored. Cions should not be cut when frozen. They should be stored in moist sawdust or sand in a cold cellar, or buried in the ground outdoors during the winter. But this does not apply in the case of plum cions, which generally do best when cut in the spring as needed. Plum cions are stored with difficulty as they quite often lose their buds in storage. Cherry cions are most safely carried through the winter when packed in moist leaves. If packed in sand or sawdust, they sometimes become water soaked.

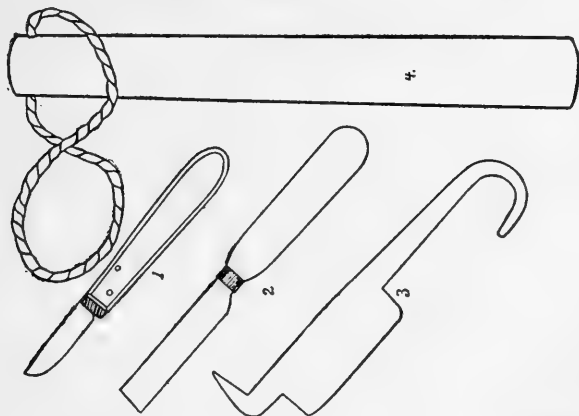


Fig. 82.—Tools used in grafting and budding: 1.—Budding knife. 2.—Grafting knife. 3.—Grafting chisel. 4.—Club mallet.

The principles which underlie grafting are the same as in budding, i. e., the cions and stock must be closely related; the work must be done in such a manner that the inside bark of both cion and stock come closely in contact; and at a season of the year, and under such circumstances that they may unite at once, or as soon as growth starts. The success of the operation largely depends (1) on having the stock and cion perfectly healthy; (2) in selecting the proper season, which varies some-

what with the different plants; (3) in getting a perfect union of the inner bark of cion and stock at least on one side; (4) in making all the cuts with a sharp knife, that the parts in contact may have a smooth surface; (5) in doing the work rapidly, so that the surface may not be exposed.

Grafting wax is generally used for covering the wounds made in some kinds of grafting. A good grafting wax is one that will not become too soft in summer, so as to melt and run down the stock, or so hard in winter as to crack and split off. A very reliable grafting wax is made by melting together resin, four (4) parts, by weight; beeswax, two (2) parts; tallow, one (1) part. When well melted, pour into a pail of cold water, grease the hands slightly and pull the wax until it is about the color of pulled molasses candy. Make into balls and store for use. This wax should be warmed when applied. If it is too hard, more tallow and less resin may be used. Some propagators use linseed oil instead of tallow. The linseed oil should be pure. If adulterated with cottonseed oil, the wax becomes very stringy and difficult to handle.

Clay is frequently used for covering wounds made by grafting, and it gives quite as good results as any of the waxes, if properly applied, but is not so convenient. For this purpose some very tenacious clay should be used, and it is thought to be improved when mixed with about one-third fresh cow dung and a little plasterer's hair. The whole mass should be thoroughly worked over and kneaded before using.

Cleft grafting is very common and more universally known and used than any other. It is commonly performed to change the variety of apple, plum and various other trees and plants. It is generally the most practical method to use on branches one or two inches in diameter or larger, but it also works well on small stocks.

Cleft grafting is performed as follows: The place selected for the insertion of the cion should be where the grain of the wood is straight. The stock is then cut square off with a sharp saw and is split through its center, with the grafting chisel, to a depth sufficient to allow the cion to be put in place. The cleft is held open by the grafting chisel until the cion

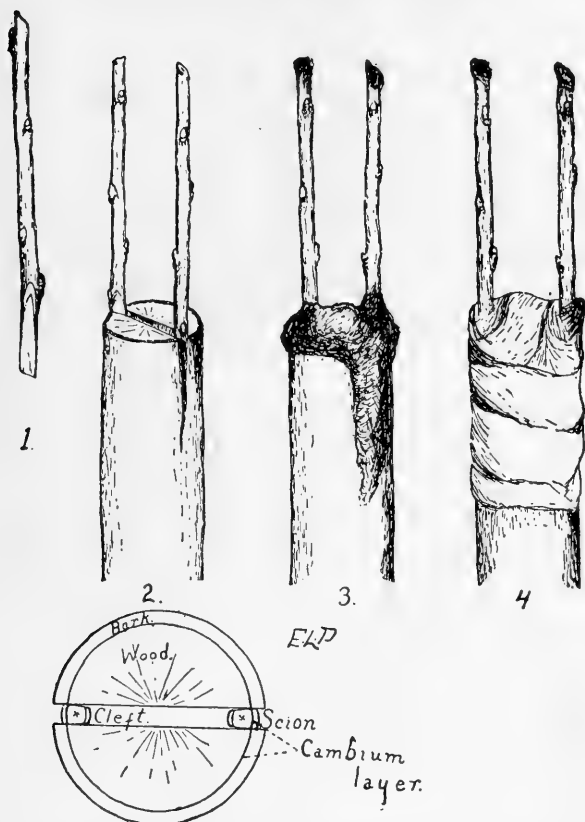


Fig. 83.—The cleft graft. 1.—Side view of cion cut for grafting. The opposite side is cut in the same manner, making the lower end wedge shaped. 2.—The stub with the cions inserted in the cleft. 3.—The graft waxed. 4.—Cloth wrapped over the wax. 5.—Diagram of cross section of stub with cions inserted. Note that the cion is inserted in such a manner that its cambium layer comes in contact with the cambium layer of the stock. Note also that the cion is cut in such a manner that the side nearest the center of the stub is a little thinner, thus permitting the cleft to pinch down closely onto the cion where the cambium is located.

is cut and inserted, when it is withdrawn, allowing the stock to close on the cion and so hold it in place. If the stock does not spring back so as to hold the cion firmly, it should be tightly drawn together with a string. The number of cions inserted will depend on the size of the stock. If the stock is not over three-quarters of an inch in diameter, one cion is enough to insert, but on larger stocks one may be put in each side of the cleft. All the cut surfaces, including the ends of the cion, should now be covered with wax, as shown in fig. 83.

The cion to be inserted in cleft grafting should be cut wedge-shaped lengthwise and its cross-section should also be wedge-shaped. Fig. 83 represents a cross-section through a newly made graft, showing cleft in the stock and two cions in place (note how the edges of the wood come together). Fig. 83 also shows the successive stages in cleft grafting.

Whip grafting is illustrated in fig. 84. When finished, all the cut surfaces should be covered with grafting wax or waxed paper. In this form of grafting it is seldom that the inner barks come together on more than one side of the cion and stock. It is a method that is very quickly performed by one accustomed to it, but its use is limited to branches or stems under three-quarters of an inch in diameter, but for stocks coming within this limit, it is very convenient and reliable. It is much used by nurserymen in root-grafting apple, pear and plum seedlings. It is done to a large extent during the winter months, when but little can be accomplished out of doors.

Root-grafting.—Seedlings, which are dug in autumn and packed in sawdust or moss in a cold cellar, are taken as needed, to a warm room and cions grafted upon them just below the collar, i. e., the place where the root and top are joined, where only one graft is made to a root. The kind of graft made is illustrated in fig. 84 which shows the successive stages of the work. A common practice among nurserymen is to use a cion about six inches long and insert it on a root about three inches long, the treatment in every respect being the same as where only one graft is made up from each root. In each case, when completed, the union is wrapped with a strip of paper or cloth about three-fourths of an inch wide which has previously

been covered with grafting wax. Some prefer waxed string for this covering. The cion should be at least five inches long to allow the graft to be set deep and thus encourage rooting from the cion. When completed, they should be tied in bundles and put away, packed in boxes very firmly in clean sand or

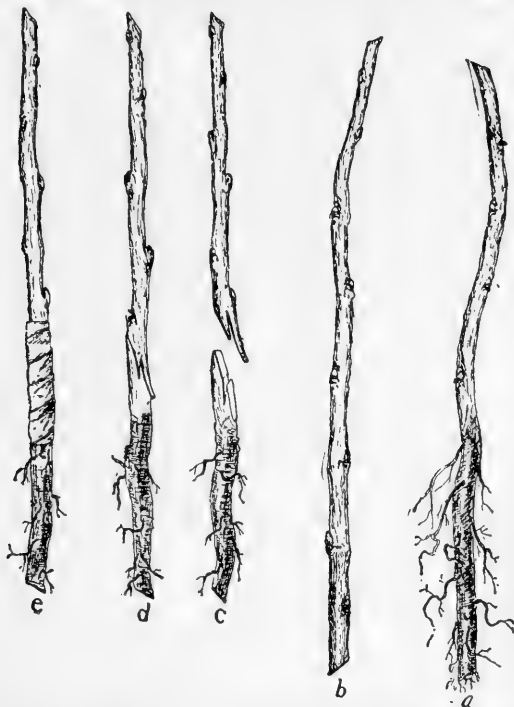


Fig. 84.—Root grafting. a.—Apple root such as is used in root grafting. b.—Cion. c.—Cion and root prepared for putting together. d.—The graft made. e.—The graft wrapped with waxed paper.

sawdust, in a cold cellar. Early in the spring they should be planted in the nursery, about six inches apart, in rows three feet apart, setting all but the upper bud of the cion below the surface of the ground. It is important to plant the cion deep, so as to encourage it to throw out roots, as the trees are then

more hardy than when they depend entirely on the seedling root for support. Great care should be taken to have the soil very firm and solid around the base of the root and at the union. This may be secured in several ways. Some nurserymen use a large dibber, having a guard on the side to prevent its going too deep. With this a hole is made sufficiently wide and deep to permit the insertion of the graft easily so that not more than one or two buds project above the ground. To do this work most expeditiously, the grafts should all be of the same length and free from side branches. Two persons should work together, a man who uses the dibber and a boy who carries the grafts. The man makes a hole with the dibber, the boy puts in a graft, when the man immediately makes another hole by the side of and two inches away from that containing the graft, and, pressing toward the graft, packs the soil firmly around it. After each row is finished in this way, the man should turn back on the row and press firmly by the side of each graft with the ball of the foot.

Another method of planting root-grafts and cuttings, which is applicable for planting cuttings on a small scale, is as follows. This is not a fast method but is very excellent for a few grafts: The thoroughly plowed land is smoothed off, a line stretched and walked on where the row is to come and then thrown to one side. With a spade throw out a furrow along the line, leaving the edge straight and smooth and nine inches deep. Against this place the grafts and then with a hoe turned bottom up push a little earth against the lower part of the root of each graft, and afterwards draw three inches of soil into the furrow around the grafts and then press firmly against each graft with the ball of the foot. Fill the trench full and repeat the footing process again. A more expeditious way is to plow out a furrow instead of making it with a spade, and then fill the trench with a plow. In this way the work may be successfully done if the soil is not dry and the season is favorable. But it pays well to do good work, and, where one has only a few hundred or a thousand grafts to plant, the spade method is most certain. In planting in a dry time the great key to success is to have the land firm and solid around the

root and the union so that there will be no air spaces. This is very important. In two or three years from the root-graft, the trees will be large enough to be transplanted to the orchard. At that time some of the trees will be well rooted from the cion and others will scarcely show any at all. Others may have lost the stock on which they were grafted and be entirely on their own roots. In this latter case the trees will not have made a first class growth, although they may make trees of good size later on.

Side-grafting.—Side-grafting is a form of union in which the cion is inserted in a cut made in the side of the plant grafted on

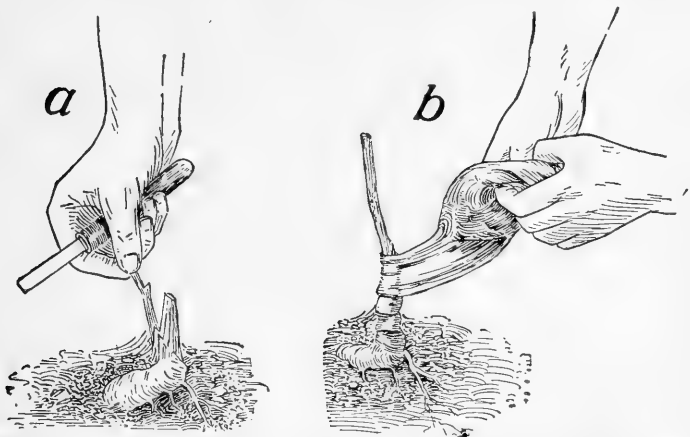


Fig. 85.—Crown grafting below the surface of the ground. a.—Inserting cion in root of seedling. b.—Waxing the graft.

and the stock is not cut off until the cion has started to grow. It is especially applicable to cherry seedlings, on which the union should be made at the crown of the plant, which is the point on the seedling where the root and top join. This form of grafting may be successfully used on plums, apples, and other fruits. If it is done on the branches of a tree there is no necessity of cutting off the part above the graft until the cion starts into growth.

Grafting below ground.—If grafting is done just below the surface of the ground the work is more certain of being success-

ful than if above the surface, and the resulting tree will be hardier than if the union was above ground, since the weakest point in a tree (the graft) will be protected by the earth. Of course, very frequently it is impracticable to do the work in this manner. The methods adapted for grafting below ground are the same as for above ground, only not so much wax is required.

In grafting below ground, it is important to remove the soil until a smooth, straight place in the stem is found of sufficient length to contain the cion. In the case of most fruits this is preferably at the crown, i. e., where root and stem meet. It is important, also, to keep the wounds free from dirt, for however much it may help to have the whole graft covered in this way, any soil on the cut surfaces will prevent that desirable close contact of the cells which is necessary for successful work. When grafting is done below ground, suckers will often start from the stock in great numbers. These should all be removed or the graft will be ruined. A little observation soon teaches one to

distinguish at a glance the sprouts from the stock and cion. In removing these suckers, they should be pulled away from the stock and not simply cut off. Only one shoot should be permitted to grow from each cion and this should be the thriftiest and generally that starting lowest down. The lowest is saved because, wherever a shoot starts, there is generally a crook formed, and if near the ground it is not unsightly.



Fig. 86.—Night-cap. — Graft protected by paper bag.

Night Cap is a term given to signify a paper bag that is sometimes drawn over and tied below a graft made in the open as soon as it is completed. It is illustrated in Fig. 86. Its use is to prevent the shriveling of the cion due to exposure of drying winds. It is especially desirable in top-grafting trees in dry seasons or in exposed locations. It is a very valuable adjunct to the grafting outfit and its use should be more general. Of course the bags should be removed as soon as the cions start and the

same care should be taken in the use of wax around the graft as if the night cap were not used.

The following notes on grafting different fruits will perhaps be of interest:

Grafting apples.—Top-working and crown-grafting of apples in the open ground should be done about the time the buds are nicely started, but the cions should not have started at all. It is perhaps the easiest of all the fruits to graft, and almost any method may be employed on it. The cions should be from four to six inches long.

Top-working.—By top-working is meant the grafting or budding of a tree after it is of some considerable size. The term is used to distinguish such trees from those that are root-grafted. It is here recommended for severe locations and for somewhat tender kinds, such as the Wealthy in Central Minnesota, which, besides being somewhat tender and liable to sun-scald, is weak in the stem and crotches.

If this variety is grafted on the branches of the Hibernial, which is a very hardy sort with strong crotches, a tree is formed that has much of the hardiness of that variety but at the same time bears Wealthy apples. By this method we may increase the hardiness of trees to a considerable degree. Some varieties seem to be better adapted to one stock than to another. The Hibernial is a stock that is hardy in every particular and especially desirable for top-working. It grows rapidly, makes a large tree and will keep up in rapidity of growth with any of our larger apples. Most of the larger growing crabs make good stocks for top-working. The Transcendent Crab may be successfully used for this purpose. When it is intended to grow an orchard by this method the stocks should be set in the spring, to be budded the following August or to be grafted the following spring. If to be budded the buds should be inserted in about the same positions in the head of the tree as the grafts.

Grafting the Plum.—The plum is most successfully grafted very early in the spring—even before the frost is out of the ground or a bud has commenced to swell. When done at this time the work is generally successful, though not as certain as the apple. It is said that the plum may be grafted very suc-

cessfully later in the spring, even after the buds have commenced to swell, providing the buds on the cion are started as much as those on the stock at the time the work is performed.

The plum may be quite successfully root-grafted in the house in the winter, as recommended for the apple and treated the same way, but it generally takes a year longer to get the tree formed, since in this case the growth from the cion is quite slow the first two years. On account of this slow growth root-grafted plum trees are often crooked and unpromising. This defect, however, may be remedied by cutting away in the early spring of the second year all the growth from the cion except one strong bud at the base. If this work is done very early in the spring it will result in throwing the whole strength of the root into a single bud and the forming of a stem that is straight in place of the former crooked one. A much better and more satisfactory plan than root-grafting is to plant the stocks in the nursery one year before they are intended to be grafted, and then graft them below the surface of the ground very early in the spring. For this purpose cleft or whip-grafting should be used. When the work is done in this way the result is a very strong growth from the cion. If the suckers are pinched off and the whole strength of the root forced into one shoot, the result, on right land and in the case of strong, healthy stock, will be to give a growth often exceeding four feet in height. Sometimes the growth in this latter case will be so heavy that the branches are liable to be broken off in the wind, and should be tied to stakes with soft string. The cions should be from four to six inches long.

Grafting the Cherry.—The cherry may be root-grafted indoors in the winter. When this is done, side-grafting is employed and gives results far ahead of any other method. But with the best of care the losses from in-door grafting of this fruit make it very unsatisfactory. Much better results will be achieved by side-grafting them at the crown of the plant on stocks well established in the open ground, as in the plan recommended for propagation of the plum. In regard to this fruit it is also reported that, as in the case of the plum, the work may be done after the stocks start into growth a little, providing the cions

are as far advanced. The cions should be from four to six inches long.

Grafting the Peach is occasionally practiced but it seldom gives best results. Its most common use is on stocks on which the buds have failed to grow and it is sometimes very successful.

Grafting the Grape is done most safely very early in the spring, even before a sign of growth appears, but it may also be grafted about the time the first leaves are nicely expanded, if the cions are kept dormant until that time. The work should always be done below the surface of the ground. Any form of graft may be used, but that most commonly used is cleft-grafting, as described. In making a cleft-graft upon a grape root it is often necessary to saw the cleft in the stock with a fine saw, on account of the crooked, twisted grain of the wood, which does not allow it to split straight. Some growers do not use any wax around the graft but simply cover it with a mound of well packed earth up to the upper bud of the cion. In grafting after the leaves are expanded some propagators prefer to use side-grafting, and do not cut the vine severely until it is believed the cion has grown fast to the stock, when the vine is cut entirely away. Whip-grafting is also used for this purpose. The cions should be about six or eight inches long.

To change varieties in a vineyard grafting on a cane from the old vine is sometimes practiced. In this case a cane from the old vine long enough to reach nearly midway between the vines is grafted with a cion which should be at least two feet long. When grafted the graft, including the cane and cion, should be buried six inches deep, the end bud of the cion being brought above the ground where the new vine is desired. The following year the old vine may be largely cut away and the growth from the cion will take its place. This method is not so neat as when the vine is cut off and grafted below at the surface of the ground, but it has the merit of being very much more certain of not necessitating the destruction of the old vine until a new one is established.

Grafting by approach or inarching is a form of grafting in which the branches of growing plants are brought together. It is sometimes used to change the bearing of vines or trees, or to

grow two branches or stems together. It is much used in propagating such ornamental trees as cut-leaved and purple birches. It may be done at any time during the growing season and on any flexible growth of whatever age. It is formed by shaving out a piece of bark and wood from the stock and from the cion, of the same size and in such a way that the inner barks of each may be tied together. If this is done even so late as the middle of July they will grow firmly together before winter. It is customary, when this method is to be used for propagation, to either set a lot of small plants around the one from which the cions are to come, or to grow them in pots and set pots and plants near by. When the branches have united they are permitted to grow until autumn, then the cions are cut off just below the union and the plants with the cions on them are heeled in for winter or protected in some other way. No wax is needed, as the union is very sure if the parts are closely tied together. This is a very safe and sure method and is easily performed, even by the novice.

QUESTIONS—CHAPTER X.

1. For what purposes are plants propagated from seed?
2. What is meant by stratification?
3. What kinds of seed are stratified?
4. What are offsets and how are plants propagated from them?
5. What are layers? Spring layers? Summer layers? Mound layers?
6. What plants are adapted to propagation by layers?
7. When are layers made?
8. How are cuttings made?
9. What are soft wood cuttings?
10. What are hard wood cuttings?
11. What conditions are necessary for successful growing of hard wood cuttings?
12. When should they be made?
13. What soil is best for planting cuttings?
14. How should they be planted and when?
15. What is the solar pit?
16. How is it made and for what purpose?
17. What does graftage include?
18. What are the limits of graftage?
19. What is meant by stock, cion?
20. When is budding practicable?
21. What is the best stock to be budded upon?
22. What is the bud-stick?
23. When is the best time for budding?
24. What conditions are necessary for successful budding?
25. What implements are necessary?
26. What material is used for tying the buds?

27. How are the buds cut from the bud-stick?
28. When is the bark in the best condition for budding?
29. Describe the process of inserting the bud in the stock.
30. What precautions must be taken in budding?
31. What care is necessary in the spring and fall, after the buds have started?
32. How should the buds be protected from winter injury?
33. When and where is June budding practiced?
34. How do June-budded trees differ from other budded trees?
35. How is June budding performed on peaches and plums in the South?
36. What is shield budding? Flute budding?
37. What is the difference between grafting and budding?
38. What precautions must be taken in budding?
39. What is grafting wax used for?
40. How is it made?
41. What other materials can be used instead of grafting wax?
42. How is cleft-grafting performed?
43. What tools are necessary for cleft-grafting?
44. How should the cion be cut for cleft-grafting?
45. How does whip-grafting differ from cleft-grafting?
46. How and when are root grafts made?
47. How are they planted? On a large scale? On a small scale?
48. What care should be taken when planting the grafts in a dry season?
49. What is side-grafting?
50. What fruit plants is it best adapted to?
51. What advantage is there in grafting below the ground?
52. How should the work be done?
53. For what purpose is the night cap used?
54. How are apples grafted?
55. How are they budded?
56. What is the result of top-working varieties?
57. What is meant by top-working?
58. How is the plum most successfully grafted?
59. How is the plum root-grafted?
60. What forms of grafting are used on the cherry with best results?
61. How is the peach grafted?
62. When is the grape grafted?
63. What methods are used?
64. How may the varieties in a vineyard be changed by grafting?
65. What is "inarching" and when is it used?

CHAPTER XI.

POME FRUITS.

THE APPLE.

Origin of the Cultivated Apple.

Classes of Apples:

(a) The true apples have descended from the *Pyrus malus* of Europe. Characteristics: Woolly twigs, on new growth, calyx and flower stems; fruit, various but always holding its calyx, i. e., the parts of the flower commonly found on the end of the fruit; leaves, thicker and broader and the twigs thicker than those of the crab apples (*P. baccata*). The common apple of commerce comes from this species.

(b) The crab apples have descended from the *Pyrus baccata* of Europe and Asia. In Europe the term "crab" is often applied to any small inferior kind of an apple which may be said to be crabby. Characteristics: Growth, smoother and more wiry than that of the true apple; leaves, narrower, thinner and with longer stems; flower clusters and leaves seldom woolly; fruit, small on long, wiry, slender stems; seed, enclosed in hard, close fitting hulls; calyx falls off when the fruit is mature. There are few, if any, of these pure crabs in cultivation. Possibly, however, the Yellow and red Siberian crabs are of this parentage.

(c) Hybrid crabs are sometimes known to botanists as *Pyrus prunifolia*. They are undoubtedly the result of crosses between the true crabs and the larger apples. In this group are included most of the so-called crabs of commerce, such as the Transcendent, Hyslop, Sweet Russett, Excelsior and others. In them are to be found the quality of the *P. malus* and the *P. baccata*, mixed in various proportions.

(d) *Pyrus coronaria*, the largest of Western crabs, has a form which has become known as *Pyrus ioensis*. This is a native of the Mississippi Valley and eastward. Characteristics: Tree, vigorous, especially when young; young growth, woolly; leaves, often deeply indented; fruit, green or later yellowish, aromatic,

hard, bitter, keeps through the winter; resembles quince in quality and used like the quince for making an excellent jelly.

There are but few varieties of this in cultivation, among them are the Soulard and the Fluke. It does not readily cross with the cultivated apple.

Groups of Apples:

Among cultivated varieties of apples we often find several that closely resemble one another in fruit, foliage and habit. Some of these groups are as follows:

(a) The Fameuse group includes Fameuse, Shiawassee Beauty, McIntosh and St. Lawrence.

(b) The Duchess of Oldenburg group includes Duchess, Borovinka, Gilbert and Charlamoff.

(c) The Ben Davis group includes Ben Davis, Gano, Shockley and Black Ben Davis.

Other groups will suggest themselves to those acquainted with many varieties of apples.

For describing apples a certain convenient nomenclature has been adopted. It frequently happens that the color, shape and quality of fruits are changed by soil and location. The characteristic appearance of the wood and foliage, however, is less liable to change; in the identification of fruits it is often necessary to take them into account as well as the fruit, and a good description should include the tree as well as the fruit. These terms, as applied to the growth of a tree, are "strong and vigorous," as the Duchess of Oldenburg; "vigorous and slender," as Anisim; "stout and short jointed," as the Yellow Transparent.

For the general form of the tree the term "upright spreading" would indicate the Duchess; "spreading" the Roxbury Russett; "upright" the Whitney; "round headed" the Red Astrachan.

In describing the fruit the word "base" means the part of the apple at the stem end; "apex," the portion at the blossom end; "cavity" is the depression around the stem; "basin," the depression around the flower end; "calyx," the so-called flower in the apex of the apple. The general form is referred to as being "round," "oblate," "conical," and "oblong," which terms are illustrated in fig. 87. As regards size, apples, when under two and a half inches in diameter, are said to be small; when from

two and a half to three and a half inches in diameter they are termed "medium," and above this, "large."

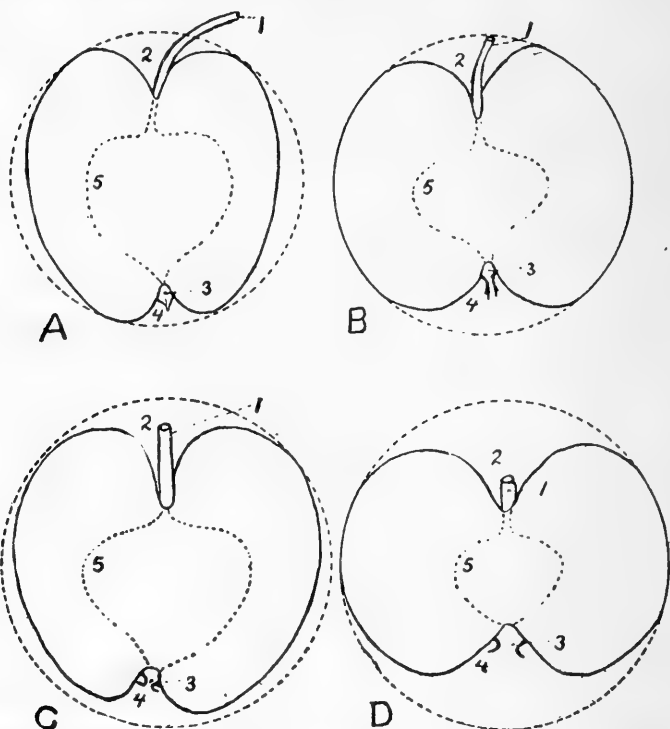


Fig. 87.—Forms of apples. a.—Oblong. b.—Round. c.—Conical. d.—Oblate. Numbers refer as follows: 1. Stem. 2. Cavity. 3. Calyx. 4. Basin. 5. Core.

Propagation of Varieties:

Apples are commonly propagated

(a) By root-grafting in-doors in winter on whole or piece roots.

(b) By crown-grafting in the field in spring.

(c) By budding.

Various other forms of graftage may be successfully used in growing the apple as it is easily worked in this way.

Stocks for the Apple:

(a) Seedlings of vigorous, hardy sorts are commonly used as stocks for the apple in the best apple districts and little attention is paid to the source of the seed.

In the Central and Northwestern states, where the winters are severe and the snowfall often scanty, the apple is liable to winter injury and much care is taken in getting hardy stocks. For this purpose seedlings of the hardiest varieties are sought.

(b) Seedlings of hardy hybrid crabs are now much favored for severe locations and are giving good results, but are not sufficiently tested so that their value can be definitely stated. It seems from present experience that their use should be extended.

(c) Seedlings of the pure *Pyrus baccata* are of great hardiness and are now being widely experimented with in severe locations, especially in Minnesota and the Dakotas. Some varieties do well on it when budded or grafted at the crown while other kinds unite poorly with it and there is at least something of a question as to its future usefulness as a stock.

(d) Dwarf apples are formed by working them on the Paradise stock, which is a dwarf apple stock much used in Europe for this purpose but seldom used in America. It makes small trees that are adapted to training in various forms.

(e) Top-working or grafting the tops of trees is practiced in some sections to change the bearing of trees and to overcome weaknesses in the trunk of certain kinds, such as the Wealthy, which is liable to canker in the crotches in Minnesota and the Dakotas. Some varieties are much more productive when top-worked than when merely root-grafted.

Location of the apple orchard.—The best location for an apple orchard is on high northern slopes tipping down to the northeast, and the steeper the slope the better, provided it does not interfere with cultivation. The northern slope is preferred because it is least affected by drouth, sudden changes of temperature, and by drying winds, which very uniformly come from the South. However, some excellent orchards in the Northwest are located on southern slopes. It is important to plant apple trees

on the highest land available. Even if the elevation is not more than ten feet above the general level of the adjacent country, it is a great advantage in furnishing air-drainage and thus equalizing the temperature and lessening the danger from frost in the blossoming period.

The worst location for an orchard is what is called a warm sheltered spot, where the sun has free access and the winds are entirely shut off. Into such a place the cold air from the surrounding higher elevations settles, making it cold at night and the hottest place during the day. Blight and winter killing are apt to be abundant in such a place. In some sections—most generally those protected by water or forests of wooded hills—but little, if any, difference is to be noticed in the growth and productiveness of trees on the various exposures, while in exposed places this difference is very marked.

Windbreaks.—A free circulation of air is very desirable in an orchard, and full exposure is better than shutting it in too closely, yet in a full wind-swept exposure, the best conditions for a successful orchard are not found. It should be surrounded with windbreaks on the exposed sides, sufficient to somewhat break the force of the wind but not heavy enough to prevent a good circulation of air through the orchard at any time. It is much more important to have a windbreak on the south and west sides of an orchard than on the north or east, for it is from the former directions that the most injurious winds come from.

The land best adapted to the growth of apples is what might be called a deep, open, clayey loam, that is well drained, either naturally or artificially, and does not suffer severely from drouth or excess of water. However, the apple may be grown successfully on almost any soil, even on that which is dry and gravelly, providing it has a reasonable amount of plant food; but orchards require more careful management in severe situations than in those which are favorable and of course are not as long lived and productive.

The soil for apple orchards must be retentive and rich in plant food, for it is impossible to raise good fruit on poor soil. Sufficient moisture can generally be secured by heavy mulching, and the newer soils of the Northern states are generally rich

enough for apples without manuring; indeed, heavy, black prairie loam is generally so rich in plant food that it stimulates in most varieties of apples a late growth, especially when the autumn is warm and moist, and only the hardiest kinds, such as those that do not make a late growth in autumn, should be planted in such locations.

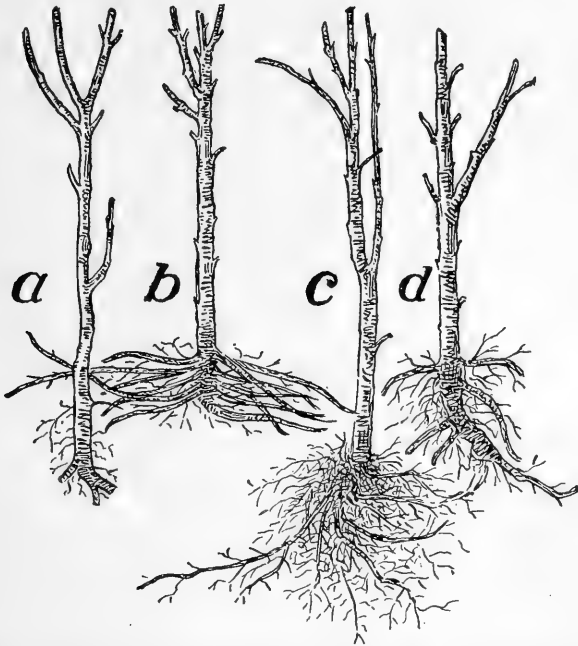


Fig. 88.—Various kinds of roots on apple trees. a.—Cut too short. b.—Stock has died and roots have been sent out from the cion. c.—Similar to b, but with more fibrous roots. d.—A good form well dug, in which the stock is still preserved.

If the sub-soil is a very hard clay that the roots can scarcely penetrate, very deep plowing should be resorted to; but as this is not deep enough to give the roots much of a chance in very hard, dry clays, the holes should be dug very deep. A better way than digging holes into such hardpan is to explode a medium charge of

dynamite in each hole, which will so loosen the soil that the roots can penetrate it. In some locations, such treatment will make all the difference between success and failure.

Trees should be selected that are vigorous and healthy, with plenty of strong roots. It is really of little importance what the size or form of the top of the tree may be, provided it has good roots and is healthy and free from blemishes; for, if vigorous, the form of the top may be readily changed. The best trees are those, not over four years old, that have made moderate but not rapid growth in the nursery. Three-year-old trees, of most varieties, are generally the best to set. Two-year-old trees do very well and are often as good as any. One-year-old trees are too small to conveniently cultivate around them in the field and are better off in the nursery for another year.

Seedlings.—Apple seed grows readily and generally forms plants about twelve inches high, with tap-roots of about the same length, the first season. The seed does not reproduce in quality the fruit it was taken from, and probably not one seedling in a thousand is as good as any of the better cultivated kinds. Seedlings, however, are raised in large quantities, to be used in grafting and to increase the named varieties. Apple seed is generally obtained by washing out the pomace from cider mills. The seeds are heavier than the pulp and are readily separated from it by water. It is best not to allow the seed to get very dry after cleaning, and on this account some growers prefer to sow it in the fall shortly after cleaning, while others mix it with sand and keep it buried in the ground until spring. If the seed gets very dry it often fails to start, or does not start for one year, unless scalded or mixed with moist sand and allowed to freeze and thaw a few times. In a small way the seed may be kept mixed with sand and buried in a box in the ground until spring, when it should be put in a warm place until it starts into growth a little. It should then be sown in drills three inches deep and about three feet apart, in rich, warm soil, sowing about twenty seeds to the foot.

Root grafted trees should always be preferred to those that are budded for severe sections, although in the case of hardy trees that have already been root-grafted, budding is as good as

grafting to change the bearing qualities, where extremely hardy stocks are used. The objection to budded trees is not in the method of propagation, but in the fact that the buds must be inserted above or close to the ground in a seedling root which is often of doubtful hardiness and may be quite tender and the bud is partly exposed above ground, where it is liable to fail at any time. Root-grafted trees have the graft below ground and send out roots from above the graft, which increases the hardiness of the tree. Quite frequently the roots of a budded or grafted tree will be tender and kill out, while the top is healthy and sound, consequently it is desirable to have the roots as hardy as the top. But as this is not always practicable, every effort should be made to get the hardiest roots obtainable. In most favorable locations, budded trees may be just as desirable as those which are root-grafted. The kind of root-graft, whether it is made with whole or piece roots, makes but little difference to the ordinary planter, who should try especially to get good trees and then be careful to plant the graft well below the surface of the ground.

Planting.—For planting, the land should be in as good condition as is required for corn. The work of planting will be greatly facilitated if the land is furrowed out both ways with a large plow, and the trees set at the intersections. If the trees must be set in sod, a hole five feet in diameter should be dug for each tree; no grass should be allowed to grow in this space, and it should be heavily mulched. In setting the trees, the holes should be made large enough to take in all the roots without crowding. If it is necessary to set trees into the subsoil, as it often is, then in digging the holes the top-soil should be kept separate from the sub-soil and be put back in the bottom of the hole so as to be in contact with the roots. The roots should be evenly spread out in the hole and the fine top soil carefully worked among them so as not to leave any air spaces between or under them. If the soil is dry it can hardly be made too solid around the roots. If wet, but little pressure should be used.

The time to plant.—In the extreme North, fruit trees should never be set in the fall of the year as they are then especially liable to winter injury, nor should they be dug from the nursery

rows in the spring, as they are very liable to have been weakened by unfavorable winter conditions and will often start poorly. They should be dug in the autumn and buried root and branch—"heeled in"—in dry soil until spring, or else be carried over the winter in a cold cellar. As few cellars are fit for this purpose it is generally safer to bury them outside. As a rule, it is best for planters to get their trees in the fall, as they are then more certain to get good stock, and there is no delay in waiting for them to come in the spring. The trees may be set as soon as the soil works easily in the spring, and until the trees break into leaf. Usually moderately early planting gives the best results, but it is bad practice to set trees in wet, sticky soils.

In the more favorable sections for apple growing there is very little danger of trees in the nursery being injured in winter and hence it is safe to dig the trees in the spring and set them out. Autumn planting is also successful with apples in very favorable locations but must be done with much care for best results.

Autumn planting.—While it is best, as a rule, to plant trees in the spring, yet it is quite practical to plant apples, plums, and most other fruit trees in the autumn, provided that they are afterwards laid on the ground on the approach of winter and covered with earth and a little mulch. This makes considerable additional labor over spring planting. On the other hand, however, it permits of planting in the autumn when the general farm and garden work is not as pressing as in the spring. It really amounts to the "heeling in" of each tree separately. In the spring the trees should be uncovered and straightened up before growth starts, and they are then all ready to go on and grow.

"Heeling in" is a term used to designate the temporary burying of the roots of trees or plants in earth or other material. If the trees are to be moved again within a few days, a very light covering will be sufficient; but if they are to remain several weeks much care should be taken to do the work well. To begin with, select a dry, mellow piece of ground; dig a wide ditch, put in the trees—a few at a time—either in an erect or sloping position, and cover them so deep and firm that they cannot dry out. If apples or some other somewhat tender trees are to remain

"heeled in" over winter, it will be found best to commence by digging a trench about two feet deep and three feet wide in dry land, where no water will stand in the trenches; put in a layer of trees, sloping; cover over the roots with a thin layer of fine, mel-



Fig. 89.—Heeling-in. Showing methods followed in heeling-in trees of orchard transplanting size.

low earth, filling in carefully and solid all the interstices among the stems and roots; continue thus until all the trees are in, when the tops should be bent to the ground and covered with a few inches of earth.

Depth to plant.—In the best locations, the trees should be set about four inches deeper than they grew in the nursery. In very dry, light soil, they may be put, perhaps, twelve inches deeper than they naturally grew. On steep hillsides, they must be set much deeper or they will come too near the surface, owing to the slope of the land. One of the most important objects secured by deep planting is the sending out of roots from the cion, for when trees are well rooted from the cion they are generally much improved in hardiness. However, in deep, retentive soil deep planting is not desirable.

Distance apart to plant.—In favorable locations apples should be set farther apart than where the conditions are very severe. Most varieties do best toward the northern limits of apple growing

when not over thirty feet apart. In favorable apple districts in the Eastern states apple trees are generally set 35 to 40 feet apart, while in some of the Pacific Coast fruit sections, where the trees seldom become large, they are set out 25 to 30 feet apart. Apple trees should be set so as to "break joints" north and south—that is, the trees in one row should be set opposite the vacancies in the next. If the rows run northeast and southwest the trees will shade one another on the southwest side, which is the side most liable to injury from the sun.

Cultivation.—Young orchards should be cultivated in some hoed crop which does not necessitate the working of the soil in autumn, but will keep the land well cultivated early in the summer. For this purpose corn, early potatoes or squash are good crops. Do not sow the ordinary small grains in orchards. Buckwheat, however, seems to be an exception to the rule, and on account of its dense shade is a very good crop for this purpose. After the trees begin to bear it is often a good plan to seed the land to clover, which should be broken up occasionally. The trees, however, should be well mulched with stable litter and, if they do not make a satisfactory growth, should be manured. When an orchard becomes "sod bound" nothing will do it more good than a drove of hogs, sufficient to root up all the sod, but they must not be allowed to gnaw the trees. Besides breaking up the sod the hogs are very beneficial in destroying many kinds of insects.

Forming the tree.—Whatever the shape of the tree when it is received from the nursery, it will need careful attention in the orchard. The question whether to grow trees with a long or short trunk is a much disputed one; but it may be laid down as a general rule that in favorable locations the trunks of the hardier kinds should be free from branches for fully three feet from the ground, but in such cases they may need some protection from sunscald. In very severe and exposed locations, or in the case of somewhat tender varieties, it will be better to have the trees branch near the ground. When formed in this way, they are hardier and less exposed to the wind than if they have tall trunks. There is a constant tendency for trees to incline to the northeast, and this should be prevented as far as possible. To do this, the growth should be encouraged on the southwest

side by light summer pruning on the north side. Also, in setting the trees, they should be slightly inclined to the southwest and an effort made to keep them in that direction.

Sprouting from the roots.—In the case of young thrifty trees, such as the Wealthy and some other kinds, even with trees up to six inches in diameter, vigorous sprouts will often be pro-

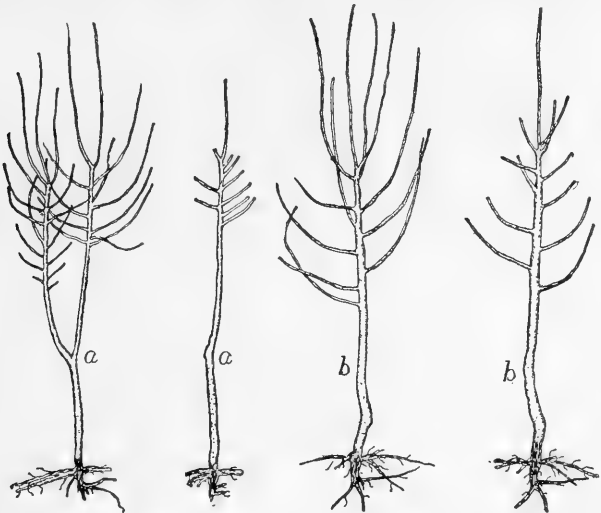


Fig. 90.—Apple trees of various forms showing method of pruning for planting.

duced from the trunk when the top is badly injured and such sprouts will make profitable trees. This has been the experience in Minnesota where trees have been killed back in severe winters.

Mulching.—The advantage of a mulch around trees in apple orchards is not generally appreciated. It checks evaporation and prevents the running off of water and allows it to soak into the ground. It helps to equalize the moisture in the soil throughout the growing season, and prevents root-killing in winter. It is of the greatest assistance in rather dry locations, where its use makes success possible with many varieties that otherwise

would be complete failures. In almost any soil of the Northwest the chances of trees living and doing well would be increased by the use of a mulch around them, but this is especially true of trees on sandy land and in southern exposures. It is generally best to cultivate the land around trees when they are small; but if they are set on sod land, or after they begin to bear, or if they suffer from drouth, they should be heavily mulched at once, and this should be renewed as often as necessary to keep a covering five or six inches in depth on the ground at all times extending at least four feet on all sides of the tree, and, in the case of larger trees, extending out as far as the branches. Trees that are mulched should for best results have the mulch removed and the soil spaded up around them each spring. Mulch, however, encourages the presence of mice which are liable to gnaw the bark from the stems which must be protected against them.

The varieties of the apple differ greatly in their resistance to severe climatic conditions. Some varieties have wonderful hardiness and recuperative qualities and are adapted to a wide range as, for instance the Oldenburg, Baldwin, Ben Davis and Tolman Sweet, while others are adapted only to a limited range, like the Yellow Newtown. There are a large number of different kinds, although but few of them are cultivated in a large way commercially. The varieties of the first degree of hardiness are recommended by the Minnesota State Horticultural Society and may be taken as illustrating the kinds that should be tried in the most severe northern sections. They are Hibernial, Duchess of Oldenburg, Charlamoff, Patten's Greening and Okabena. This list illustrates the way in which we are developing an American pomology of our own, for of this list the first three are of northern European origin and the last two are American seedlings; one, Patten's Greening, originated in northern Iowa; the other, Okabena, originated in southwestern Minnesota.

The principal varieties of apples cultivated in the large commercial orchards of the chief apple-growing regions include the Baldwin, Ben Davis, Gano, Winesap, Greening, Grimes Golden, Jonathan, Missouri Pippin, Northern Spy, Oldenburg, Tolman Sweet and Wealthy.

The insects and diseases commonly attacking the apple are the codlin moth, flat headed apple tree borer, tent caterpillar, apple curculio, apple leaf lice, and among the common diseases are scab and fire blight. See Chapter III, Insects, and Chapter IV, Diseases.

Pear.

Pear growing has been an important matter in the North-eastern states since the early settlement of the country, and has attained great commercial importance in parts of California of late years. In the interior states the pear has been subject to fire blight and its cultivation has made little progress. In the Gulf states the sand pear hybrids only are grown. The pear is probably nearly as hardy as the apple against climatic troubles.

Origin.—The commonly cultivated pear of America and Europe has been developed from the wild pear (*Pyrus communis*) of Europe and Asia. In its native state the fruit is hard and inferior. Pliny said of the pears in his time that they all had to be cooked to be eaten. The greatest improvement in pears was made by Von Mons in Belgium early in the nineteenth century. He originated many of the best kinds now grown.

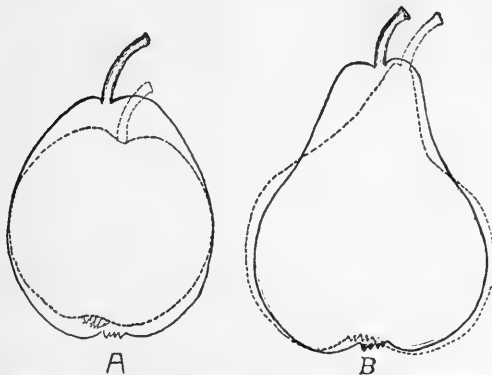


Fig. 91.—Forms of Pears. A.—Solid line shows obtuse pyriform. Dotted line, round. B.—Solid line shows oblong obovate. Dotted line, acute pyriform.

The Chinese Sand Pear (*Pyrus sinensis*) was introduced into this country about the middle of the last century and was for many years cultivated mostly as a curiosity and for ornament. It is a vigorous tree, with broad, shining, very resistant foliage and conspicuous fruit

so gritty, hard and acid as to be valueless for desert purposes but useful like the quince when cooked. It readily crosses with the ordinary pear (*P. communis*) of gardens and a large number of more or less mixed seedlings has been the result. Among these are two that have become commercially valuable. These are the Kieffer and the Le Conte. The Le Conte was for a long time thought to be entirely resistant to fire blight and especially adapted to the Southern States, but of late years it has been badly affected with this disease and now the Kieffer is regarded as the most reliable even in the South, although it is not entirely resistant to the fire blight. At the North, and over a wide range of territory, the Kieffer has proven a profitable sort on account of its fine appearance and keeping qualities, although of inferior quality. It is also less liable to attacks of the San Jose scale, at least in some locations, than varieties of *P. communis*.

The flowers of the pear are perfect and yet there are many varieties that are most certain only when grown mixed in the orchard with other kinds and it is now a customary practice to mix the varieties in the orchard. This weakness of pears does not seem to be constant but varies possibly according to soil and location.

Standard pears.—What are known as Standard pears are worked on seedlings of the small wild crabby pears which are common in Europe, botanically the *Pyrus nivalis*, or on seedlings of the Oriental pears. These have lots of plump seed and are vigorous and thrifty. Most of the stocks used in this country are imported from Europe. The seedlings are not easily grown as they are liable to leaf blight when young.

Dwarf pears.—When the pear is worked on what is known as quince stocks, the resultant trees are dwarf in size and bear fruit very young. Some varieties of the pear bear best and the fruit is of improved quality when worked on this stock. The stocks for this purpose are generally grown by layering the vigorous Angers quince. The layers are then planted out in nursery rows and when growing thriftily are budded or grafted in spring with the pear. The pear does not make a good union on the Japanese quince and all attempts to use it for this purpose have failed.

If dwarf pears are planted deep, they throw out roots above the graft and then become Standards, but quince stock must be below ground for protection. An observant person can easily distinguish the dwarf pear trees that have roots from the cion by their greater vigor and, if desired, these pear roots may be cut off and the strong growth checked.

Dwarf pears have the merit of fruiting very young and heavily, often when only three years from the bud. They are especially fitted for the small garden and of little importance

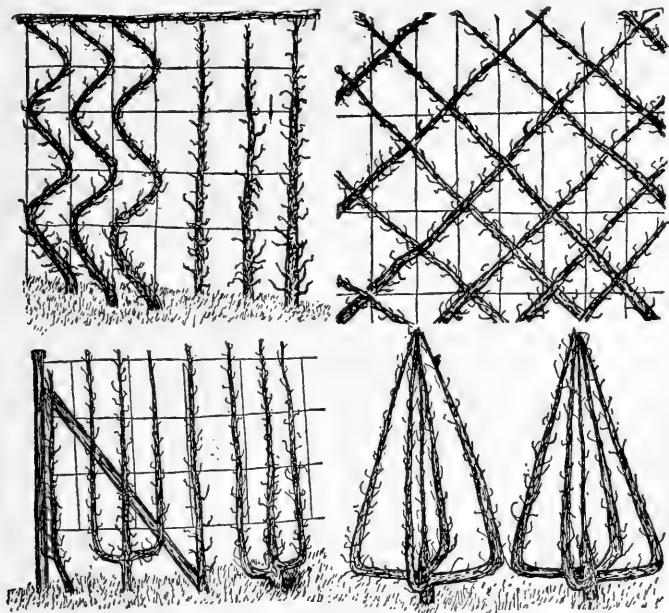


Fig. 92.—Some of the peculiar ways in which pear trees are commonly pruned in French gardens.

otherwise. Dwarf pears need to have their new wood shortened each year if they are to be kept in compact form, otherwise they get too rangy. About twelve feet is the proper distance between them. The Duchess pear is the most popular sort for growing on quince roots.

Thorns, (*Crataegus*), Mountain Ash and even Shad Bush (*Amelanchier canadensis*) have been used as pear stocks with fair results. The Mountain Ash is occasionally used for this purpose in Sweden, where ordinary pear stocks are tender.

The Kieffer pear is sometimes grown from cuttings in the South and used as a stock for other pears.

Propagation.—The pear is grown in practically the same ways as the apple, that is, (a) by crown-grafting in the field, (b) by root-grafting in the house in winter on whole roots—in this case the growth is generally quite slow the first year, (c) by budding in summer.

Soil and cultivation.—The pear needs a rich, retentive soil but thrives on a variety of soils and especially likes a rather hard sub-soil clay. It is short lived on soils of a loose, open texture. Fire blight is especially troublesome on soils where the trees make a very rapid growth and it is the practice of some growers to keep the land in sod to prevent too rapid growth of wood. Yet the pear orchard must not be allowed to become so firmly bound in sod that the trees are prevented from making a reasonable growth. Nitrogenous manures and the use of nitrogenous cover crops should generally be avoided in the pear orchard and most attention given to the use of potash and phosphoric acid.

Trees and planting.—Young, thrifty trees, about two years from the bud or three years from the root graft, are best for planting. Standard pears are generally planted 16x16 or 20x20 feet apart, according to the form and size of the varieties. Pears generally bear paying crops younger than apples. This quality, however, varies with the different kinds.

Pruning.—Pears need more pruning than apples when young. During the first few years after planting, the few central shoots that often seem to occupy all the attention of the tree when young should be pinched or shortened except the strongest central shoot, which should be preserved through the life of the tree. Proper attention to this when the trees are young will develop a head that will need but little training after the trees commence to bear.

Fruit.—Pears vary greatly in size, quality, color and form, and also in season of ripening, from early summer to late winter.

Some are valuable only for cooking, others are of finest dessert quality. The fruit should be protected by spraying and should be picked when full grown, even if very hard, as they are improved by being ripened under cover. Some varieties that water core badly on the tree are exempt from it when the fruit is ripened under cover. Fruit allowed to hang long on the trees in autumn does not keep well.

The fruit is marketed as fresh fruit, dried, canned and used for making pear cider known as "perry."

Insects and diseases commonly attacking the pear are much the same as those attacking the apple. The pear is, if anything, more liable to fire blight than the apple. See Chapter III, Insects, and Chapter IV, Diseases.

The varieties of the pear that are most popular include the Bartlett, Kieffer, Clairgeau, Anjou, Howell, Sheldon, Seckel and Nelis. The Duchess is the most popular dwarf kind. By the proper selection of varieties the season for the pear may be extended from early summer to late winter, but the very early, and especially the very late, pears are not of the best quality and are generally supplanted by the apple which is more easily grown.

Quince.

Origin.—The quince (*Cydonia vulgaris*) is a fruit of comparatively little importance. It is a native of Asia and South-eastern Europe. There are not many varieties of it and few of these are much known. The plant is a shallow rooted shrub, seldom over twelve feet high, and is sometimes trained to the tree form. It is chiefly grown in New York, New England and on the Pacific coast. It prefers a cool, rather moist climate and is uncertain elsewhere. There is a demand for it in most of the markets of the Northern states.

Flowers.—The flowers of the quince much resemble those of the apple but are larger and more open, are white, shaded to pink, are produced singly at the ends of the twigs and are very ornamental. They are supposed to be self-fertile.

Propagation.—The quince is easily propagated. The most common ways are as follows:

(a) Cuttings of the new wood planted in autumn (common) and from cuttings of the surface roots (uncommon).

(b) Mound layering, i. e., by piling the soil up among the stems which causes them to root, after which they are separated and set out.

(c) Budding or grafting the cultivated kinds on the free growing Angers Quince (uncommon).

(d) By grafting long quince cions on pieces of apple roots, perhaps one or two inches long, which are broken off in one year and the plants then obtained on their own roots. This method is generally successful and especially desirable with some kinds that do not grow easily from cuttings. It is customary to use the short pieces of apple root commonly wasted in root-grafting the apple, for this purpose.

(e) The quince grows well from seed which starts readily. The fruit of seedlings may be either pear or apple shaped.

Soil and planting.—Rich, retentive, not moist soil is best. Sandy soils are not so desirable as clay soils. The bushes should be planted out about twelve feet apart each way. Avoid cultivation of the soil as much as possible, especially in late summer, and avoid stable manure, as these have a tendency to encourage fire blight. Nitrogenous fertilizers and nitrogenous cover crops should be avoided. Fertilizers containing potash and phosphoric acid are best.

Pruning.—Little pruning is required, except to keep the suckers off from the roots and trunks. The trees should branch close to the ground.

Picking.—The fruit should be picked when it begins to turn yellow and it must be handled with great care, as it bruises easily. If stored in a cool place the fruit will keep a month or more. It is used only for cooking when it has a peculiar and delicious quality quite its own. Most of it is preserved in the form of jelly or marmalade but when baked it makes a desirable dessert.

Insects and diseases.—The quince is attacked by nearly the same insects and diseases that affect the apple and pear and is especially liable to leaf rust, fire blight and leaf blight. See Chapter III, Insects, and Chapter IV, Diseases.

The varieties of the quince commonly grown are the Orange, Champion, Rea and Meech.

QUESTIONS—CHAPTER XI.

Apples.

1. Into what classes may apples be divided?
2. Characterize each.
3. Into what groups of varieties may apples be divided?
4. What terms are applied in descriptions of apples?
5. How are apples propagated?
6. What stocks are used in different localities?
7. How are dwarf apples formed?
8. What is meant by "top-working?"
9. What is the best location for an apple orchard?
10. What is a poor location for an apple orchard?
11. Of what advantage is a windbreak to an orchard?
12. What soil is best adapted to apple growing?
13. With what kind of trees should the orchard be started?
14. How are seedlings grown and for what purpose?
15. How is apple seed obtained?
16. How is it cared for and planted?
17. What are the merits of root-grafted trees?
18. What are the merits of budded trees?
19. How should apple trees be set out?
20. What care should be taken in planting?
21. When is the best time to plant trees?
22. When should autumn planting be practiced?
23. What is meant by "heeling in?"
24. How are plants heeled in?
25. What depths should trees be set?
26. How far apart should trees be planted?
27. What cultivation do orchards require?
28. What pruning should be done?
29. In what case should sprouting from the roots be encouraged?
30. What are the advantages of a mulch in the orchard?
31. When and how should a mulch be applied?
32. What varieties are best adapted to the North? To the South?
33. What varieties are most grown for commercial use?

Pear.

34. In what sections of the country is the pear grown?
35. Of what country is the pear a native?
36. What are the characteristics of the Chinese sand pear?
37. What is the origin of the Le Conte and Kieffer pears?
38. What are Standard pears?
39. What are dwarf pears used for?
40. What are their characteristics?
41. What trees are used as stock for the pears?
42. How is the pear propagated?
43. What cultivation and soil is best for the pear?
44. How should young trees be planted out?
45. What pruning do the trees need?
46. What are the qualities of the fruit?
47. How is the fruit marketed?
48. What insects and diseases are injurious to the pear?
49. What are some of the common varieties of the pear?
50. How are pears packed for market?

Quince.

51. Of what country is the quince a native?
52. What are the characteristics of the quince?
53. In what ways may the quince be propagated?
54. What soil and cultivation is best for the quince?
55. What pruning does the tree require?
56. When should the fruit be picked?
57. For what is it used?
58. What are the common varieties of the quince?

CHAPTER XII.

THE STONE FRUITS.

Under the head of stone fruits we include peaches, plums, cherries, almonds, nectarines, and apricots, all of which are classified under the genus *Prunus*. This is one of the most important groups to horticulturists and contains some very valuable fruits and ornamental plants. The almond is an important fruit that belongs under this head, but its cultivation is not referred to in this chapter as it is included under the head of nuts.

The Plum.

There are more species of the plum cultivated in a large way in this country than any other of our common fruits. In the Northeastern states and on the Pacific coast the European or Domestic plums are much at home and commonly grown. In many of the Central states the Japanese plums are widely grown and are increasing in popularity. Even as far north as southern Minnesota, they are grown successfully in the best plum localities. In the great Mississippi Valley, extending from far north to the south, the most popular varieties of plums are those that have sprung from the native sorts. These have been developed within less than half a century.

The different species.—There are several species from which the cultivated sorts have come. They are as follows:

(a) European or Domestic plum group (*Prunus domestica*). This plum is a native of Europe and Western Asia and includes most of the finest plums of commerce. Its most common color is red or purple, but it is also found with yellow or green skin. In Europe it is cultivated far into the north, but the same varieties that are successfully grown in the cold north there have failed in the northern part of the Mississippi Valley. Popular varieties in this class are Lombard, German Prune, Victoria and Bradshaw.

(b) The Myrobalan or Cherry plum group (*Prunus cerasifera*). This plum is native to southeastern Europe. It is a favor-

ite stock on which to bud varieties of the *P. domestica*. The De Caradeuc and Mariana plums, which are supposed to have sprung from species native to this country, are probably closely related to this species.

(c) Japan plum group (*Prunus triflora*). This plum comes to us from Japan, whence it was introduced about thirty years ago. It is probably a native of various parts of Asia and is closely allied to our American plum. The fruit is of large size and brilliantly colored in red, yellow and purple. It does especially well in good plum sections and has a wider range than the Domestica class of plums. Many varieties flower so early in the spring that their crops are uncertain. It seems quite probable that crosses with it and some of the native kinds will give rise to very valuable varieties adapted to a wide range of conditions. Examples of this class are Kelsey, Burbank and Abundance.

(d) American plum group (*Prunus americana*). This is the common wild plum of the Northern states and Canada, extending from the Rocky Mountains eastward across the continent and well to the south. It is admirably adapted to the severe conditions of the northern Mississippi Valley and the plains, and from it have come a large number of varieties, including such well known kinds as De Soto, Wyant, Wolf, Weaver and Rollingsstone. A form of this, sometimes known botanically as *Prunus nigra* and having some quite evident characteristics of its own, is found somewhat north of the range of the typical *Prunus americana*. Good examples of this are the Cheney and Aitkin, both of which flower early and mature their fruit early. Plums of this class seem to do best in northern Minnesota, northern North Dakota and Manitoba.

(e) The Wild Goose group (*Prunus hortulana*), represents a group of plums that seem especially adapted to southern Iowa, Missouri, southern Illinois and adjacent sections. Among these are such well known popular varieties as Wild Goose and Wayland.

(f) The Chickasaw group (*Prunus angustifolia* or *P. chickasaw*) are native to the Southern states and include such varieties as Newman, Pottawatomie and Lone Star.

Bailey classifies the various varieties of the *Prunus domestica* substantially as follows:

Prunes.—These are known by their sweet, firm flesh, which contains enough sugar to permit of their being dried and made a commercial product. As a rule a good prune should contain not less than 12 per cent of sugar. Many plums that are grown as prunes on the Pacific coast and elsewhere are cultivated in the Eastern states as plums.

The Damsons represent a small class of plums having very firm flesh, the fruit of which is borne in clusters and the foliage is small. These are commonly seen along fences and in various wild places in many of the Eastern states. They are generally grown from seed and not grafted. The fruit is valuable principally for cooking.

Gages.—In addition to these there is a class known as Green Gages, which are round and generally of good table quality. The variety known as Green Gage is typical of this group. Large, yellow plums, such as Coe's Golden Drop, may be used to represent another group. Large purple and blue plums represent another section, and some of the most important under this class are Lombard, Bradshaw and Quackenboss.

Propagation.—The plum is propagated in a variety of ways. The American sorts are sometimes grown from root cuttings. In this case the trees used are on their own roots. Cuttings for this purpose consist of pieces of the smaller surface roots that are cut up in autumn, about four inches long. They are then mixed with sand in boxes or nail kegs and stored in a cold cellar until spring, by which time they will be calloused and very likely will have started buds. These cuttings are generally sown thickly in drills about three feet apart and covered about three inches deep.

Growing plums from suckers.—The American plums are also grown from suckers which are encouraged by cutting the surface roots about trees that are growing on their own roots. This method is a favorite one for many small growers and amateurs. Some horticulturists consider trees grown on their own roots much superior to those that are grown in the usual way.

The European, Japan and American plums are mostly grown by budding or grafting on seedling plums. Crown-grafting in spring on well established seedlings, is a common practice. Root-grafting on whole roots in winter is practiced the same as root-grafting the apple, and is successful but not as reliable as crown grafting in early spring, and the plants start slowly when grown in this way.

Stocks for the plum.—The Myrobalan plum is in common use as a stock for the plum. The Mariana, a nearly allied stock, is also used and both make good stocks for the plum in the milder sections. For the colder sections, as in Minnesota, the Dakotas, northern Iowa, Wisconsin and adjacent states, seed-

lings of the native *Prunus americana* are much to be preferred. Seedlings of the Wild Goose type of plums, as well as those of *Prunus americana*, make excellent stocks for southern Iowa, Missouri and Kansas. Peach seedlings are largely and successfully used as stocks for the plum in milder plum-growing sections, while for the colder states they are to be avoided. The apricot has been tried as a stock for the American varieties of the plum but fails to make a permanent union with it.



Fig. 93.—Sprout of a plum root taken off with a piece of a parent root; the best way.

The soil for the plum should preferably be one that is thoroughly well drained and reasonably retentive of moisture,

but it will succeed in any good agricultural soil. The trees hold on well, even on quite gravelly ridges, but in such situations in dry years the fruit is exceedingly small and the trees make but little growth and are short lived.

Trees and planting.—It is best to set only young trees, that

is, those under three years. Plums that have made a strong growth may be set at one year old. Most planters prefer them at this age as they are cheaper and easier to plant out than older trees. Plums are generally planted from 16 to 20 feet apart each way and for some dwarf varieties the smaller distance may be sufficient, but for the stronger growing kinds twenty feet is little enough between them. As a rule a better plan than planting equi-distant apart each way is to plant the trees



Fig. 94.—Old plum tree pruned in order to renew the top.

16 to 20 feet apart in rows forty or fifty feet apart and grow some other crop between.

Mixing Varieties.—There is some uncertainty as to the flowers of the plum. Some varieties are generally, if not always, self-fertile, while others are commonly, if not always self-sterile. These qualities seem to vary more or less, according to location and soil. Much disappointment has arisen from the

planting of self-sterile kinds singly, as, notably, the Wild Goose. It can be laid down as a general rule, and it will apply especially to the native kinds, that varieties of the same time of flowering should be mixed in orchards.

Cultivation.—Good cultivation is as essential in the plum orchard as with other kinds of fruit. The best growers agree that spring plowing, followed by shallow cultivation during the summer, and the planting of a cover crop in July or August will give best results. Growing the trees in sod will lessen the size of the fruit. Frequent cultivation during the spring months will keep down the sprouts which are likely to come up around plums which are on Americana roots.

Pruning.—The European plums usually make good heads and need little pruning. On the other hand, many varieties of American and Japanese plums are of a very sprawling and awkward habit of growth and require severe heading in to keep them in good shape. Pruning should be done regularly, so that it will not be necessary to remove large limbs. The larger wounds are quite likely to become diseased if they are not painted or covered with grafting wax. Broken or split branches, which are often found on plum trees unless the fruit is properly thinned, should be removed at the first opportunity.

Thinning.—Proper thinning is even more essential with plums than with most other fruits. Nearly all varieties have a tendency to set many more fruits than the trees can mature properly. Thinning increases the size of the individual fruits and their market value, and saves many broken limbs. Overbearing may even shorten the life of the tree, particularly in the Japanese varieties. The fruit should be thinned after the June drop, the proportion of the fruit which is removed being a matter which the grower must settle for himself. The fruits should not be less than five or six inches apart on the branches.

Picking.—The European plums should be picked with the stem on; the American plums naturally become detached from the stem at maturity. The fruit may be either a free stone or a cling stone and examples of each are found among the different classes of the plum. (The word "prune" is applied to a class of plums having firm flesh and a larger per cent of sugar

than the ordinary plum, which dries readily.) Some of the best plum growers practice thinning the fruit. The time when the different varieties come into bearing depends much on the peculiarities of each sort. The different classes of plums usually bear fruit in three years.

Packing and Marketing.—Plums are sold either in berry boxes, in ten-pound baskets, or in special boxes or baskets. The usual method of marketing Americana plums is in quart boxes or in half-bushel or bushel baskets. Only the fancy fruit should be put in boxes. The ten-pound grape basket is a common package in the East for the European varieties. Western plums and prunes are usually shipped in small baskets or flat boxes, the individual fruits often being wrapped in paper.

Insects.—The insects most injurious to the plum are the Curculio, Peach Borer, Tent Caterpillar and Leaf Lice, which see in chapter on Insects.

The diseases especially injurious to the plum are Brown Rot, Plum Pocket and Leaf Curl. Plum Knot and Shot Hole fungus are discussed under the head of diseases.

The varieties of the plum are many and various. In the great plum growing sections of the Pacific Coast the principal kinds grown are Burbank, Climax, Clyman, Satsuma, Wickson, Yellow Egg, Grand Duke, Washington, Blue Damson.

In the Northeastern states the principal varieties grown are Lombard, Abundance, Wildgoose, Burbank.

The varieties best adapted to Minnesota and the surrounding states are Wyant, De Soto, Wolf, Stoddard, Surprise, Cheney and Forest Garden.

Cherry.

The cultivated kinds of cherries probably came from the two species known botanically as *Prunus avium* and *Prunus cerasus*, both of which are natives of Europe and Asia, but in the centuries in which they have been under cultivation they have been crossed and recrossed until it is impossible to separate the varieties into their species.

The Different Classes.—The cultivated sorts are divided for convenience into two classes:

a. Kinds with sweet juice, including what are known as Mazzard and Hearts cherries. These are generally tall, rather erect growing trees. They do best in a somewhat moist climate, notably in coast states where the winters are not severe.

b. Kinds with sour or sub-acid juice, including what are known as sour and morello cherries, of which the Montmorency and Early Richmond varieties are examples. These types are usually low-headed, with spreading branches. They include the hardiest known varieties, some of which do well even in dry cold climates.

Prunus mahaleb, a slender, small tree bearing small, dark red austere fruit, a native of southern Europe, is sometimes found in cultivation. It is used for stocks upon which cherries are propagated.

The wild American cherries include the sand cherry (*Prunus besseyii*); the large choke cherry of the Western states (*Prunus demissa*), and the bird cherry (*Prunus Pennsylvanica*).

Location and Soil.—The cherry will succeed on a drier soil than most other fruits. It must have good drainage in both soil and air if it is to be successfully grown. In wet places or water-soaked subsoils it soon perishes. The best locations are on high land tipping to the north, as in a location of this sort growth does not start as early in the spring and the buds are not so apt to be injured by frost. A rise of even a few feet above surrounding land is desirable, if high land cannot be obtained. Cherries do best on a rather light sandy or gravelly loam. If the soil is very rich they tend to produce too much wood. The subsoil should be porous and well drained, neither clay hard pan or dry gravel. A good cherry soil should contain plenty of moisture early in the spring months and up to the time of ripening of the fruit, but after that only enough to ripen the wood slowly.

Planting.—The soil should be thoroughly prepared and in good working condition before the trees are set. The distance between trees will vary with the variety, climate, soil and rainfall. The sweet cherries on rich soil in a good location require from thirty to forty feet distance, while the sour cherries under the same conditions require about 400 square feet of soil or to be set 20x20 feet. If the soil is not very rich and is rather dry

a distance of from 25 to 28 feet for sweet cherries is sometimes used and of 16 to 20 for sour cherries.

The cherry should never be used as a filler. It requires different cultivation and attention than the apple or peach and hence should be by itself.



Fig. 95.—Sour cherry tree of good form.

Either the square or hexagonal system of planting are desirable. The square system gives a little more land to each tree and consequently less trees per acre than the hexagonal plan.

Time of Planting.—In mild sections where spring comes early and there are no late spring frosts, or where the rains continue late, planting may be done in the fall. In the colder sections, and in fact generally, early spring planting will be found to give best results.

Stock may be purchased in the fall and carefully heeled in over winter ready for early spring planting. The holes should be dug large enough so that the roots will go into them without

crowding. All bruised or injured roots should be cut off and the top cut back to correspond to this trimming. In severe climates it is well to set the trees from four to six inches deeper than they grew in the nursery. In some good cherry districts they are set only two or three inches deeper than they originally grew. Put in some rich black loam and lean the tree slightly to the direction from which the prevailing winds come. Tramp the soil firmly about the roots. Then add more soil and tramp it lightly, finally filling the hole and raking the top soil or leaving it loose and fine on top. Some water may be used in the bottom of the hole to help pack the earth if desired.

Age of Trees.—Good strong first-class one-year-old or low headed two-year-old trees should be used in planting. In the West one-year-old trees are preferred. In some other sections, two-year-olds with a good root system are used.

Cultivation.—For the first five or six years at least the orchard should be thoroughly cultivated. After that a grass or mulch system may be followed, though it is a question if cultivation is not better. Some vegetable crop may often be raised though it is not desirable to crop the ground too much. Cultivation should start as soon as possible in the spring and continue until the last of July or middle of August, when a cover crop should be sown.

If the trees are not making a good growth Canada peas or a vetch may be used; if the growth is too rapid and too much wood is being produced, rye may be sown. A bearing orchard should not be permitted to grow too vigorously in late summer, as late growth is made at the expense of fruit.

Propagation.—The cherry, in common with other fruits, does not come true from seed, though the seedlings are often of good quality. The seedlings are generally used as stocks on which to work named varieties. The pits should be managed as recommended for plum pits. Named varieties are propagated by grafting, budding or suckers. Cherries may be grown on a number of different stocks, but the Mahaleb (*Prunus mahaleb*) and the Mazzard, a strong growing variety of *Prunus avium*, are most often used. These are imported from France. Cions should be taken from healthy bearing trees, and if grafting is employed, the work

must be done early in the spring before growth starts. Budding is usually done in August.

The Mahaleb stock is hardier than the Mazzard, especially in a dry climate, and is used almost entirely as a stock on which to bud the sour cherries. It is too tender for severe climates.

The Mazzard is a native of eastern Europe and is used as a stock for sweet cherries. It is not hardy enough for severe locations. It may be used for root grafting, but budding is the method usually employed.

Where the cherry is on its own roots, suckers may often be taken and planted to advantage. It is a poor plan to follow with grafted or budded stock, however, as the quality of the plant is usually not known.

A few varieties may be grown by cuttings, but it is a rather uncertain method and is seldom used.

Top-working.—In some sections where the body of the tree is apt to suffer from sunscald or other trouble, varieties may be grafted on resistant trees to advantage. The work must be done early in spring before the buds start.

Pruning.—The cherry needs only enough pruning to keep the tree in shape. In Russia it is grown in bush form and when it becomes too old to be profitable the old parts are cut away and new sprouts take their places. The important thing to remember in connection with this, as well as all other stone fruits, is that they should be trained low.

Picking and Marketing.—Cherries must be picked by hand as soon as they begin to color in order to have them ship well. They require very careful handling, although there is a difference in varieties in this respect. They must not be poured from one receptacle to another.

They should be packed immediately after picking, precooled and shipped at once. One day lost in starting or in transit may mean a considerable loss when the fruit is put on the market. Cherries are usually packed in ten pound boxes, or in the case of sour cherries, in quart boxes or market baskets.

Insects and Diseases.—The insects and diseases affecting the cherry are much the same as those affecting the plum.

Among the worst of these pests are the curculio, which stings the fruit; the leaf slug, which injures the foliage; borers which work in the trunk; and brown rot, which is often very destructive to the fruit just as it is ripening.

These and other pests affecting the cherry will be found described in the chapters on Insects and Diseases.

Varieties.—Among the sweet cherries Lewelling, Napoleon, Royal Duke and Windsor are probably the best. Montmorency, English Morello and Early Richmond are good varieties of sour cherries.

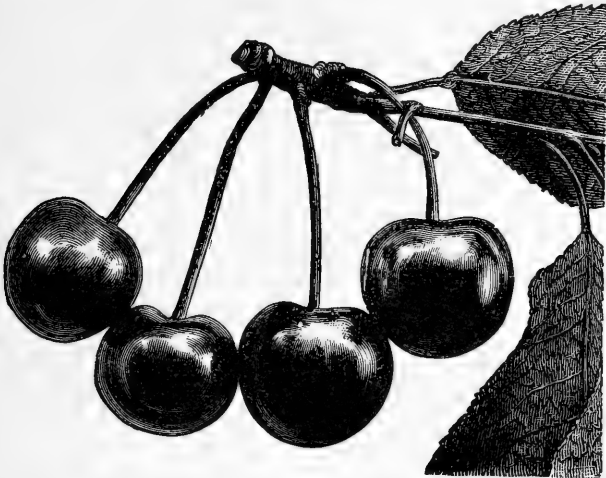


Fig. 96.—English Morello, one of the best cherries for the North.

Peach.

The peach is one of the most uncertain of our cultivated fruits. It is highly esteemed and is used almost entirely as a luxury by the greater part of our people. It is nowhere adapted to great areas, although widely grown in a small way. It is grown in a large commercial way in a few favorable sections, among which may be mentioned: 1. The section along the south shore of the Great Lakes, including portions of southern Michi-

gan, New York, Ohio and southern Canada; 2. Long Island and portions of Connecticut, southern New York, New Jersey, Delaware and Maryland; 3. Further south there is a great peach section in the highlands of northern Georgia, Alabama, etc.; 4. Southern Illinois, Missouri, and portions of Kansas, Iowa and Nebraska; 5. Parts of Texas; 6. Parts of eastern Colorado; 7. A large part of California.

The northern limits of successful peach growing in New England is perhaps central Massachusetts, and even in southern New Hampshire peaches are raised in favorable years. In the Mississippi Valley peaches are raised as far north as southern

Iowa. However, as the northern limits of peach raising are reached, the crop becomes uncertain, owing chiefly to the killing of the fruit buds in winter, which will generally stand a temperature of over 25 degrees below zero if the wood is well ripened in autumn. The flower buds are much more tender than the leaf buds and are often killed without injuring the growth of the trees. On rich soils, especially on those that are liable to be moist, the peach grows too late in autumn and the flower buds will kill in such locations even when uninjured



Fig. 97.—Protecting peach trees. Peach tree tied up, ready for winter covering. (After Whitten.)

on higher, drier, and perhaps poorer, soils. In central Iowa the planting of the hardiest kind of peaches has been attended with some success.

Laying the peach trees down in winter.—In northern Iowa and southern Minnesota a few peaches are grown each year by

bending the trees to the ground in winter and covering the tops with corn stalks, marsh hay or similar material. The wood of the peach is exceedingly brittle but the roots are very tough and the trees are bent in the roots by digging a hole at the side of the tree deep enough to reach the pliable portion of the root. Forked roots are preferred on peach trees that are destined to be treated in this way, as their roots are smaller, and hence do not get stiff as quickly as these grown to one central shoot.

Origin.—The peach is native of Asia, but was introduced into America at a very early date, and in the last century was spontaneous over a large area of country in the mountainous



Fig. 98.—Protecting peach trees. Peach tree covered with corn stalks. (After Whitten.)

section of the Southern states. While there are many forms of the peach, they are all classed as coming from the same species, *Prunus persica*. Professor R. H. Price, in the report of the American Pomological Society for 1903, classifies the various kinds of peaches under five heads, although he says that some varieties cannot be placed in either, and that the practical application of this classification lies in the fact that the grower should not be concerned so much about what varieties he has as about having the varieties he plants of the proper group for his location. The following classification is taken from this article;

(a) Peen-to group. This is distinguished by its vigorous willow-like branches. Flowers appear very early; fruit flattened and much like an oblate apple; stone flattened in an opposite way from that of the ordinary peach; leaves narrow and long and hang on in winter. They are adapted especially for the Southern states and near the coast. Angel and Waldo are varieties of this group.

(b) South China group. The parent of this race is the variety Honey, which is supposed to have come from South China. The tree is smaller than the Peen-to. Valuable seedlings of this group are Climax and Coleman.

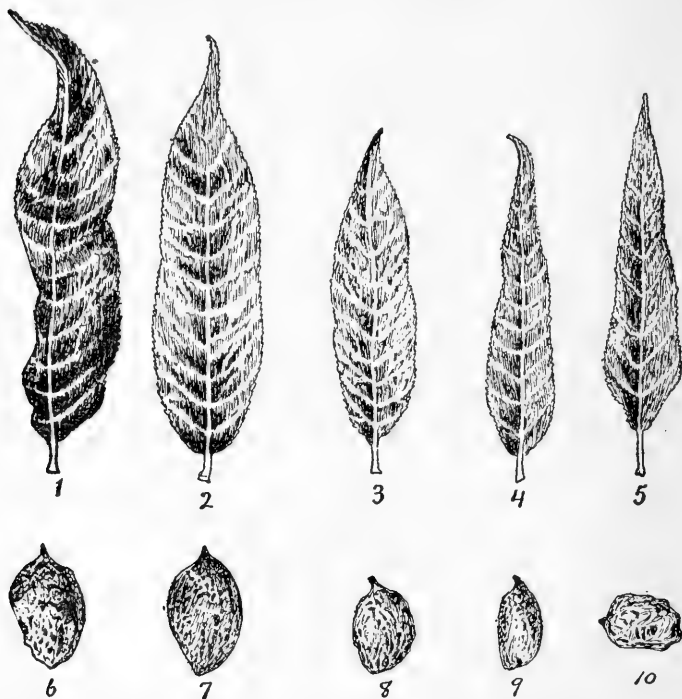


Fig. 99.—Leaves and pits of the different types of peaches. 1.—Persian. 2.—North China. 3.—Spanish. 4.—South China. 5.—Peen-to. Pits numbers 6, 7, 8, 9 and 10 are of the same type as the leaves over them. (After Price.)

(c) Spanish group. The tree is the largest of all supposed to have been introduced by the Spaniards; leaves small, flat, and hang on late in autumn; fruit ripens late and nearly always downy; tinged with yellow; nearly always acid and of low quality. This variety bears heavily in the district to which it is adapted, which includes the Southern and South Central states. Among the varieties belonging to this group are Galveston, Guadaloupe, Onderdonk and Victoria.

(d) North China group. The parent of this group is the Chinese Cling which is supposed to have originated in North China. The tree is of medium growth; flowers large; fruit large and white with a red blush. Such varieties as Elberta, Mamie Ross and Carmen belong to this group. These are raised in enormous quantities on the high lands of the Southern states.

(e) Persian group; of unknown parentage, but is supposed to have come from the high altitudes of Persia. Tree is medium in size; flowers varied in size; foliage nearly always crimped, trough shaped and fall off the tree early in autumn. This tree needs a long period of rest. Well known varieties of this group are Crawford, Alexander, Mountain Rose, Oldmixon Free and Oldmixon Cling. This group includes most of the varieties that are successful in the North.

Propagation.—The peach is sometimes grown from seed. Some varieties come so nearly true from seed that they are propagated in this way, but it is an uncommon method with commercial varieties. Budding is the common and almost exclusive method used in growing the peach although success often attends grafting, which is of convenient use for working over in the spring those budded plants on which the buds failed to take. In the South the peach stocks are commonly budded in June and make large, full sized trees by the end of the first autumn. In the North the peach is usually budded the first year in August when the seedlings will be about two feet high, and the stocks are cut back the following spring. June budding at the North is not popular, as the resultant plants are too small.

The seed must be stratified over winter and then cracked in the spring, if not already open, and the kernels planted. Vacancies in the nursery row may be filled from the seed bed

when the seedlings are very young. Seedlings from natural fruit are preferred for stocks from sections where the peach is healthy and free from yellows. A favorite place for obtaining peach seed is from Tennessee and Kentucky where the peach grows in thickets. Plum stocks are sometimes preferred for the peach where it is grown in heavy, moist soil but are seldom used in commercial peach growing.

Planting.—The trees for planting out should be one year old from budding, small but not weak. They should be trimmed to a straight shoot one to three feet high and all side branches removed at planting, making them appear as a mere whip stick. This facilitates forming the head. It saves freight and packing if they are to be shipped long distances, to have this done before they are shipped. Trees more than one year old are not desirable for orchard planting. At the North peach trees should be set out in the spring. The distance apart will



Fig. 100. Pruning peach trees. a.—Before pruning. b.—After pruning.

vary with the locality, soil and variety. In a general way it will be found that 15x15 feet apart is about right. Some growers put out twice as many trees as can grow well to maturity. In such cases they must be thinned out when they commence to crowd one another.

Pruning.—On inferior soils, such as those of parts of the peach region of Michigan and the Maryland peninsula, it is customary to do but little pruning and the trees are allowed to branch close to the ground and form rangy heads. On better soils it is quite customary to cut back the new wood severely after the tree is formed, cutting off from one-third to one-fourth of the new growth and the weak wood out of the interior of the tree. This thins the fruit by removing many fruit buds and keeps the tree in compact form. When the trees are injured

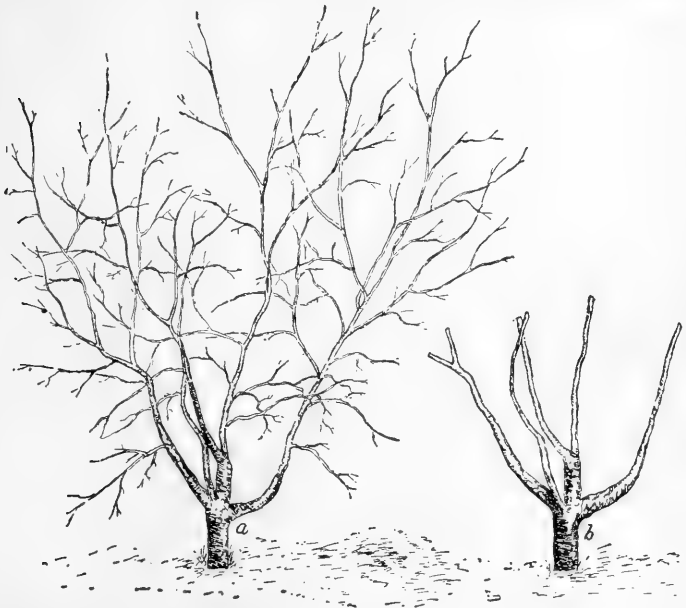


Fig. 101.—The proper method of pruning peach trees injured in winter. a.—Before pruning. b.—After pruning.

in the winter, they recover most quickly, if at all, by being cut back severely.

Location and soil.—The peach grows well even in quite poor soil. In very rich soil it is liable to grow late in autumn and the buds kill in winter. Some of the best orchards are on very poor soil. It does best on high ridges, especially in locations exposed to the north and west. Southern slopes are liable to start the buds too early. Where late spring and early autumn frosts are prevented by proximity to water, as in Michigan, the peach does well at the north, but as the northern limits of peach growing are reached, extra skill is required to grow it.

Thinning the fruit.—If the close pruning referred to is followed, many fruit buds will be cut off and thus the crop is thinned, but in addition to this, special thinning is most important with the peach. If it sets fruit at all it generally sets too much, and if all is allowed to grow the tree is weakened and the fruit becomes small and poor. Trees that are thinned generally yield as much fruit in quantity and that of much better quality than trees not thinned. In thinning, take out all curculio-stung and imperfect fruit as they are of no value. Thinning should be done as soon as the imperfect fruit can be determined and after the natural fall of small fruit has taken place. Thin to from four to six inches apart on the branches. It often requires much will power to do this, as such thinning will seem excessive at the time it is done.

Peach trees bear young, not infrequently at two years old. The fruit of the peach is used fresh, for canning, evaporating and as a kind of cider which yields brandy by distillation.

Insects and diseases.—The trunk of the peach tree is frequently injured by the Peach Borer, and the fruit by the Curculio. The diseases of the peach are as follows: Brown Rot, Leaf Curl, Scab, Postular Spot, Yellows, Rosette, Little Peach.

Varieties.—There are many varieties of the peach. Growers must study the conditions in their own localities and the adaptation of varieties to them. The most important varieties in the North are Elberta, New Prolific, Kalamazoo, Smock and Triumph. Those most important in the South are Alexander, Carmen, Elberta, Greensboro, Mountain Rose and Sneed.

Nectarine.

The nectarine is a smooth-skinned peach. It is interesting to know that peaches have been grown from the seed of nectarines and nectarines from the seed of peaches. The fruit is usually inferior to that of the peach in size, quality and appearance. It is grown the same as the peach but not nearly as successfully, and is liable to the same insects and diseases. It seems to do best in the Pacific Coast states.

Apricot.

The apricot is a fruit somewhat intermediate between the peach and the plum. The bark resembles the peach but the leaves are very broad and almost circular.

Origin.—The apricot commonly cultivated in Eastern and European gardens is a native of Asia. Botanically, it is known as *Prunus armeniaca*. The Russian apricot is a hardy form of this species having small fruit. There are a few varieties cultivated that belong to other species but they are of poor quality and of little importance, except the so-called Chinese apricot plum (*Prunus simoni*) of Asia which is referred to under the head of plums. The apricot is as hardy as the peach and thrives under the same soil and climatic conditions but prefers a rather heavier, although well drained soil. The apricot is grown in Europe and in a large way in the Pacific Coast states. In the Eastern and Central states it has not been much planted because its early period of flowering makes it susceptible to injury from frost and the liability of its being injured by *Curculio* has made the crop so uncertain that the peach has taken its place.

Stocks.—The apricot may be grown on seedlings of the European plums and on the peach. It is said that apricot stocks are not as good as either of these, especially on land that is liable to be very wet in the spring. Some experience seems to show that the apricot does not work well on the *Prunus armeniaca*.

Planting and pruning.—The apricot requires about the same care in planting and pruning as the peach. However, it does not need quite such close pruning but only enough to keep it in good form.

Picking and marketing is much the same with the apricot as with the peach. However, it is generally looked upon as a dessert fruit and is generally marketed in small packages.

Insects and diseases affecting the apricot are practically the same as those that attack the peach but it is more liable to injuries from the Curculio, which must be carefully held in check by jarring and clean cultivation. Arsenical sprays cannot be recommended as the foliage is too susceptible to injury from them.

Varieties.—The most popular varieties of the larger apricots are Moorpark and Royal. Of the Russian apricots the best are the Gibb, Budd and Alexander, but they are little grown.

QUESTIONS—CHAPTER XII.

Stone Fruits.

1. What fruits are included under the head of stone fruits?
2. What is the distribution of plum growing in the United States?
3. What is the origin and distribution of the Domestica plum?
4. What varieties belong to the class and what are their characteristics?
5. What is the origin of the Myrobalan plum?
6. What varieties belong to this class?
7. What is the origin and distribution of the Japan plum and what varieties belong to the class?
8. What is the origin and distribution of the American plum?
9. What varieties belong to the class?
10. What is the origin and distribution of the Wild Goose class of plums and what varieties belong to the class?
11. What is the origin of the Chicasaw group of plums?
12. What varieties belong to this class?
13. Into what groups does Bailey classify the plums?
14. What are the characteristics of each?
15. In what ways may the plum be propagated?
16. What is the common way of propagating the American sorts? The European? The Japanese?
17. What stocks are used for grafting the varieties?
18. What kind of soil is best for the plum?
19. How should the trees be set out?
20. Why should varieties be mixed in an orchard?
21. How and when should plums be picked?
22. What insects are injurious to the plum?
23. What varieties are grown in the Pacific Coast states? In the Northeastern states?
24. What varieties are best adapted to Minnesota?
25. What are the general classes of cherries?
26. What soil and location are most suitable for cherry growing?
27. How far apart should cherries be planted?
28. When and how should cherries be planted?
29. What care should be given a cherry orchard?
30. How is the cherry propagated?
31. How should cherries be picked and marketed?
32. What are the most important varieties of cherries?

33. In what sections of the United States is the peach grown commercially?
34. How far north is the peach grown successfully?
35. What is the effect of good soil for peach growing in the North?
36. How are peaches protected in winter?
37. What are the characteristics of peach wood? Of peach root?
38. What is the origin of the peach.
39. Into what groups may peaches be divided?
40. What is the origin and characteristics of each class?
41. How is the peach propagated in the North? In the South?
42. How and when is the peach budded?
43. How are peaches set out in the orchard?
44. What pruning of peach trees is necessary? On poor soil? On good soil?
45. What location and soil is best adapted to peach growing?
46. How should the fruit be thinned?
47. For what purpose is the fruit used?
48. What insects and diseases are injurious to the peach?
49. What are the important varieties grown in the North? In the South?
50. From what did the nectarine originate?
51. How is it grown?
52. Where did the apricot originate?
53. Over what territory is it distributed?
54. What are its characteristics?
55. What trees are used as stocks for the apricot?
56. How are apricots planted?
57. What pruning do apricots require?
58. How is the fruit picked and marketed?
59. For what is it used?
60. What insects and diseases are injurious to the apricot?
61. What are the most popular varieties?

CHAPTER XIII.

THE GRAPE.

Origin.—There are about twenty species of wild grapes in America and but few of them have been fully tested under cultivation. No part of habitable North America is found without some native species and in many sections these are important fruits in their wild state. The grapes commonly cultivated in this country east of the Rocky Mountains are of native origin but in the Pacific Coast states the best European grapes are grown in great perfection. They are also grown under glass. The species commonly grown in vineyards in this country are as follows:

(1) **Northern Fox Grape** (*Vitis labrusca*), the species from which almost all of our popular varieties have sprung. Examples of these are Concord, Worden, Moore's Early and Lady. As found in its native state, it has a large purple fruit, thick skin, and very pulpy meat surrounding the large seeds. The flowers are either perfect or staminate; the leaves are large, with whitish down on the underside. It is found occasionally in the southeastern part of Minnesota, and very abundantly in states farther east and south and in parts of Canada. The Concord grape resulted from the selection of seed from a wild vine which had been cultivated for two generations by Ephraim Bull of Concord, Massachusetts. Seedling Labrusca grapes are frequently white or greenish in color. The cultivated grapes of this class have perfect flowers with well developed stamens. They also cross readily with the European wine grape, the River Bank and several other native grapes.

(2) **River Bank or Frost grape** (*Vitis riparia*), the common wild grape found far north in Canada and in the northern United States, is as yet scarcely cultivated, but it is probable that some of its hybrids will prove valuable for cold locations. This grape has thin, smooth foliage, green on both sides; short jointed wood and perfect or staminate flowers. The vines bearing the staminate flowers generally make an extremely rapid

growth and produce a great number of delightfully fragrant flowers but no fruit. This species, when crossed with the *V. labrusca*, has given us Beta and Janesville, two varieties of great hardiness. From this source will probably come the hardy grapes for the colder portions of the United States and Canada.

European Wine grape (*Vitis vinifera*).—To this species belong most of the cultivated grapes of Europe and Asia. Its flowers are either perfect or staminate. It has been cultivated since the remote past and has given rise to a large number of kinds having widely varying characteristics, but none of these have been successfully cultivated in the open air in the portion of North America lying east of the Rocky Mountains, although they have been grown successfully in California and some adjacent states. The reason for this is undoubtedly the susceptibility of the roots of this species to attacks of the grape vine root louse (*Phylloxera*) which is abundant over a large part of eastern North America, but to the attacks of which the American vines are largely immune. This pest has of recent years been introduced into both California and Europe, so that many vineyards in these sections have been of necessity grafted on American roots to stem its ravages.

Hybrid American grapes.—The poor success attending the introduction of varieties of European grapes led to early attempts at crossing them with native Fox grape (*V. labrusca*). Among the first and most successful of these were the crosses made by E. S. Rogers of Salem, Mass., who originated and distributed a large number of varieties, some of which still remain in cultivation. These are known as Rogers' hybrids and include such well known and productive sorts as Lindley, Agawam, Aminia, Herbert, Barry and Salem. These have been largely replaced by the pure *labrusca* sorts of more recent introduction which are nearly or quite as good in quality and less liable to disease in ordinary locations.

Prof. T. V. Munson of Denison, Texas, has paid special attention to the development of varieties of grapes adapted to the Southern and Southwestern states and has sent out a large number of good varieties. Among them are the following: Carman, Headlight, Brilliant and others. In his work he has used

a large number of little known species in addition to those mentioned. Among them are the following: *V. rupestris*, *V. solonis*, *V. doaniana*, *V. Champini*, *V. candicans*, *V. bouquiniana*, *V. lincecumii*, *V. aestivalis*, *V. berandieriana* and *V. rotundifolia*.

Flowers of the grape.—In the wild state some species of grapes produce some plants that have perfect flowers and others that have staminate flowers. Our cultivated kinds, that are not the result of crossing distinct species quite uniformly, have perfect flowers and no crossing is needed to make them productive. The sorts that have originated from the crossing of two or more species, such as Brighton and Lindley, often have flowers in which the stamens are reflexed. Such stamens seldom if ever produce germinable pollen and hence must be supplied with pollen from other vines. When this is not supplied the flowers generally fail to set fruit, or if they set fruit at all it is very small and seedless.

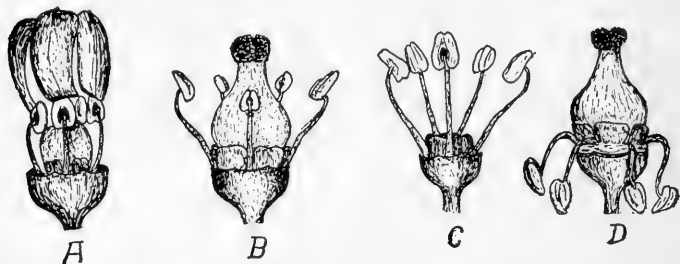


Fig. 102.—Flowers of the grape. a.—Flower just opening, with cap pushed off. b.—Perfect flower. c. Staminate flower. d.—Flower with reflex stamens.

Propagation.—The grape is increased from cuttings and layers and, to a very limited extent in this country, by grafting. In California it is considered good practice to graft the European kinds on American roots to avoid the phylloxera.

By seed.—Propagation by seed is used for growing stocks and to obtain new varieties. If vines are to be grown in this way the seed should be at once sown in boxes of rich soil, or in a fine seed-bed. (The seed should be saved from ripe berries). Cover it half an inch deep and protect by a mulch in winter. The plants will make a growth of one or two feet

the first season and will show blossoms about the fourth year. Some will have perfect and some staminate flowers, while others will have flowers with reflexed stamens; not one seedling in a thousand will be worth anything for fruit. The chances for obtaining good kinds will be much increased if careful, intelligent hybridization is resorted to.

By cuttings.—Grape cuttings are of three kinds—long and short hard-wood cuttings, and soft-wood cuttings. The processes by which they are rooted vary greatly in details but the general principles are the same in every case.

Long hard-wood cuttings.—These should be made in the fall from the hard, well-ripened new wood of the season. It is best to make them about eight inches long, if wood is abundant. The length will necessarily depend somewhat on the distance between the buds on the canes, and when three-bud cuttings are made of some varieties they may be ten inches long. They are often made six inches or less in length, but as short as this they are more liable to fail from drying out than if longer. They will send out roots best if cut just below a bud, but this is not necessary. These cuttings should be put up in bundles of about one hundred each. Bury them in some well-drained place with the tops down, and cover with about six inches of soil and a foot or two of mulch. Be sure the soil is packed firmly around and between the bundles, so that they cannot dry out in winter. In the spring, when the ground is dry, take all but about three inches of the soil from over the cuttings and replace it with about one foot of hot stable manure, to induce the cuttings to callous. This is very necessary to insure their rooting, and they should never be planted out until well calloused. The same object may be secured by covering the cuttings with a box and sash, which will confine the sun's rays and so warm the roots that they will start a callous. When the soil is settled and warm they should be planted out six inches apart, in rows two or three feet apart, putting the cuttings down to the top bud. They should be put at least seven inches deep in most locations.

The land for cuttings.—The land selected for growing grape cuttings should be warm, light and rich. Its condition will be

greatly improved if it is warmed by being plowed several times and has a coat of fine, warm manure turned in before planting. When planting on a large scale the land may be marked off with a line, and a sub-soil plow run eight inches deep in the mark to loosen the soil, after which cuttings can easily be pushed into place by hand. The after-cultivation consists in continually working the top soil and keeping it loose and open. In the fall, if the plants are weak, they may be covered with earth and left where they are for another season's growth; but if strong, they may be dug and used for vineyard planting the following spring. It is customary to dig all the vines late in the fall, carefully sort them and heel them in outdoors for winter, or else put them in a cold cellar. In the spring the strong vines may be used in the vineyard and the weaker ones be set out in the nursery to grow another year. (See p. 152 on growing cuttings in chapter on Propagation).

One-eye cuttings.—The wood for these should be cut in the fall and wintered over in a cold cellar buried in moss, sand,

sawdust, or other similar material, or it may be buried outdoors. In the spring, generally in February or early in March, these canes should be cut up into pieces having one inch of wood below and half an inch above the bud. Boxes about the size of an ordinary soap box, but only four inches deep and having holes for drainage, should be prepared by putting in one and a half inches of rich soil and then about the same amount of clean sand on top of it.



Fig. 103.—One year old grape vine from one-bud cutting.

The cuttings should be set deep enough in the sand to just cover the bud, putting them two inches apart each way. The boxes

may now be put in a gentle hot-bed, or on a greenhouse bench, and kept moist. They should be rooted in about six weeks. When they have made a good root growth they should be planted, after the soil is warm, in rich soil outdoors. The time for this will be as late as the latter part of May in this section. Very nice plants may be grown in this way, but they do not make as strong a growth the first year as plants from long cuttings, and often need a second year in the nursery before they are large enough for transplanting to the vineyard.

Soft-wood cuttings.—These are made from the green wood taken off while the plant is growing. They are rooted in sand in much the same way that florists root cuttings of geraniums, fuchsias, etc. It is a method used only where wood is very valuable, and as a means of increasing new varieties. Plants grown this way are apt to start slowly and to be weak until well started, and should not be used when those grown from hard-wood can be obtained.

Layering.—This is the simplest, surest and easiest method of increasing the grape, and is the best way to grow it where but few vines are wanted. There are two kinds of layers, called spring and summer layers from the season in which they are made.

Summer layers are made in the summer, generally the last of July, from a branch of the same season's growth. They are likely to be weak for several years, and do not make as good plants as spring layers. In making them the wood should be slit for an inch or so near the buds that are covered. Bury about one foot of the cane four inches deep in the ground and it will be rooted by late autumn, when it may be treated as

recommended for weak yearling vines grown from hard-wood cuttings.

Spring Layers.—These may be made by laying down any cane early in the spring. It will root in one season and by fall will have made a good growth of roots, when it may



Fig. 104.—Ordinary layer of a grape vine.

be cut from the main cane, and if strong enough may be divided into two plants. By a little different treatment of the spring layer, a vine may be grown from each bud on the layered cane. For this purpose some thrifty cane should be selected in autumn, pruned of its laterals and buried. In the spring it should be uncovered and only one shoot permitted to grow from each joint. After the new growth has started about six inches from each bud, the whole cane should be layered about four inches



Fig. 105.—Ordinary layer of grape cut apart and made into two plants.

deep, handling it carefully so as not to break the new growth. Fig. 106 shows such a layer after it has rooted. It is a good plan to cover it not more than three inches at first and to fill up the trench as soon as the shoots grow. It covered four inches deep at once, the young growth will

sometimes rot, though this seldom happens, and some skillful growers fill the trench full at once. In the autumn roots will be found growing from each joint and these may be cut apart and treated as recommended for weak vines grown from cuttings. If this method of propagation is to be used to some considerable extent, vines should be grown especially for the purpose. It is not a good plan to use fruiting vines for layering to any great extent, though it may be safely done in a small way. For directions as to grafting the grape see chapter on Propagation.

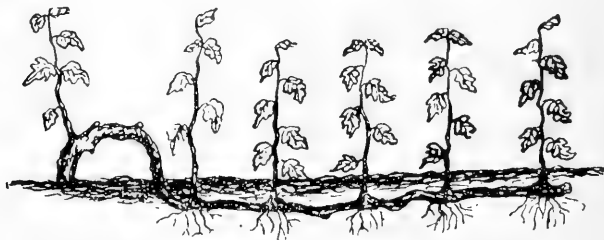


Fig. 106.—Layering grapes. Showing how to get a plant from each bud of the cane layered,

Location of the vineyard.—Some of the hardy, early ripening but inferior grapes will mature in almost any situation, but the better kinds need a warm exposure and free circulation of the air about them to insure their ripening each year. High southern slopes generally offer the best locations; in such places there is the greatest amount of heat in summer, very general immunity from the late frosts of spring or the early frosts of autumn, and a movement of the air at all times; all of which are important matters in growing grapes. Other slopes, and even level land, may be successfully used for this purpose, but on northern exposures, the fruit will be later in ripening than if in situations where the plants receive the direct rays of the sun. However, excellent fruit may often be grown on a northern slope if it is near some large body of water, which will help maintain an equal temperature, and especially to keep off the early frosts of autumn. In a vineyard closely shut in so that the foliage of the vines does not dry off quickly after summer showers, it will be found very difficult to grow many of our better kinds of grapes on account of the prevalence of fungus diseases in such places. The cutting away of a belt of trees surrounding a vineyard, so as to allow a free movement of air through the vines at all times, has often been the means of making the difference between failure and success in growing grapes.

Soil.—The best soil for a vineyard is a rich gravelly or sandy loam, with an open clay sub-soil; but a somewhat clayey loam will do very well if sufficiently drained to remove excess of moisture. Before planting, the land should be thoroughly prepared by plowing and harrowing until in the best condition. Where there is not good surface drainage, as on some prairie farms, it will be found a good plan to plant the vines on ridges made by turning six furrows back to back. In other locations the land should be kept smooth. A limestone soil or loess loam is almost ideal for the grape.

The best vines for planting are strong one-year or thrifty two-year-old plants from layers or cuttings, and only those having a good root system should be used. Plants more than three years old are not desirable, as young, thrifty plants soon out-

grow those that are old and large when transplanted. It matters little about the direction of the rows; they should be laid out so as to prevent erosion as much as possible.

The proper distance between the plants will depend somewhat on the vigor of the kinds planted, the manner of pruning, and the soil; but the strong growing varieties, which are most desirable, should generally be set ten by ten feet apart each way, or in some cases eight feet apart in rows ten feet apart, to allow for the growth of roots and a good circulation of air between the vines. When the vineyard is much shut in it will be found advantageous to increase this distance, but when located in an airy position and on retentive soil the plants may be set eight by eight feet.

Planting.—The most rapid way of planting grape vines is to furrow out the land one way and mark the other, putting the vines at the intersection of the furrows. Before planting, the tops of the vines should be cut off so as to leave only two or three buds, and if the roots are very long it will facilitate planting to cut them back to twelve inches in length; shortening the roots to this extent does not seem to injure the growth of the plant. On light soil and on hillsides it is exceedingly important to get the roots down deep in the land, and the holes should be made large enough to allow the lower roots to come about fifteen inches below the surface. The top loam should be put around the roots, but the plants should not be covered at once more than two inches deeper than they grew in the nursery. The soil should be gradually worked in around the vines as they grow until the holes are full. On heavy soils, especially those quite moist, it is not safe to plant deep, and eight inches will probably be found about the right depth in most locations. In planting vines to be pruned on the one-cane system, it is best to incline them somewhat in the direction in which they are to be trained on the trellises. This should be in the direction of the prevailing summer winds.

Cultivation.—Soon after planting, the vines should be well cultivated, and some hoed crop that will not shade them may be grown between the rows for the first two years. After this the vines will need all the land. Cultivation should consist of

a shallow plowing early each spring and during the summer. The top soil should be kept loose and light by shallow cultivation. Deep cultivation or much cultivation late in summer is not desirable in a vineyard, and it may cause serious injury by encouraging a late growth. If the land is lightly plowed each spring no large surface-roots will have time to form; but if this is neglected for several years large surface-roots will get started, and then plowing may seriously injure the vines.

Pruning and training are the great bugbears to amateurs in grape growing, and the attempt to follow some peculiar method has done more than anything else to discourage the growing of this fruit by farmers. As a matter of fact, vines will grow and bear fruit without any pruning whatever. Pruning is done simply to get the most good fruit from the least amount of vine, and for practical purposes it is a very simple matter. There are, however, many systems described in books, and occasionally used in practice, that are quite complicated and difficult for a beginner to understand and even for the experienced to carry out in practice. The practical points to have in mind in pruning grapes are: (1) That the old wood which has borne fruit once never bears again. (2) That the wood that is formed one season produces the bearing wood for the next season. (3) If all the new wood is left on the vine it will bear ten times more clusters than it can properly develop, and they will be small and imperfect.



Fig. 107.—Grape vine pruned and covered for winter at the end of first year. With extra strong vines the formation of the vines is started the first year.

(4) If nine-tenths of the new wood is cut away, leaving only from thirty to fifty good buds to each vine, the yield of good grapes will be much increased. (5) It is desirable in severe climates to train the vine so that it can be laid down on the ground with but little resistance, for in such locations it is necessary to protect it each winter.

If these points are borne in mind it matters not so very much what system is pursued in pruning. However, it will be found most convenient to adhere somewhat clearly to some simple system of pruning. But whatever plan for after-

training is adopted, the care of the vine for the first two years should be about the same.

The first year no support or pruning is needed. The vines will ripen their wood as well on the surface of the ground as if tied to stakes, but it will be more convenient about cultivating if they are staked. Late in the autumn of this year, all of the vines should be cut away except three or four buds as shown in fig.107, unless the wood is exceedingly firm and ripe, in which case it may be practical to start forming the vine the first year. The vine should be covered with a mound of earth four or five inches deep. Later on, before severe weather sets in, it is a good plan in the more northern states to apply a covering of mulch two or three inches in depth, of straw or litter of some sort. This mulching is absolutely necessary to insure the wintering of newly transplanted vines.

Trellis.—The following spring, a trellis should be built unless stakes were set the first year, when they may be used again and the work of putting up a trellis be deferred until the opening of the third year. The most desirable kinds to use will depend upon the method of training followed.



Fig.108.—Spur of a Grape Vine.

Spur is a term used to indicate the short stubs of the lateral canes that remain on the main cane after pruning, from which

the new growth starts. It is generally desirable to keep the spurs as short as possible.

Systems of Training and Pruning the Grape.

There are two fundamental systems used in training the grape, which underlie all methods in common use. In one system the shoots are trained upward from the cane. This is called the **upright system** and embraces a large number of methods. In the other, or **drooping system**, the shoots are allowed to hang

naturally from the cane from which they grow. The upright methods have been more widely used than the drooping methods although they are more expensive in practice, since they generally require a more elaborate trellis and the labor of pruning and training is much greater. Further, some of our strong growing vines produce more fruit when trained on the drooping than on the upright system, but there is still quite a difference of opinion among commercial growers as to the relative merits of each, so it is certain that good results are obtained by both of them.

The single post method is the simplest method of pruning the grape on the upright system. In this, generally two canes

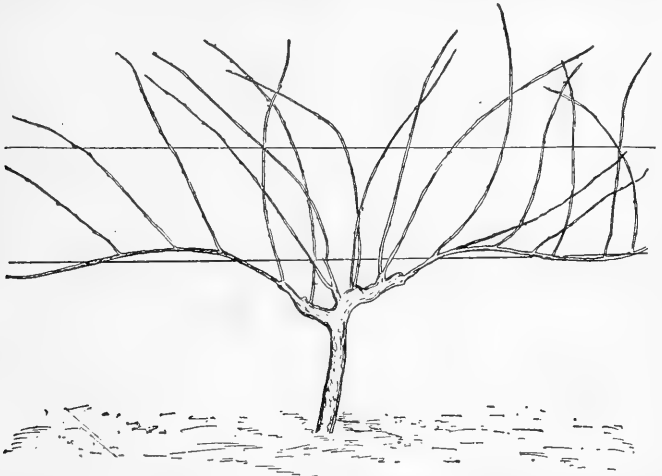


Fig. 109.—Pruning grape vines. Vine treated on high renewal system at end of the season.

are selected and wound about the post, each in opposite directions and tied in place. In pruning in after years these canes are preserved and the canes that grow from them are shortened back to two or three buds. The advantage of this method consists in the fact that it permits cultivation of the vineyard both ways and in the cheapness of the support. Its disadvantages

are that probably the vines are too crowded and the foliage and fruit do not have the best chance to develop. This crowding also encourages disease.

High renewal method of training is a form of the upright system that is extensively and successfully employed on a large scale. It starts the branching of the vine at about twenty-four inches from the ground, which is the height of the lower wire of the trellis. A single stem is carried up to the wire where it branches and its two arms are trained in opposite directions along the wire. In this style of training, the end of the second season will find the vine with two well developed canes extended on the lower wire of the trellis. These should be cut back at pruning time to firm, strong wood. At the beginning of the third season, the buds on this wood will start and form canes that should be trained upward and be tied to the second wire. The third wire is generally put up during the second season, although it is very likely that it will not be needed until the following year. Some of the upright shoots will bear a little fruit the third season but unless the growth is very strong, this should not be permitted. At the end of the third season, all the vine is cut away except two strong canes nearest the center of the vine, which are merely cut back to firm wood and extended along the lower wire. It is from these canes that the vine starts the next year. The subsequent training of the vine is a continued succession of preserving the two best central shoots and the cutting away of all the rest of the vine. If the two central shoots are not strong enough, the nearest strong shoots are preserved.

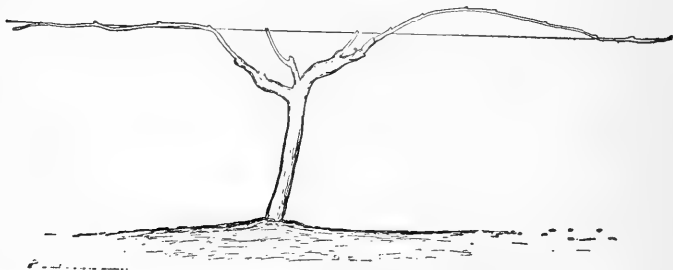


Fig.110.—Vine in Figure 109 after pruning.

In the case of strong growing varieties of grapes like the Concord and Worden, it is customary to leave more than two canes in pruning; often four and occasionally six are left. When four are left, two are often tied together along the bottom wire. If six are used, the two extra canes are tied along the second wire in the same manner.

The amount of wood that should be left on a vine after pruning will depend upon the vigor of the variety grown. In the case of the weak growing sorts, like the Delaware, from twenty to thirty buds should be left on the vine after pruning. This means that all the buds left on the new wood shall not be more than this number on the whole vine and these shall be on two or more canes. In the case of strong growing kinds like the Concord, as many as ten or twelve buds may be carried on each cane and four canes may be left. In other words, such vines may safely carry from forty to fifty buds each year. In any case, a weak vine should have fewer buds left than a strong vine.

As the vine acquires age, the spurs at the top of the trunk get weak. It is customary then to encourage a shoot from near the ground and treat it much the same as if it were a new young vine and from it form a new top. The second year after it is well started, i. e., when it is in good bearing condition, the old cane may be cut away and the young vine allowed to take its place. A top will retain its vigor six or eight years under ordinary treatment but seldom much longer, although the roots will still be vigorous and will form several successive tops.

The high renewal method requires much more tying than any of the forms of the drooping system of training. In doing this, the vine should be firmly tied to the trellis and the new growth, as it reaches it, should be tied to the second wire and later to the third wire. It will be necessary to go over the vineyard several times each season to accomplish this. All shoots do not start with the same vigor, but after they have reached the upper wire and are well tied they are allowed to hang down and need no further pruning or tying.

In the case of the drooping method of training the only tying that is ordinarily practiced is that of tying the main cane very strongly to the wire. In this method, the vines are trained un-

til the canes reach the upper wire, after which no further training is given and the summer shoots are allowed to hang from the upper wire.

In tying the canes, and especially in tying the main arms, allowance should be made for their growth or they may be girdled. They should be tied loosely and for this purpose it is customary to use roping, cotton warp, green Kentucky Blue grass or even willow twigs.

The One-Cane Spur Renewal Method.

The one-cane spur renewal method of pruning is a form of the upright system that is adapted to sections where vines must



Fig. 111.—Method of forming vine trained on one cane spur renewal system.

be laid down in winter, although some of the *Labrusca* sorts seem to fruit better when they are not pruned so close as is necessary in adhering to this system. Its chief advantage is that the vine is trained close to the ground where it may be easily laid down and covered with earth in winter.

Trellis.—A form of trellis well adapted to the upright and fan methods may be made by setting posts sixteen feet apart in the row, and using four wires of No. 12 galvanized iron, putting the lowest one about eighteen inches from the ground, and those

above ten inches apart. The wires should be securely fastened to one end post passing through the other end and through staples driven in the inside posts, so as to allow the wires free play through them. This method allows loosening of the wires in autumn and tightening of them in summer. The form of trellis best adapted to the Kniffen and Munson methods will be found described under those heads.

The second year after planting and as soon as the weather is settled the vine should be uncovered, using a garden fork, which is the best tool for this purpose. Permit only one cane to grow, and that the strongest which starts. Rub off all the other buds that show while they are small. Tie the cane, as it grows, to stakes or wires and if it grows rapidly, pinch off the top once when it reaches the upper wire.

The pruning in the fall of the second year should consist in cutting off all the laterals—in other words, in cutting off all the

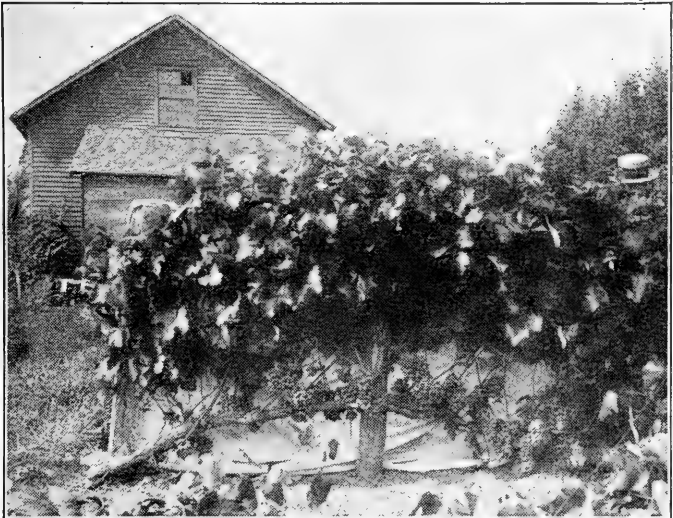


Fig. 112—Pruning grape vines. Old vine trained on one cane spur renewal system.

side branches close to the main cane. In pruning the main cane, leave about two-thirds of the growth it has made but not more than four feet long. The vine should then be buried as directed for the previous year, and it will be found convenient to bend it as low as possible. To do this to the best advantage, take away a little soil from near the vine, to permit part of the bend to come near the ground. As the vine gets older and stiffer, it will bend most easily and safely below ground.

Third season.—The third spring the cane should be tied along the lower wire (fig. 112). If it has wintered well two shoots will start at nearly every joint. As soon as these are three or four inches long the weakest should be broken off and only the strongest ones, that come about ten inches apart, be allowed to grow. In selecting these shoots preference should always be given to those coming out on the upper side of the main cane. As these shoots push upwards they should be carefully tied to the wires, and when they have reached the top of the trellis each of them should be pinched off at the end. This pruning will check the growth a little and result in the fruit buds being formed nearer the main cane than they would if not checked. Further pinching is sometimes practiced when the finest bunches of fruit are wanted, but for practical purposes one pinching is enough, and some large, successful growers do not pinch at all, though it is probably a mistake not to pinch once, if this system of pruning is followed.

If the vine is thrifty it will bear several pounds of fruit this year. As soon as convenient after gathering the ripe fruit the vines may be pruned. It is not necessary to wait for a frost to kill the leaves, and it will not do any harm to bury with some of the leaves on the vine. Where one has but few vines it is best to wait until there is danger of the ground freezing hard before laying them down, but in large vineyards it is not practicable to wait so late, and the work must commence earlier. In pruning the third fall, first select a cane near the extremity of the main cane and cut it off at a length sufficient to reach the next vine on the trellis. This cane must be tied to the lower wire the following (or fourth) spring, and will complete the permanent main cane, fig. 114. The rest of the pruning this fall will con-

sist of cutting away all but from three to six buds of the other shoots that have grown from the main cane. In pruning do not cut nearer than within one inch of any bud, to avoid winter killing. Bury as directed.

The following spring each of the buds left will start shoots; two vigorous ones should be selected from those nearest the main cane and the others rubbed off. The pruning in after years will be a repetition of this cutting of the canes back to several buds in autumn and allowing two shoots to start from each spur each spring.

The Kniffen Method of Training.

The **Kniffen** method of training the grape is a form of the drooping system. This is a method of training which originated in the Hudson valley, perhaps fifty years ago, and which is now widely used since it gives good results and requires less expense, in the items of support and tying, than any others. It is especially adapted to strong growing varieties of grapes and to those of drooping habits. In this method a trellis with two wires is commonly used and these are respectively $3\frac{1}{2}$ and $5\frac{1}{2}$ feet from the ground. It is especially important to have the end posts set solid in the ground and well braced. The intermediate posts are generally driven and they usually stand about twenty feet apart, which allows for a post between every other vine, if they are set ten feet apart—the common distance between them. Vineyardists often grow their vines two years on stakes before putting up the trellis when following this method.

Four-cane Kniffen system.—In this method a single cane is carried up the trellis to the top wire and two canes are trained outward from side spurs at each wire. The vine has then four horizontal canes tied to two wires. These are far enough from the ground so that the drooping new growth is pretty well out of the way in cultivation. The pruning of vines on the Kniffen system is much the same as in the case of the High Renewal system. Each year all the tops are cut away except the four best canes nearest to the trunk and these are cut back to sound, firm wood, extended on the wires and tied the following spring. In case the canes nearest the trunk are not strong enough for **main** canes, these may be cut back to one or two buds (i. e., to

spurs), and the nearest strong cane used to form the vine. The following season the shoots growing from these spurs will probably be strong enough to be used to renew the vines. As the vines become well established, it is customary to leave the upper renewal canes longer than the lower. Under this method a

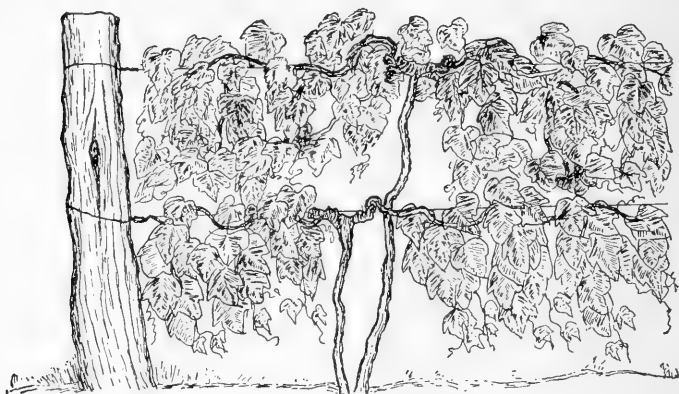


Fig. 113.—One form of the four cane Kniffen system of training the grape.

strong growing variety, like Concord, should be allowed ten buds for each of the canes on the upper and five buds each for those on the lower wire or a total of fifty buds for each vine, while such varieties as Delaware should not bear more than thirty buds. There is no summer pruning practiced in the Kniffen method although the young, superfluous, summer shoots should be broken out when they start, as is necessary for best results in any system.

Two-cane Kniffen system.—Since the greater part of the fruit under the four-cane Kniffen system is borne on the upper canes, a modification of this system, in which the lower canes are dispensed with and the upper canes left longer, has come into practice in some sections. In this case the lower trunk is tied to the lower wire to steady it, and two canes, each bearing ten to fifteen buds, are left on the upper wire. Sometimes the lower wire is not used at all.

The Munson Method of Training.

The Munson trellis is referred to by its author, Professor T. V. Munson, as the Three-Wire Canopy Trellis and is a form of the Kniffen system of pruning. It is described by its author as follows:

"The posts should be of some durable, strong wood. The end posts of every row should be large and strong and be set three and one-half or four feet in the ground and well tamped. The intermediate posts, which may be much lighter than the end posts, should be six and one-half or seven feet long and set two to two and one-half feet in the ground, with twenty-four foot spaces between posts, which will take three vines eight feet apart or two vines twelve feet apart. After the posts are set a three-eighths-inch hole should be bored through each, four feet from the surface of the ground in the direction in which the rows run, leaving six inches or more of post above the hole. These holes are to admit the middle, lower wire of the trellis. For each end post prepare a cross arm of 2x4 hard pine or oak, two feet long; at one inch from either end, and one inch from the upper side, bore a three-eighths of an inch bit hole to pass the lateral wires through, and in the middle of the lower side saw a notch one-half inch deep. For each intermediate post prepare a board of similar wood and likewise bore and notch."

"Through the holes in the posts run a No. 11 galvanized wire, fasten at one end, tighten at the other end with a wire stretcher and fasten. This will be the middle and lower wire of the trellis, and all that will be needed the first year, when the young vines are trained up a string tied from the vine to the wire and along it.

"The arms and the two lateral wires which they bear need not be put on the trellis until after the vines are pruned and tied the next winter.

"Each end cross arm is placed inside the post, and against it, on top of the wire with notch side downward, straddling the wire to keep it from sliding. Then take a piece of the same size wire, about seven feet long, pass one end through the bit hole in one end of arm and fasten the cross arm thoroughly in place. The wire will hold the arm in place and not weaken or split the arm as do nails or bolts, and will be longer lasting,

quicker, cheaper, and more elastic, so that when struck by the hames or collar in cultivation, it gives a little, receiving no damage.

"Likewise place the cross arms on the intermediate posts, leaving the ends of the wire projecting about six inches after fastening. Then fasten a piece of wire about twenty-four feet long to each end of the cross arm at either end of the row and draw both tightly around the next post from the end near the ground and fasten so as to hold the arm at right angles to the middle wire. Then fasten the lateral wires firmly with the above mentioned six inches of wire left after fastening the intermediate posts, as may be seen in fig. 114. This will prevent the arms from slipping out of position.

"Pruning and training on this trellis is very simple and easy, with a little instruction for a few minutes with a vine or two pruned for example. The first season the vine is allowed to grow up on the middle wire by a string about which it is coiled by hand, by going over the vineyard once or twice until the selected shoot of each vine is upon the wire, after which it is allowed to ramble at freedom over the wires. By getting on to the trellis the first year one strong shoot, and allowing no other to grow, a partial crop may be had the second year without damage. On all weak growers, like the Delaware, this should not be allowed to bear until the third year. At the first regular pruning, (all pruning should be done in November, after leaf fall, and never so late as to cause the vines to bleed), the vine should be cut back to two or three buds that have reached the middle wire.

"If the vines are strong growers, cut back to six or eight

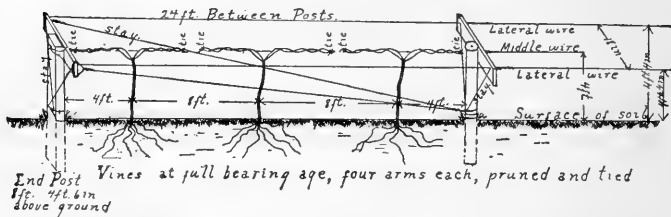


Fig. 114.—The Munson method of pruning; a modification of the Kniffen system.

buds each on two arms, one going each way along the lower wire, from where the ascending vine first touches the wire. After the vines are thus pruned, the outer end of each arm is firmly tied to the lower wire, along which it is gently coiled. These two ties hold the vine firmly in place. The buds on the arms push and ascend, passing over the lateral wires, clinging thereto with their tendrils and hang over like a beautiful green drapery, shading the fruit and body of the vine according to its natural habit. Buds that push on the body of the vine are rubbed off as they appear, and after blooming the tips of all the bearing shoots are clipped off with a quick stroke of a sharp knife. This causes the growth to concentrate in the fruit, greatly increasing the size of the berries. The four or five shoots pushing nearest the crotch of the vine should not be tipped, but the flower clusters, if any, on them picked off and the shoots allowed to grow in freedom along the trellis above the bearing shoots, to better shade the fruit and develop themselves ready for cropping the next year. This is known as the 'long arm renewal system,' in contradiction to the spur system of pruning and gives much better results.

"At the second year's pruning and others following, the old arms with all the bearing shoots on them are cut off down to the new arm and the new arms cut back to lengths they can fill with fruit and mature well. In this, critical judgment and knowledge of capabilities of different varieties are more required in the pruner than in any other part of the training work. Some varieties, such as Delaware, cannot carry more than three to four arms, while Herbemont can more easily carry four arms, each eight feet long. Hence the Delaware should be planted eight feet or less apart, while Herbemont and most of the Post Oak hybrids should be twelve to sixteen feet apart. In other words, each variety should be set far enough apart so that it will fill the trellis with fruit from end to end and mature it well so as to better economize space and not be crowded.

"By the third year, the vines should come to full bearing and be pruned with four bearing arms, two to go each way along the lower wire of the trellis, gently coiling around the wire, one arm in one direction, the other in opposite direction, and should be of about equal lengths, so that one firm tie with jute yarn,

/

near the ends, will be all the tying the vines will need—that is, two ties to each vine—the least required by any trellis system, and the pruning is also simplest and the results every way the best.

“Some of the advantages of this trellis are its cheapness, its simplicity, bringing the work up breast high so that pruning, harvesting, tying, and spraying can be done in an erect position, saving back strain; perfect distribution of light, heat and air to foliage, fruit and soil, yet protecting body of vine and fruit from sunscald and birds; giving free ventilation and easy passage of wind through the vineyard without blowing down the trellis or tender shoots from the vines, and allowing ready passage from row to row, without going around, thus getting larger and better crops at less expense and increasing length of life of vineyard and the pleasure of taking care of it.”

Training vines against buildings or walls is a good plan, and such treatment will hasten the period of ripening and protect from early and late frosts. Of course, the southern exposure is always preferable. The trellis for this purpose should be about one foot away from the wall or building. In such locations it is possible to mature good varieties of grapes where otherwise they would be a failure. It is doubtful if there is a habitable section of northern United States where fairly good grapes will not ripen nearly every year in such positions, and almost every farm offers several favorable opportunities of this sort. The soil close to buildings may not be such as is desired, but it can easily be improved, or entirely removed and a better kind substituted. And sometimes what would be a very poor soil for many other crops is just what is needed for the grape. There are many cases where in such locations single vines have borne several hundred pounds of grapes in one season.

Pruning neglected vines.—When vines have been neglected for several years it is often a difficult matter for the beginner to bring them under any system of pruning, and they are on this account allowed to go unpruned and unproductive. Sometimes such vines may best be brought into shape by cutting away nine-tenths of the wood and then carefully thinning out and pinching the young growth that may start. At other times,

again, it may be best to cut the whole vine off at the surface of the ground. If this is done at the proper season for pruning several sprouts will start from near the root, but only one, or at most two, should be saved. These sprouts should be trained the same as a newly planted vine, except that in one season they will make a vine large enough to bear a good crop of fruit the following year. By either method only one fruiting year is lost, but as a rule the greatest success attends the latter method.

Time of pruning.—The best time to prune the grape is late in the fall or early in the spring. If the vines are to be laid on the ground in winter of course they should be pruned in autumn, as doing it then will greatly facilitate the laying down process. If for any reason the vines have not been pruned until the buds have started, it is far better to do it then than not at all. The so-called "bleeding" of vines does not appear to seriously injure them, though pruning when the sap will run from the cut surfaces is a bad plan and generally causes the bleeding wood to die back.

Spring pruning of the grape should consist only in pulling out the extra shoots that start from each spur that have been left to produce bearing wood. No matter what training method is followed, the vine is liable to produce a number of weak shoots that are of no help to it and should be removed if not needed to carry out the plan of training.

Removing foliage.—Under no circumstances should any considerable foliage be taken from the vine while it is growing. The notion that ripening fruit needs the sunlight is very much at fault. Grapes ripen best where the fruit is in the shade and the leaves in the bright sunlight. The leaves are, so to speak, both lungs and stomach to the plant and anything that injures them prevents the ripening of the fruit.

The tying material commonly used in tying vines consists of raffia which can be purchased from the dealers in garden and florist supplies. Many vineyards are tied with green rye or even with green bluegrass.

Thinning the fruit.—Under almost any system of pruning, some varieties will set more fruit than they can properly mature. Where this is the case, the poorest bunches should be cut away

as soon as the berries are well formed. As a rule, the improved appearance of the remaining fruit is so great, as the result of this thinning process, as to make the operation a paying one.

Manures.—Ordinarily new soils contain an abundance of plant food. Grapes do not require much manure, and the best kinds for them are those which have but a small amount of organic matter, such as wood ashes, or acid phosphate and potash. Yet on gravelly or sandy lands, they may be much benefitted by the liberal use of stable manure. Never apply manure as long as the vines are making a satisfactory growth without it. A very rapid, long growth is not nearly as desirable as that which is firm, well matured and moderate in quantity.

Bagging grapes.—In sections of the country where black rot of the fruit is abundant it may be profitable to put all the grapes in bags, but in sections where this disease is only occasionally destructive it will seldom be a paying operation. But in growing fruit for home use, or where something very nice is wanted, it will often be worth undertaking, as the expense for labor and material need not exceed a half cent per pound. The bagged grapes have a little thinner skin than those not bagged, are free from dust and spiders' webs, and are not so liable to be caught by the first autumn frost. Some varieties seem to ripen more evenly when bagged.

Bagging should be done when the berries are about the size of small peas, and if there is danger from rot, even earlier. For this purpose ordinary two-pound manila paper bags should be used, such as may be obtained from any grocery store. They should be cut down about two inches on each side, and a small hole made in each bag, generally by cutting off the lower corners, to let out any water that might collect in them. They are then ready for use. A bag is brought up over the bunch, above the branch, and securely fastened with a pin. The bags should be left on until picking time, when the bag and bunch may be taken off together. If the fruit is to be stored it will be found that it will keep longer in the bags than without them. Generally the bags remain on the whole season without trouble, and some growers use the same bags for two seasons. Cloth bags made especially for this purpose will last about four years. In France a wire bag is used to some extent for this purpose.

Keeping grapes.—The keeping quality of grapes varies much with the different kinds; some varieties will hardly keep a week after being gathered, while others are easily kept for two or three months by using only ordinary care. A moist, cold cellar is a very good place to keep them. The bunches should first be relieved of any cracked or injured berries, and then laid one tier deep on shallow trays or shelves, so that the air may circulate freely among them. The fruit should be perfectly dry when put in the cellar. If the cellar is not cool when needed for use some ice may be put in it in a tub and the windows kept shut in the day time and opened at night. If the grapes are packed in dry saw dust or cork bark they will keep even better than on trays. Where cold storage is accessible they may be packed in baskets before being stored, but in any case great care should be taken to remove any injured berries, or they will rot and spoil those near them.

Girdling the grape to advance the period of ripening is practiced to a limited extent, but there is quite a difference of opinion

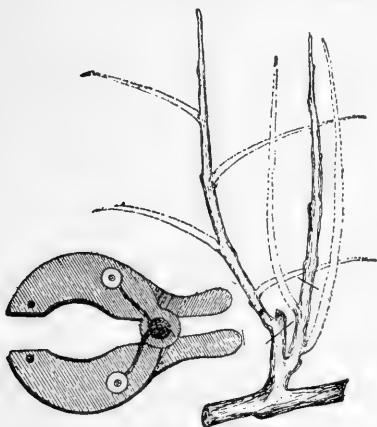


Fig. 115.—Girdling the grape. French girdling tool which removes a section of bark about one-fourth inch wide. Branch of grape vine showing where girdling can be safely done on the portions of the cane that are pruned away.

regarding the ultimate effect of the operation on the health and vigor of the vine. It seems, however, to be pretty generally conceded that it can be done to a limited extent without serious, if any, injury; that it generally advances the period of ripening from seven to ten days, and that the fruit from girdled vines is considerably larger than from vines not girdled and of just as good quality. The operation consists in taking out a ring of bark one-fourth inch or more in width at any time during the growing season but gener-

ally soon after the berries are well set. For this purpose a special tool is often used which makes two cuts and takes out the bark with one movement. If the whole vine is girdled at the surface of the ground, it will soon show great weakness, so when practiced at all it should be confined to girdling the lateral canes that are to be cut away entirely when the vine is pruned. In sections where early autumn frosts are common, it is frequently desirable to try this method of advancing the period of ripening.

QUESTIONS—CHAPTER XIII.

The Grape.

1. Where did the grape originate?
2. Describe the Northern Fox Grape.
3. Describe the River Bank Grape.
4. Describe the European Wine Grape.
5. Describe the flowers of the grape.
6. How is the grape propagated?
7. What are long hard wood cuttings of the grape?
8. How should they be cared for?
9. How should the land be prepared before planting the cuttings?
10. What are one eye cuttings?
11. How are they planted?
12. What are soft-wood cuttings?
13. How are they grown?
14. What is layering?
15. How are summer layers made?
16. How are spring layers made?
17. What is the best location for a vineyard?
18. What soil is best for a vineyard?
19. How should grapes be planted?
20. What cultivation do they need?
21. What points should be remembered when pruning the grape?
22. What pruning is needed the first year?
23. What is meant by a "spur?"
24. Explain the two "systems" of training.
25. What is the single post method? The high renewal method?
- The Kniffen method? One-cane spur renewal method?
26. What pruning is needed the second year?
27. What pruning is needed the third year?
28. Explain the Munson method of training?
29. What pruning is required the first year, second year and third year in this system?
30. Describe a method of pruning.
31. What effect does training vines against buildings or walls produce?
32. How should neglected vines be pruned?
33. When should grape vines be pruned?
34. What material is commonly used in tying vines?
35. To what extent should the foliage and fruit be thinned out?
36. What fertilizers do grapes require?
37. What is meant by "girdling?" How should it be done?

CHAPTER XIV.

THE SMALL FRUITS.

The strawberry is the most important of small fruits. It is found growing from the far North to the hot South and around the world. It is easily grown, stands transportation moderately well and is almost universally admired.

Origin.—The cultivated varieties of strawberries have come from the following species: **Chilian strawberry** (*Fragaria chilensis*). This South American species evidently enters most largely into the parentage of our cultivated kinds, although this fact was not generally acknowledged, and until recent years it was thought that the native North American strawberry was the parent of nearly all our cultivated kinds.

American strawberry (*Fragaria virginiana*).—This species enters in a small way into some of our cultivated kinds. It was formerly believed to form the largest part of the parentage of the best American kinds, but this has been shown to be a mistake.

Alpine strawberry (*Fragaria vesca*).—This is a native of Europe and of the northern parts of this country and Canada. From it have come some of the ever-bearing varieties whose praises are so often talked of. It will not readily hybridize with either of the two kinds previously mentioned. This species is not sufficiently productive to warrant its being largely cultivated. The ever-bearing or perpetual varieties are not desirable since they produce a few berries all through the season, but do not produce enough at any one time to make their cultivation an object of importance. This class of strawberries is generally grown from seed but may be increased by runners.

Propagation.—The strawberry is increased by seed, runners and plant divisions. The plants of the commercial kinds do not "come true" from seed, but seedlings vary very much in their value for cultivation. Probably not one plant in five thousand seedlings that may be raised will be as good as any of the best half dozen varieties now in cultivation, but there will be a good

many plants out of such a number that will be fairly productive of good fruit. It is this variability that gives us an opportunity of originating new kinds that are better than those now grown.

To raise **strawberries from seed** the ripened berries should be crushed in a small amount of dry sand or loam as soon as they are "dead ripe." The seed and sand should then be sown at once in a somewhat shaded bed of rich soil, when the seed will come up in a few weeks if well cared for. The plants should be transplanted four inches apart in another bed as soon as large enough to handle. By winter, if carefully attended to, they will be of good size and may be moved to the fruiting bed in the spring, where they will fruit the following year; that is, in two years from the time the seed was sown. It is a very simple process and may be carried on by any careful person. The raising of seedlings is not often profitable, but is a very fascinating line of experimental work on account of the possibility that one may develop a variety of more than ordinary value.

For practical purposes, **strawberries** are increased only from **runners**, which most desirable kinds produce in great abundance when growing in rich soil. These runners are attached to the old plant only one season, the connection dying the first winter if not before. It is common to separate them into old plants and young plants. By old plants is meant the plants that have once borne fruit. They can be distinguished by their black roots, and should never be used for starting new beds except in an emergency, as they often fail to grow. The young runners are what should be set out. They have never fruited, have white roots, and were formed the season just preceding the spring they are set. Strawberries should never be grown from divisions, unless it is necessary to save the stock of a valuable kind.

Location and soil.—A northern slope is most to be desired for strawberries as there they are not exposed to drying southerly winds, which occasionally in exposed locations so dry out the land that the crop is seriously lessened; also, as the plants start latest on north slopes the blossoms are not as liable to be injured by the late spring frosts which sometimes cause serious injury to plants that start early. Some growers, however, are very successful in growing them on southerly slopes or on level

land. In a general way, any land or location that is good enough for a crop of corn will do admirably for strawberries, but strawberries should never be planted on sod-land on account of the liability of its being infested with cut-worms, or with white grubs which feed on the roots of the plants.

Manure and preparation of the land.—The strawberry is a gross feeder and needs plenty of plant food in the soil. The best fertilizer is barn-yard manure, but it should not be plowed in very deep because the plant feeds mainly in the surface soil. It is generally best to plow the land in autumn, turning in the manure about six inches deep if it is coarse, but if partially rotted, four inches is deep enough to cover it. The land should be thoroughly dragged and smoothed in the spring when it is ready for the plants. When so prepared the land has a loose surface bed in which to set the plants, while underneath it the soil is so firm as to retain the moisture and yet it is open enough so that the young roots can push into it.

Time of planting.—Practically there is only one time to plant and that is in the spring. It is occasionally recommended to plant in August. It may be all right to do so in case there is no strawberry bed in the home garden and there is considerable moisture in the ground so the plants will live without too much care; but in ordinary seasons the results from setting the plants at this time are very uncertain and do not warrant the planting of them on a large scale. If it is decided to set a bed for the home garden in August, the plants may be well-rooted layers from some bed near by, or if obtained from a distance they should have been potted and be well rooted in the pots. The potted plants cost more but are more certain to grow than layers. The growers of strawberries for profit nearly always plant in the spring. The earlier the plants can be set the longer the season for them to grow, and the cool, moist weather of early spring seems to favor the formation of roots. But they may be set as late as the first of June with fair prospect of success. However, if the land is very dry at planting time, it is best not to plant until after a rain, even if waiting for it delays the planting considerably. It is poor practice to set out strawberry plants in dry soil and try to keep them growing by watering, as so much

water and attention is required that the operation will be found a losing one—except where good facilities of irrigation are at hand. It is occasionally practiced in northern states to set strawberry plants in autumn, when the plants should be covered with soil and mulched on approach of winter. At the South, strawberry plants are set in late autumn and in winter.

If plants are received when the land is very dry, it is the

custom of the best growers to open the bundles, shake out the plants and dip the roots into a clay-loam mud and “heel them in” close together, putting a little soil between the plants. When thus treated, they may be easily watered, and will commence to grow and be ready to set out in the field or garden as soon as a favorable time offers. If the space where the plants are heeled in is surrounded by a board fence or other windbreak, a few feet high, it will aid



Fig. 116.—Strawberry roots pruned for planting out.

much in retarding the drying action of the wind.

Plants that have been some time in transit are very apt to look white and weak when received, and are almost sure to die if at once set in the full sunshine. They should be “heeled in” and partially shaded until they assume their normal color before planting.

Plants for setting out may occasionally be found to have the fleshy part of the interior of their stems discolored by the winter. If not moved, they will frequently grow and overcome this injury, but if transplanted they often die. The loss from this

cause may be greatly lessened if the plants are not set out until late in the spring, after they have partly recovered from the trouble. Cases have occurred where all the plants set early have died from this cause, while those from the same bed set out late have done well.

Methods of planting.—There are several methods of planting strawberries. Two ways are mentioned here, and they may be modified as the good judgment of the planter suggests.

The hill system.—This system is especially adapted to the home garden. By it the fruit is grown to a larger size than in the matted rows, but not so much is produced. It consists in setting the plants at about one foot distance in rows two and one-half or three feet apart, and keeping all the runners cut off. Managed on this plan, the plants become very large, have many crowns, look neat and pretty, and produce a good amount of extra choice fruit. The objection to it is that it takes three or four times as many plants to set out as are needed where the matted row system is followed, and the crop is not so large. For these reasons this system is seldom followed by commercial growers.

Matted-row system.—All large strawberry growers pursue very nearly the following plan: After the land is prepared in the spring it is marked out with a corn-marker, four feet one way and two feet the other, and the plants are set at the intersections. The horse cultivator is run both ways until the plants commence to make runners rapidly (about the middle of July), when it is run only in the four-foot intervals. The runners are then pushed together by the cultivator, thus forming a bed or matted row, which by autumn will be eighteen inches wide. The ground between the rows should be worked as often as once in ten days, and after each rain, throughout the growing season up to the last of September, after which cultivation should cease for the year. Keep the soil loose and be sure the bed is free from weeds on the approach of winter. For some varieties two feet apart in the row may leave larger gaps than the runners can fill, but almost any of our commercial kinds will easily fill up even larger vacancies. Such varieties as the Dunlap will easily fill up intervals of three feet in rich soil. The runners should stand about six inches apart in the bed by the first of September, after this number is secured all others should be destroyed as weeds.

Trimming and setting the plants.—The plants, when dug, should have all the dead leaves, pieces of runners and blossoms trimmed off, and if there is a considerable growth of leaves part of them should be cut off. All flowers that appear the first year should be taken off. If the roots are large, they are not readily planted, and it is customary to shorten them to about three inches. The old roots then quickly start a lot of fresh feeding roots.



Fig. 117.—Strawberries. Cultivating the new bed about midsummer.

If a great mop of roots is planted in a bunch, a part of them is very apt to rot. Perhaps as good a way as any to set the plants is with a spade. This requires two persons, generally a man and a boy, to do the work rapidly. After the land is marked out, the man places the spade with the back side away from him, presses it about six inches into the moist earth, moves it from him and lifts it out. The boy takes up a plant, separates the roots, and puts them in the hole. The man puts the spade in the ground about four inches nearer him than he had it before and presses the soil against the plant. The boy finishes the operation by firming the plant in the soil with his hands. As soon as the planting is done, the cultivator should be started to loosen up the soil between the plants. Great care should be taken to keep the plants from getting dry when planting them out.

Some large growers have used a transplanting machine such as is commonly used for tobacco for setting strawberry plants, but the ordinary transplanter requires much care to prevent its setting the plants too deep and burying the crowns. Do not set the plants deeper than they grew in the bed from which they were moved.

Winter protection.—Under whatever system the strawberry may be grown, it is benefitted by being protected in winter by a mulch of sufficient thickness to prevent frequent freezing and thawing, which is very injurious to the plants. Of course a covering of snow will answer the purpose, but it is not safe to trust it. The mulch should consist of marsh hay, corn stalks, straw, boughs, or any litter that does not lie too close and is free from weed seeds. It should ordinarily be put on about three inches deep over the whole of the strawberry bed. This should be applied in late autumn or early winter, after the ground is frozen, but some good growers think that a part of the covering at least ought to be put on before any severe freezing sets in, while others wait until the ground is frozen hard enough to bear up a team before covering. In spring the mulch should be taken off and put in the intervals between the plants where it will help to preserve the moisture during dry weather and to keep the fruit clean.

In winters when there is not much snow fall but severely cold weather, it is important to cover strawberry plants much deeper than is customary in the Eastern and Central states. Eight inches of settled straw is generally none too much where the winters are cold and dry with little snow-fall; and where straw is very abundant, as is the case where grain growing is largely practiced, it is a good plan to use as much as this every year. This is especially true in western Minnesota, the Dakotas and Wyoming where a heavy covering will often make all the difference between success and failure. However, where a heavy covering is used, it is important to set the plants in rows at least six feet apart, so that there will be room between the rows for the straw when the plants are uncovered. It is then very convenient for replacing over the plants if a very cold spell comes when the flowers are open. The use of straw as here

recommended has been known to save the crop for several years in succession in some of the most severe locations in Minnesota and the Dakotas.

How to continue beds in bearing.—Some growers prefer to fruit their strawberry beds but one season. It is probably best to fruit the beds at least two seasons, provided they are in good condition when the first crop is gathered. If properly renewed it will often happen that the second crop on a strawberry bed will be better than the first, but generally it is not quite as good.

Renewing strawberry beds.—There are several ways of renewing an old strawberry bed, but perhaps the following plan is as good as any: As soon as may be after the crop is gathered the bed is closely mowed and all the weeds and strawberry leaves are burned. A plow is then run on either side of the matted rows and all but about one foot in width of it is turned under. The furrow thus made is filled with fine rotted manure and the cultivator set going. The plants remaining are then thinned out with a hoe and special pains are taken to cut out all weeds and old or weak plants. This leaves the old bed clean and with plenty of manure close by, in which the old plants can make new roots. The plants soon send up new leaves which are much healthier than they would be were the old foliage allowed to remain, and if we have an ordinary season an abundance of runners will be sent out, and by winter the old bed will look nearly as vigorous as a new one.

This method of renewing the old bed has the merit of destroying all the diseased foliage, and to some extent, also, injurious insects. It is very important that the renewed bed be kept healthy by frequent cultivation and the destruction of any insects that may appear, in order to have it do its best in fruiting the following season. In renewing old beds a common two-horse corn cultivator will be found a very satisfactory implement. A disc harrow with the inner sections removed is also good. Either of these implements will do the work better in hard soil than the one-horse plow.

Burning over the strawberry bed is very important where old beds are to be fruited again, but it is absolutely necessary for best success that the burning shall be done quickly; that is,

the trash should be thoroughly dry, so that it will "go like a flash." If the trash is somewhat moist, so that it will burn but slowly, the roots and crowns of the plants will almost certainly be killed. Sometimes it may be impracticable to get the trash sufficiently dry to burn well. In such cases the material should be raked from over the plants into a windrow between the rows, to be burned, or it may be best to cart off a part of it if the covering is very heavy.

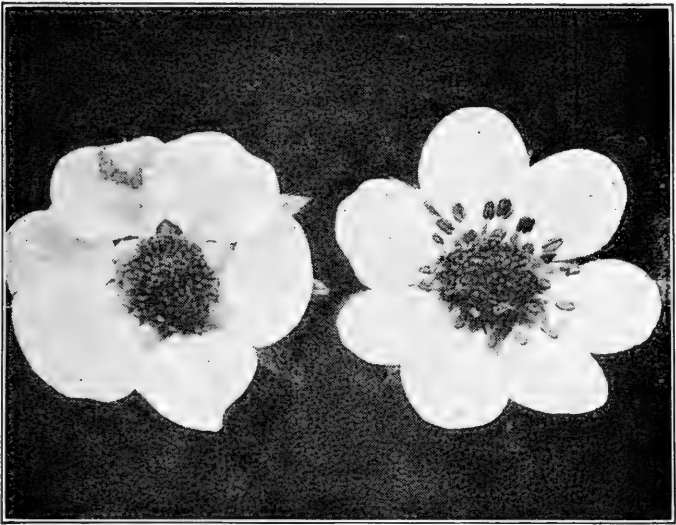


Fig. 118.—Flowers of strawberry. At left, pistillate flower; at right, perfect flower.

Sexuality of the strawberry plant.—We have two classes of the strawberry, distinguished by their blossom. One class has perfect flowers, i. e., all its flowers have well developed stamens and pistils (male and female organs). These can be planted alone without any other variety near, and will produce fruit. This class is sometimes called bi-sexual (fig. 118). The other class has pistils (female organs), but does not have stamens, or has

but very few of them. This class is often called imperfect (fig. 118). It is found in practice that the varieties with pistillate blossoms frequently produce more fruit than those with bi-sexual flowers, consequently it is often advantageous to raise as many of such kinds as possible and as few of the others, but it is necessary to have some of the bi-sexual kinds near the pistillate kinds or no fruit is produced. Just the proportion that should exist between the bi-sexual and the pistillate kinds is a disputed point,

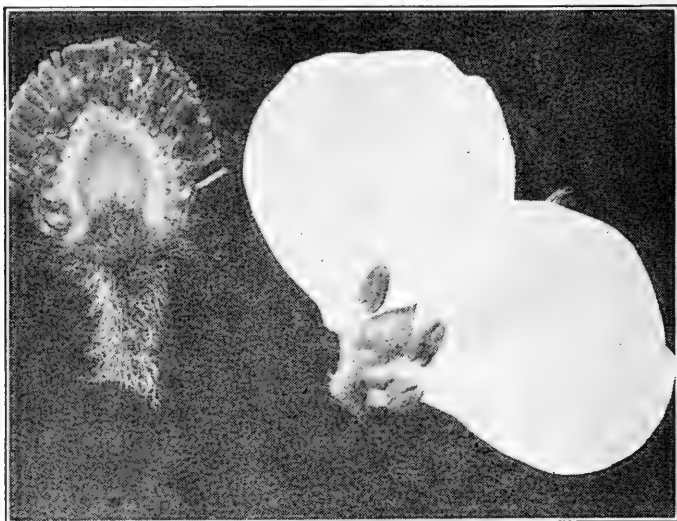


Fig. 119.—Portions of flower of strawberry. At left, cross section of receptacle, showing pistils; at right, two petals attached with three stamens to a portion of the calyx.

but it is probably about one to three or four, depending upon the weather at the time of blossoming. It is safe to say that when pistillate kinds are used, every third row should be of some bi-sexual kind, selected so that it will be in flower at the same time as the imperfect variety. The neglect of this precaution is a constantly recurring source of disappointment. Some growers recommend that every third plant in the row be of some bi-

sexual kind. The objection to this way in practice is that the pistillate kinds, being often the strongest growers, may soon crowd out the weaker variety; and then, again, when this plan is followed, the plants when taken up are so hopelessly mixed as to be worthless for setting a new bed.

Dry berries, "Nubbins."—Sometimes the berries fail to fill out evenly all over, or are small and mostly dry and hard, or one-sided. This may result from the pistils, or a part of them, being injured by frosts, dry wind, or an unusually severe rain or hail storm which, by destroying the delicate pistils, prevents the formation of seed and the development of the part adjoining, for it has been conclusively proven that unless the seeds are perfected the fleshy part near them does not fill out. Sometimes the blossoms are stung by a snout-beetle and then they hardly form berries at all. Nubbins are also caused by winter injury which weakens the plants to such an extent that apparently they are not strong enough to fill out the fruit. Imperfect pollination may also cause nubbins.

Picking and marketing.—If the berries are to be sold great care should be taken to have them carefully picked. Green berries are bad enough to have in a box, if they are to be shipped, but overripe berries will cause much more trouble for they are sure to decay before they reach their destination and damage all the good fruit. On this account the beds should be picked clean every day in warm weather. The pickers will need careful watching so as to be sure they do not put poor berries in the bottom of the boxes, and that they pick all the ripe berries so none will be left to get overripe. It is always desirable to pick fruit, that is to be shipped, in the cool of the day unless it should be wet. Sorting and grading the berries after they have been picked will be found necessary if a strictly first class product is desired, and will often pay if the general average of the fruit is large.

Gift packages holding twenty-four boxes are almost universally used for shipping strawberries in the Western states, while in some of the Eastern states the return package is still popular. The latter cost about twenty-five cents per crate, including boxes and cover. They are always made so there is room to heap up the boxes and to allow a circulation of air through them.

Avoiding frosts.—It sometimes happens that the blossoms, which appear about the middle of May and are quite susceptible to frosts, are seriously injured on cold nights. They may often be protected when in this critical condition by taking the mulching from the rows and throwing it back again on the plants for a few days, or until the danger from frost is past. If the winter mulch is left on as late as it is safe to do so, which is until the new growth starts strongly, it will serve to retard the plants and they will not come into blossom until a week or so later than they otherwise would were the mulch removed early in the spring. But aside from the risk or injury from frost, more fruit is produced from plants that come into flower early. An ordinary frost seldom destroys the stamens, its damage being confined to the pistils, therefore, the center or berry part of the frosted flower turns black.

Varieties.—The varieties vary much in size, color, and quality of the fruit and vigor, productiveness and hardiness of the plants. The flowers also vary, as has been mentioned under the head of Sexuality of the flowers. There are now several hundred varieties catalogued by nurserymen, and new varieties are brought out each year, but of the new kinds that have been tried probably not one in twenty-five has been worth the keeping, and yet we can reasonably expect that most of the kinds now popular will be displaced by better kinds within a few years.

It is well not to pay a high price for plants. The new kinds, if good, are soon offered at reasonable figures. As a rule it is not necessary to pay over twenty-five cents per dozen, or one dollar per hundred for plants. In quantities of five hundred or more they can be bought at much less cost. About two hundred plants, if well set out and cared for, will give all the fruit needed by the ordinary family. Beginners will generally be most successful if they confine themselves at the start to some good bi-sexual kind, to save the annoyance of caring for two varieties which may be easily mixed together.

The Currant.

The currant will grow and fruit abundantly in almost any soil or situation in the northern states if given good cultivation; and even when it has but little care it is still very sure

to produce a fair crop. However, no cultivated plant responds more promptly and generously to manuring and careful attention. The acid fruit, in any of the various ways in which it is used, is healthy and refreshing. It is not so universally esteemed as the strawberry, yet it is used in immense quantities each year, and first-class fruit carefully marketed generally pays the grower a good profit. No fruit is more satisfactory in the home garden. A currant bush once planted will continue to bear fruit for an indefinite period, often for thirty years. There are very many species of currants, but our cultivated kinds belong to the following:

Origin:

(a) The red currant has come from *Ribes rubrum* of northern Europe and northern America. Examples of this species are to be found in the varieties known as Red Dutch and White Grape, which have red and white fruit respectively.

(b) The black currant of the garden has come from *Ribes nigrum* of Europe. Plants and fruit of this species have a peculiar chinch-bug-like odor which to many people is unpleasant. There is no great demand for the fruit, but in some markets it is much sought after and brings a high price. Examples are Black Naples and Lee's Prolific.

(c) The Crandall currant has come from *Ribes aureum* of western America. The fruit is purplish black, shining, often large, two to several in a cluster. The variety known as Crandall is practically the only cultivated form, but it varies greatly when grown from seed. It seems to be little if any improvement over the best wild forms. The well known Missouri currant of the gardens is a form of this which seldom produces much fruit.

Propagation.—The currant does not come true from seed. The named varieties are grown from layers, cuttings, or divisions.

Seedlings are easily raised if treated the same as recommended for raspberry seedlings, but rather more care must be taken with its seed than with that of the raspberry as it germinates very quickly in the spring, and if moved after growth has started it often fails to grow. On this account the seed should be sown in the fall where it is to grow the following year. Or if sown in boxes they should be frozen until February or March,

when they may be put in a greenhouse or hotbed. But very few seedlings are of any value, and the growing of them is seldom attempted.

Cuttings are very easily rooted and varieties are almost universally grown from them. They may be taken off at almost any time while the plant is dormant, and wood of almost any age or size will root if carefully handled, but the following method is generally very certain to bring good results:

As soon as the leaves have fallen—which may be in the latter part of August or first of September—the young wood (growth of the current season) is cut into pieces about seven inches long. They are then at once set out in rich, well drained soil four inches apart, in rows three feet apart. Only about one inch of the cutting should be above ground, and great care should be taken to very firmly pack the earth around the bottom of the cuttings. When thus treated they will have calloused and made some small roots before the ground freezes, and will start vigorously the following spring. The cuttings should remain as planted for at least one, or perhaps two years. If the land is in good condition they will be ready to set out when one year old, but can remain where planted for several seasons if well cultivated. If wood is scarce the cuttings may be shorter than recommended, but in such a case more care will be required to ensure that they do not dry out in the soil. Sometimes the cuttings may consist of a single bud each, and may be sown like beans in a furrow, but much experience is required to be successful with them when made so very small.

Layers may be made at any time during the growing season, but preferably in the spring or early summer, as they will then be well rooted by autumn. They consist simply of branches which have been covered with earth and have become rooted. After becoming well rooted they are separated from the old plant. The branches are rather surer to root if the bark and wood is cut or broken a little, but most varieties root very easily without this trouble.

Soil and planting.—The currant will grow in almost any kind of land, and on that which will raise a fair corn crop it gives good returns, but the soil cannot be too rich or the cul-

tivation too constant for the best crops of fruit. Plants may be set out in the fall or spring with good results. If set in the fall each plant should be banked up with about two spadeful of soil. They should be put five or six feet apart each way, and for the strong varieties most generally grown six is better than five feet. One plant is enough for a hill, and those that are young and thrifty are better than older ones. Where practicable, they should be planted so as to allow for cultivation both ways. They should not ordinarily be set along a fence or border, as they are difficult to cultivate in such places and are often neglected. The land should be plowed lightly with a one-horse plow early in the spring, and the cultivator started soon afterward. While the plants are in fruit, cultivation will have to be suspended, as the weight of the berries will bend the branches so that they will be in the way and liable to injury. As soon as the crop is gathered the working of the land should be again commenced and continue until the middle of August, after which there is no need of it.

Mulching.—Good crops of currants may be grown without cultivation provided the land is heavily mulched, and in somewhat dry locations they are more surely grown on this plan than on any other. The mulch may consist of straw litter, coal ashes, hard-wood sawdust, or similar material. If ashes or sawdust is used it should not be mixed with the soil but kept on the surface. It is often a good plan to mulch near the plants and cultivate in the center of the rows. Ashes or sawdust used for this purpose will keep down the weeds near the plants and do away with the necessity of hand cultivating. Pine sawdust is not as good for this purpose as that from the hard woods, but may be safely used if kept on the surface of the land and not mixed with it. Partially rotted sawdust is much to be preferred to that which is fresh.

Pruning.—The currant is improved by some pruning each year. This may be done at almost any season, but preferably in August. To do this work properly it should be understood that very little fruit is borne on the wood of the preceding season's growth, and that the buds which produce the greatest amount of fruit are on wood in its third season of growth or older. The fruit buds are formed late in summer and open early

in the following growing season. In pruning, the old wood which is weakened by age should be cut out close to the ground and enough new sprouts from the roots should be encouraged to take its place. Not more than from four to six shoots from the roots should be allowed to remain. If all are allowed to grow, too much bearing wood will be produced and the fruit will consequently be very small. The wood which is infested by borers should also be cut away.

Tree currants are frequently advertised as being very desirable and are often sold at a high price. They are, in fact, merely our common currants pruned so as to make them take on a tree-like form. They appear very pretty while growing, but having only one stem the first borer that attacks it destroys the plant. To make plants take on this tree-form, all but one upper bud is rubbed off the cuttings when they are set out. The remaining bud pushes up a straight shoot, which is allowed to branch at about a foot from the ground and to make a miniature tree. Such plants seldom send up sprouts, so the stem cannot be renewed. The common red currant is sometimes grafted on the strong growing *Ribes aureum*, but such plants are open to the same objections as other tree currants and are only valuable as curiosities.

Winter protection.—The Red Dutch and a few other very excellent varieties are perfectly hardy in almost any soil or situation, but some of the kinds producing the largest fruit are occasionally injured in severe locations in winter. They may, however, be protected by covering them with earth, but if so treated they will need to be mulched or to have some support to keep the fruit off the ground, as the canes will not straighten up well in the spring after being bent down all winter. Another way of giving some protection is to tie the stems together in autumn with string or willow withes. This is very desirable where the snow drifts over the plants, as it prevents their being broken by it when it settles in the spring. More protection is afforded by this treatment than is generally supposed.

Marketing.—It is customary to market the currant in baskets holding about six or eight pounds, but sometimes quart boxes and other packages are used for this purpose. One must

study the local market to learn which package is the best to use. This fruit is generally sold by the pound. Unlike raspberries and strawberries, it will remain in good condition on the plants for some little time after getting ripe, but it does not ship as well if very ripe as when it is a little green. The fruit makes the firmest jelly before it gets fully ripe, and on this account it is



Fig. 120.—Currant bushes tied up for winter to prevent snow from breaking them down.

sometimes most profitable to market the crop when the berries at the end of the bunches are still quite green.

Varieties.—There are not so many varieties of the currant offered in the nursery catalogues as of most other cultivated fruits, but still there is much difference in the size and quality of the different kinds, as well as in the hardiness and vigor of the plants. For the home garden, about one dozen plants well cared for will give an abundance of fruit.

The Gooseberry.

The gooseberry is closely related to the currant and is fully as productive. The fruit, however, is not so highly esteemed in this country as in northern Europe where a differ-

ent species is grown and where it is a favorite fruit. There are several species of the gooseberry that enter into our cultivated kinds. The color of the cultivated gooseberries varies from a pale green to a deep red when ripe.

Origin:

(a) The American gooseberry has come from the *Ribes oxycanthoides* of America. Examples are the Houghton and the Smith. There are several other species of native American gooseberries which are used locally in a wild state. The greatest objection to this class is the large number of sharp prickles. Some of the new varieties are a great improvement in this respect.

(b) The European gooseberry is *Ribes grossularia*. Examples are the Industry and the Lancastershire Lad. They are not much grown in America as they are especially subject to mildew in this country.

Crosses.—There are a number of crosses between the European and American gooseberries. The Triumph and the Downing are each supposed to be crosses of this kind.

The directions given for growing the currant apply with equal force to the gooseberry, except in a few particulars, which are included under the following heads:

Propagation.—Most varieties of the gooseberry do not grow as readily from cuttings as the currant, and many kinds with small, slender wood it is almost impossible to root in this way. For this reason layering is a most common method of propagation. If the branches are carefully covered with soil in June, after the new growth is six or more inches long, each twig will be found slightly rooted by autumn. They should then be taken up and cut apart with a piece of the rooted main branch with each twig. These little layers should be set out at once in the spring and treated the same as recommended for currant cuttings. Some varieties need to have the bark slightly broken when they are laid down, but most kinds root readily without this trouble.

Planting.—Autumn is the time usually preferred for setting the gooseberry. The sprouts start into growth so very early in the spring that any delay at that time causes them a

set-back from which they may not readily recover. But plants may be very successfully set in the spring if planted early. Gooseberries are grown in practically the same way as currants.

Pruning should consist in taking out any superfluous or weak stems, as recommended for currants. Besides this, the size and appearance of the fruit of the common kinds will be greatly improved if from one-third to one-half of the new growth is cut off annually. However, some of the newer kinds producing the large fruit, may perhaps, need this recommendation somewhat modified. Large fruit is picked and sold most readily and the quantity produced from a trimmed bush is, as a rule, fully as much as from one not trimmed. This is especially true of our native kinds which are inclined to overbear. Pruning thins out the bushes so that picking can be more easily done.

Marketing.—Gooseberries are most in demand when perfectly green but are also used when fully ripe. They are generally marketed in quart boxes.

Insects.—The insects that commonly injure currants and gooseberries are the Currant Worm, Currant Borer, Leaf Lice and Berry Moth. See Chapter VI.

Diseases.—The more common diseases of the currant and gooseberry are Leaf Spot and Mildew. See Chapter VII.

The Raspberry.

(a) The European raspberry (*Rubus ideus*). Varieties of this class were the only kinds grown in this country for many years and they proved to be poorly adapted to general cultivation here although in a few sections, as, for instance, near the Hudson River, they were a success. Among the varieties of this class that have been grown here are the Herstine, Hudson River, Red Antwerp and Superlative. In this class are yellow as well as red kinds.

(b) The American raspberries are the foundation of commercial raspberry growing in America on a large scale. They embrace the red raspberry (*Rubus strigosus*) and the black cap varieties (*Rubus occidentalis*). Examples of the red raspberry are the Cuthbert, King and Turner and of the black caps, Gregg, Older and Kansas are examples. Among the varieties of each of these species are red and yellow varieties.

(c) Hybrids between the red and black cap raspberries are common. They were formerly considered a separate species and known as *Rubus neglectus*. Examples are the Columbian, Schaeffer and Philadelphia.

Classes of raspberries.—All raspberries in cultivation may be divided into two classes, the suckering class and the tip rooting class, according as to whether they increase by suckers or by tip layers. This is a convenient, rather than a botanical classification.

Propagation.—The methods of propagation vary greatly with the different species of raspberries. They consist of propagation by seed, by suckers, by root cuttings, by tip layers and by division of the stools.

Raspberries from seed.—All the cultivated kinds may be grown from seed, but plants from seed are not "true," i. e., are not like the plants from which they came, and it is only an occasional seedling that is nearly as good as any of the varieties commonly cultivated. To raise seedlings, the "dead" ripe fruit should be crushed in a small amount of dry sand, and the whole sown at once in a light, moist soil, somewhat shaded. The seed will seldom germinate until the following spring when, after the plants are large enough to handle, they may, if too thick in the seed beds, be set out in another bed to grow the first season, or if not crowded be left to grow where they are. The plants should be taken up in the fall, "heeled in," and planted again the following spring, when they will bear fruit the following (the third) year. Another way is to sow the seed as soon as obtained in small boxes, and cover them lightly with leaves or litter. In February bring the boxes into a greenhouse, transplant to other boxes as soon as the seedlings have their third leaves formed, and plant permanently outdoors as soon as large enough and the weather will permit; by this system some fruit is generally obtained the second year after planting out.

By root cuttings.—Most of the varieties of raspberries coming under the first three species mentioned produce suckers from the roots and these are generally used to start new plantations, but when there is a shortage for this purpose it is cus-

tomary to grow plants of the suckering kinds from root cuttings, which may be made as follows: In the autumn, after the plants have stopped growing, the roots are taken up, cut into

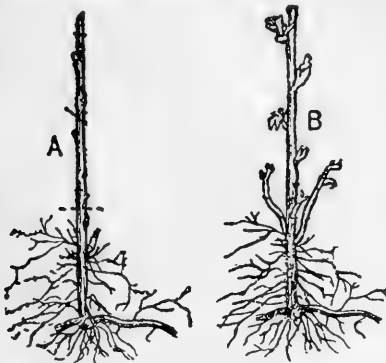


Fig. 121.—Raspberry Plants. A.—Dormant plant ready for transplanting. B.—Growth started too much to transplant.

pieces two or three inches long and put in boxes with alternate layers of sand or loam. The boxes are then buried in some well-drained spot until the land is fit to work in the spring, when the roots should show a callous on the cut ends. The roots are then planted two or three inches apart in the furrows and covered about two inches deep in rich soil. By the end of the season they will have made plants large

enough to set out permanently.

This plan of growing plants from root cuttings may be greatly changed in detail, but the general plan is the same. It is always best to make up the root cuttings in the fall, but cuttings from strong growing kinds do nearly as well made up in the spring. The cuttings are generally made with a sharp knife or a pair of pruning shears, but nearly equally good results may be had by cutting the roots in a hay cutter and this is a common practice where large quantities are grown.

By layers.—The black-caps and some other species grow most readily from layers. The tips of the new growth reach the ground about the latter part of August or first of September and readily make new plants if held in place. These tips should be covered with a spadeful of soil, or better, be inserted three or four inches straight down into a hole made by pushing a spade in the ground. They will be well rooted in a week or two. These rooted layers will be found to winter over most safely if allowed to remain undisturbed until spring, but should have a light mulch over them during winter. They may also

be wintered over if dug and very carefully heeled in, or kept in a cold cellar, but the plan recommended should be followed when practicable. It is not considered good policy to plant the layers in the fall as they are very liable to winter injury when disturbed in autumn. In digging the layers about ten inches of the cane should be cut off with the roots to facilitate handling. It is generally believed that unprotected plants are much hardier when the layers remain attached to the plant during winter than they are if the canes are cut loose in the fall.

Location and soil.—The common varieties of the raspberry succeed admirably in any good soil, but the suckering class, which includes chiefly the red varieties, produce rather more abundantly than the black-caps in moist, heavy loam, and the latter do best in a sandy loam. A northern slope is generally better than a southerly one as it is less liable to injury from drouth, which frequently shortens the fruiting season in bad situations; but it is well known that some varieties withstand dry weather and other climatic troubles far better than others of the same species.

Manure and preparation of land.—All varieties need high cultivation. The land should be heavily manured, if of inferior quality, and thoroughly plowed and brought into the best condition for corn or other gross feeding crop. The best fertilizer is well rotted barnyard manure. Raspberries, especially the black cap kinds, will produce very well even on quite poor soil, but rich land and thorough cultivation is necessary for the best success with any variety.

Time of planting.—The suckering kinds may be planted in autumn or spring with safety. When the work is done in the autumn great care should be taken to firm the soil around the roots, and a forkful of mulch over each hill is a great protection against winter injury. Many growers prefer to set in autumn, since at that season they can give the work more careful attention than in the spring. Then, again, the new sprouts from sets (suckers) start very early, and if the work is delayed in the spring the new growth is often broken off or injured in the work of planting. Black caps and other tip-rooting kinds should never be set in the fall, as they are very liable to be winter-

killed if moved at that season. They should always be set in the spring.

Selection of plants.—Since the canes are biennial there is no such thing as two or three-year-old plants, as with trees when we refer to the stems; but the roots may be of any age, as they are perennial. Plants of one season's growth are best to begin with. Sucker plants are largely used in the case of varieties increasing in that way; but plants from root cuttings are generally considered fully as good, or even better, when well grown. The old stools from raspberry plantations may be broken up and the parts planted, but such sets have few fibrous roots and often fail. With the tip-rooting kinds plants obtained by breaking up the old stools are not so good as those from the suckering kinds obtained in the same way and should not be used, as they are very apt to fail even with the best of care. It is important to use only vigorous sets taken from perfectly healthy stock. Old plantations of raspberries frequently become diseased and plants from them are often worthless, consequently much care should be exercised in buying plants. Care should also be taken to avoid using sets that are affected with root galls.

Planting.—After the land is thoroughly prepared the plants should be set out in rows seven feet apart and at three-foot intervals in the rows, putting two plants at a place. The distance between the rows may be lessened to five feet if more space is not available and the weaker growing kinds are planted, but the greater distance admits of cultivation even when the bushes are loaded with fruit. It allows sunlight to readily reach the plants and is most satisfactory every way, and for profit they should never be set any nearer; while for some of the strongest growing varieties the hills should not be nearer than five feet in the row. At the time of planting the canes should be cut off close to the ground and no fruit allowed to form the first season.

A good way to plant is to mark out the land the three-foot way and then furrow out where the rows are to come. Set the plants in the furrows, covering them temporarily with the feet, and afterwards more carefully with a hoe, firming them in with

the feet at the same time. The rows should preferably run north and south, for planted in this way the fruit is shaded by the new growth during the hottest part of the day during the period of ripening. Some garden crop may be grown between the rows the first year.

Depth to plant.—Black cap raspberry plants should be set about the same depth in the soil as they naturally grew. The roots should be carefully spread and the soil well firmed over them. The suckering kinds should be planted a little deeper than they naturally grew and be well firmed in.

Cultivation.—The soil should be kept loose with a horse cultivator and the rows free from weeds. If the land gets hard the one-horse plow may be used but the land should be kept flat and as free from ridges as possible. Frequent shallow cultivation, especially in a dry time, is important.

Pruning and thinning.—Not more than two shoots should be permitted to grow from each root the first year. The second and succeeding years the suckering kinds will produce a lot of sprouts all around the hill; four or five of those nearest the hill should be allowed to grow and the rest treated as weeds. If a great lot of these suckers are allowed to remain, but little fruit will be produced. Black cap raspberries will this year send up a half dozen or so of sprouts at the base of the old plants, and enough of these should be removed to allow the remainder to properly develop. All these sprouts should be pinched once when from twelve to eighteen inches high, if they are to be grown without a trellis. As soon as the fruit has been gathered the old canes which have borne fruit the current year should be cut out and destroyed. In the spring the suckering kinds need no pruning, but the lateral canes of the black cap varieties should be shortened back to twelve or fifteen inches, and the main cane shortened perhaps one-third its length. This is very important, as the branches of this kind are so slender that they will bend to the ground and break under the weight of fruit unless severely pruned, or they may set more fruit than they can mature and the whole be lost. When pruned in this manner the fruit will be much larger and the plant will yield fully as much fruit as if all the canes were left their whole length.

Mulching.—The first year no mulching is needed; but the second season, as early as the middle of June, the rows should be mulched for two feet on each side with hay, straw or litter, or with what is better still, green clover cut when in blossom and put on two inches deep. The latter is especially desirable because it lies close, and as it rots in one season and is very rich in plant food it makes a good manure. This material keeps the land moist, the berries clean, and kills out weeds. After putting on the mulch as recommended there will still be a space two and a half feet wide between the rows where the cultivator should be run to keep the soil loose. Too much stress can hardly be laid upon the importance of mulching this fruit. It frequently makes a difference between a good profit and a big loss.

Support.—It is desirable in severe climates to have the canes supported in some manner. In milder sections, where winter protection is not necessary, the bushes may be so frequently pinched as to make them form little trees that support themselves; but this kind of treatment is not desirable where the plants have to be covered in winter, as it makes them so very stocky they cannot be easily laid down. A very good support for raspberries and blackberries is made by running a No. 12 galvanized iron wire on each side of the bushes, attached to a good solid post at each end of the row and tied together at frequent intervals. This wire should rest on nails driven in stakes set twenty-five feet apart. Such a support permits the plants to move gently in the wind but not sufficiently to break them by its violence. It keeps the fruit off the ground and is cheap and convenient.

Winter protection.—Winter protection of some sort may be necessary for raspberries that are growing in severe locations. A good windbreak may be sufficient to make the difference between success and failure in growing this crop on our western prairies, but in many places in the extreme Northern states and in many parts of Colorado it is necessary to bury the canes to protect them from winter injury. This is especially true when tender kinds are grown. To do this, the bushes should be covered late in autumn before the ground

freezes hard and should not be handled when there is any frost in the canes. The best covering is fresh earth. In laying them down commence at the north end of the row, remove the soil from the north side of the hill, about four inches deep, with a garden fork; gather the branches together with a two-tined fork, press gently to the north, at the same time place the foot firmly on the base of the hill and press hard, bending the bush



Fig. 122.—Uncovering raspberry bushes in the spring.

in the root as much as possible and as little as may be in the canes, until nearly flat on the ground and hold it there until the second man covers with soil sufficient to hold it down. The top of each succeeding hill will lie at the base of its predecessor, making a continuous covering. It will be found that a little mulch put on the canes first after laying them down will hold the soil put on, and much less soil will be required than if no mulch is used. After laying them all down turn a furrow against each side of the rows, covering as much as possible, and draw a little over any canes that may be left exposed. It is only necessary to use enough to barely cover the canes. There are some of the strong growing varieties, such as the Gregg, that on rich land are very difficult to cover. With them it will do very well to bend as nearly to the ground as is safe and cover the tops only with enough soil to hold them in place.

While it would be better to cover them all if it were practicable, yet treated in this way enough snow will generally lodge in the canes to cover them, and if this is supplemented with a light covering of coarse litter or straw so much the better. If mice are numerous they must be poisoned or they will eat the canes under the mulch.

A machine has been originated in Minnesota that covers raspberries and blackberries quite successfully and it is there used on a large scale. It requires four horses to operate it. However, it often breaks many canes in operating and some growers prefer to take their chances of winter injury to covering with it.

Lifting canes in the spring.—The canes should be raised in the spring soon after the land is dry and well settled. To do this use a round-tined fork and after carefully removing some of the earth raise the plants slightly to a slanting position. It is found that left in this position the fruiting canes are shaded by the new growth and are not so crowded as when raised up straight.

The fruit.—The fruit is found in red or yellow colors in the red raspberry class and in black, yellow and purple in the cap class. The varieties vary in size, fruitfulness and vigor as well as in color. The red kinds are most popular but the black caps are much used. The purple and yellow varieties do not sell well in most markets but are often very satisfactory in the home garden and for drying. All kinds are used for drying in years when prices are low.

Picking and marketing.—Avoid picking when fruit is wet, if possible, and pick fruit clean. Do not leave any overripe fruit on the plants. Keep picked fruit in a cool, shady place; transport small fruit in a good spring wagon.

Red raspberries are generally marketed in pint boxes, (24 pints in a case), and black cap raspberries in one quart boxes, but some growers find the pint box best for all kinds of raspberries. In the west the gift package only is used, but in the Eastern states the return package is generally preferred. This subject should receive the most careful attention of growers.

For further notes on picking, marketing, diseases and in-

sects affecting raspberries see special chapters on these subjects.

The Blackberries.

The cultivated blackberries may be grouped under five heads as follows:

(a) The high bush of the clearings and fence rows of the Northern states, with long clusters—as those of the Ancient Briton.

(b) The type with lower growth and short clusters such as those of the Snyder and Badger. Both of these groups are probably forms of the *Rubus villosus*.

(c) The trailing dewberries such as the Lucretia and the Austin, known botanically as *Rubus canadensis*.

(d) The forms that are intermediate between these species are probably hybrids between the two species above mentioned. Among these are varieties such as the Wilson and the Rathburn.

(e) The cut-leaved or evergreen blackberry (*Rubus laciniatus*) is probably a form of the European blackberry (*Rubus fruticosus*). This kind is cultivated on the Pacific Coast where it remains green all winter and is very prolific and highly esteemed.

Propagation:

(a) The high bush blackberry is propagated by suckers and root cuttings in the same way as the suckering raspberries.

(b) The dewberry is propagated by layering the growing canes, which root readily about midsummer. Varieties of this group are not generally cultivated with success, but in some locations they fruit abundantly.

Soils:

(a) The best soil for the high bush blackberry is a heavy clay loam, but it grows on a wide range of soils.

(b) The dewberry does best in a warm, sandy or gravelly soil, but is not nearly as reliable as the blackberry.

Planting, Cultivation and Pruning:

(a) Plant and cultivate the same as the suckering raspberry.

(b) It is considered important by many growers to pinch

the high bush blackberry canes at least once when two feet high, as this encourages the low setting of the fruit buds.

(c) Spring pruning should not be done until the blackberry canes are in flower and the amount and location of bloom is seen, otherwise too many fruiting canes may be removed and thus no fruit left. As a rule, about one-half of the bloom should be cut off in the pruning.

(d) It is desirable to have a trellis for blackberries and dewberries.

Dwarf Juneberry.

Dwarf Juneberry (*Amelanchier canadensis*, variety *oblongifolia*).—This is also called shad bush, service berry and suscutan berry, native of the Northern states and far into western Canada where in thickets it reaches the height of 16 feet and produces heavy crops of large fruit that is much prized by the settlers and Indians.

There are several so-called varieties of it found in the Northern states, one of which makes a small tree, but it is better known in its dwarf form, which is so very distinct from the tree form as to seem quite worthy of being made a separate species. This latter form is quite abundant and occasionally very productive. It is the selected kinds of it that are cultivated for fruit. It generally grows from four to six feet high; is covered with a profusion of white flowers early in the spring, and ripens its fruit in July with the raspberries. The berry is of a purplish red color, often nearly one-half inch in diameter. Figure 124 shows its size and form. Like the blueberries, the quality of the fruit is sweet though rather tame, but by the addition of a little lemon juice it makes an excellent pie or sauce. It is readily cultivated and yields regular and abundant crops. However, when grown in a small way the fruit must be protected from the birds or they will take it as fast as it ripens. Mosquito netting, or the coarse wire netting—such as is used for chicken yards, is useful for this purpose. When grown on a large scale, the depredation of the birds is not so apparent. The plants are extremely hardy, seldom if ever being injured by our most severe winters, and are healthy and free from insect pests. On account of its many good qualities, it should

find a place in the home garden, and it could often be cultivated for the near market at a profit.

Propagation and cultivation.—The plants are readily increased from suckers, which are produced rather sparingly



Fig. 123.—Dwarf Juneberry. Flowers.

around the old plants unless they are cut back. These should be set out at about four-foot intervals in rows five feet apart, on rich upland. They commence to bear in two years, but will not produce a full crop until the fourth year. They need clean cultivation, and in dry situations should be mulched to protect from drouth. They require but little pruning, though the suckers should be thinned out if they become abundant.

Varieties.—There are but few varieties of this fruit offered by nurserymen, and these are the result of selections made from plants growing in the wild state. They are, however, much superior in size of fruit and in productiveness to the plants commonly found in the fields, although these latter are greatly improved by cultivation. It is very probable that by growing seedlings, new varieties much superior to those now known will be originated. The kinds now grown require several weeks in which to ripen their fruit. The only variety of importance is known as Success and probably originated in Kansas. It is productive of large purple fruit of good quality; rather spreading in habit, with pendulous fruit clusters; earlier than the others

mentioned, ripening with the early currants. Probably as good as any if not the best for general cultivation.

Aside from its fruit-producing qualities the Dwarf Juneberry makes nice lawn shrubs, being clean in habit and very pretty when covered with their profusion of graceful white flowers, which appear early in the spring.

Sand Cherry.

Sand Cherry (*Prunus pumila*).—This fruit plant is found in northern Michigan, Wisconsin, Minnesota, the Dakotas, and elsewhere. It frequently fruits prodigiously on dry, gravelly

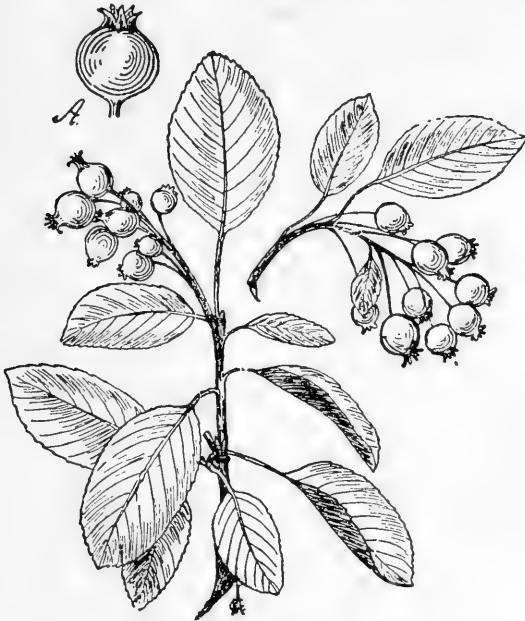


Fig. 124.—Dwarf Juneberry. Foliage and fruit.

embankments where scarcely any other plant can find existence. In fact, it seems to be better adapted to a very dry rather than to a moist location. Plants on rich, moist land will often flower profusely but fail to set much fruit. It seems quite prob-

able that where the rainfall is light this plant will do well on rich soil, but where the precipitation is abundant it is best adapted to sandy or gravelly land. Thus it fruits abundantly on the sandy land of northern Minnesota and on the dry, rich land of the Dakotas.

Description.—Some plants will reach a height of four feet and spread five feet on the ground, while others attain only half that size. The fruit resembles the cultivated cherry, but varies considerably in form, size and color on different plants. It is generally of a reddish—almost black—color when ripe.



Fig. 125.—Sand Cherry. Foliage and fruit.

The ripe fruit varies from the size of a large green pea to five-eighths of an inch or more in diameter. In some, the pit is small, while in others it is very large. The quality is generally too astringent to be relished uncooked, but this quality varies greatly in the different plants. When cooked, its astringency disappears and it makes a most excellent sauce. Where it grows abundantly it is used for sauce and for a sort of wine, which

is said to be very palatable. It is not only a productive fruit plant, but a clean, strong growing shrub, and well adapted to severe locations on the lawn. The fruit ripens in the latter part of July and first of August. It seems to be much more like a plum than a cherry, and perhaps the name sand plum would be more appropriate for it.

Propagation.—It grows freely from seed, which should be sown as soon as ripe and not be allowed to get dry. Seedlings vary much, and selected plants should be grown in other ways. They fruit in about three years from seed. In many sections the wild plants may be dug and transplanted to the garden. Plants may be increased by layers, suckers and root cuttings, and by budding and grafting on the sand cherry or the native plum. The easiest way to increase them is by cutting the roots around the plants about eight inches away from the main stem sometime when the plant is dormant, and all the cut surfaces will sprout and form new plants. If the roots are cut into pieces about six inches long and these treated like willow cuttings, they will grow nearly as readily. When budded on the plum, peculiar-looking, interesting trees are formed, which are quite fruitful. The plum may also be worked on the sand cherry and it forms a good union, but the roots are so flexible that the trees are liable to blow over unless the union is set very

deep. The common cherry does not take freely on it. At present only seedlings are offered by nurserymen, there having been no named kinds introduced.

A form of this, called the Dwarf Rocky Mountain cherry, has recently been sent out from Colorado, but has not been sufficiently tried to warrant conclusions as to its value here. It is, however, extremely doubtful whether it is any better than



Fig. 126.—Buffalo berry. Flowers.
a.—Pistillate. b.—Staminate.



Fig. 127.—Buffalo Berry. Foliage and fruit.
a.—Fruit, natural size.

the best of our native kinds. The Utah hybrid cherry somewhat resembles this but has a more erect habit. A quite limited experience seems to show it is much inferior to our best native kinds.

Bullberry, or Buffalo Berry.

Bullberry, or Buffalo-berry (*Shepherdia argentea*).—This plant is found abundantly along the river banks and coulees of the Dakotas, Montana, Wyoming and Idaho, though but sparingly, if at all, in Minnesota or the more eastern and central states, yet it grows freely and fruits abundantly in all the northern states.

Description.—A small tree or shrub with light colored foliage, young growth and opposite leaves. The flowers and fruit are clustered near the base of the small branchlets on spurs on very short stems. The plants are dioecious, i. e., one has pistillate and the other staminate flowers, so that it is necessary to have both kinds near together in order to get fruit. The flowers appear very early in the spring before the leaves and are small and inconspicuous. The fruit is produced in great abundance—often so thickly as to conceal the branches on which it grows—and when ripe gives a scarlet appearance to the

whole plant. Occasional plants have yellow fruit. It is about the size of red currants, and contains one oval, quite large seed. The quality is much like that of rather sour red currants. It makes a fine jelly, but on account of the large seeds it is not so desirable for a sauce as red currants, and it is doubtful whether it will ever be popular for fruit where the red currant is productive and reliable, but it is of use as an ornamental shrub, and it will probably be used to quite an extent for this purpose.

Propagation.—This plant suckers readily if the roots are cut, but it is generally grown from seed, which germinate readily if not allowed to dry and are winter covered with earth and sown in the spring. An easy way to winter it is to cover the seed on the surface of the ground with an inverted sod.

Mulberries.

The mulberry is seldom grown in this country and then is generally limited to two or three trees. This is probably on account of its lack of keeping qualities and its peculiar flavor which is not generally highly esteemed. It is classified by Prof. L. H. Bailey as follows:

1. The White Mulberry group (*Morus alba*).
 - a. Russian Mulberry (*Morus var. tartarica*).
 - b. Nervosa Mulberry (*Morus var. venosa*).
2. The Multicaulis group (*Morus latifolia*).
3. The Japanese group (*Morus japonica*).
4. The Black Mulberry group (*Morus nigra*).
5. The Red or Native Mulberry group (*Morus rubra*).
 - a. Lampasas Mulberry (*Morus var. tomentosa*).

The best variety of the mulberry for growing in the north Central states is known as the New American but it is not hardy in the more northern states where the Russian Mulberry takes its place. This latter is known as *Morus alba var. tartarica* and is described in Amateur Fruit Growing as follows:

“The Russian mulberry was introduced from Russia and is very hardy over much of the Northwest. The Mennonites of Nebraska were among the first to introduce it into this country and they grew it from imported seed. It makes a small tree but is much better adapted to being grown in the form of a

hedge or windbreak. In this form, it will often attain the height of twenty feet and becomes very close and pretty if given an occasional pruning. It is of a rapid growth and very hardy in southern Minnesota and southern Dakota, Nebraska and Kansas, and even north to the latitude of St. Paul, it stands fairly well. Occasionally in very severe winters, it will lose a part of its new growth but it quickly outgrows this injury and is less liable to winter killing when old than when young."

Its fruit.—With few exceptions, all trees of this species now growing in this country have been propagated from seed, and as with most other fruits, not one seedling in five hundred produces fruit of much value. Most seedlings have very small fruit, while others are staminate and have no fruit at all. Quite frequently some trees will bear fruit as large as a medium-sized blackberry, and occasionally considerably larger. The quality of the fruit varies nearly as much as the size of the berries; some being insipid and even unpleasant, while others are sweet and agreeable, but like all mulberries, they lack high quality.

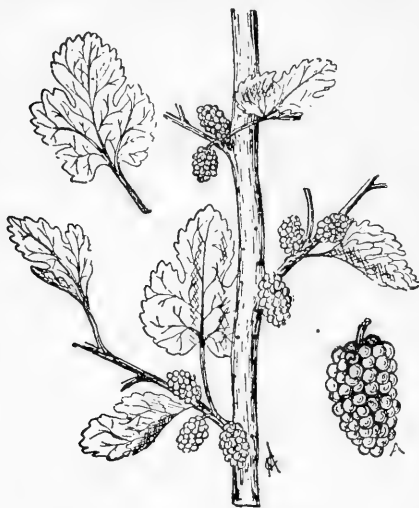


Fig. 128.—Russian Mulberry. Foliage and fruit.

They are quite soft when ripe and quickly fall to the ground, which should be kept smooth so that they may be readily gathered. It is at its best just as it falls from the tree and generally commences to ripen just before the first currants, and continues ripening for a week or more. It resembles the blackberry in appearance, but the fruit of some seedlings is nearly white in color, though the latter are seldom, if ever, as good eating as the blackberry. The age at which plants com-

mence to produce fruit varies greatly, but when five or six years old, they may be expected to commence fruiting, and as they grow older their fruitfulness increases. As a market fruit it probably has no value, but a few trees should be in every garden. Children generally relish the fruit, and the birds let other fruit alone to feed on it. It is also used for sauce and pies, but for this purpose something should be added to it for flavor.

Propagation.—The seed grows readily if sown as soon as ripe. For this purpose, the berries may be crushed in dry sand and sown with it in a rather moist, somewhat shady situation. In two years the seedlings may be transplanted to the permanent location, but seedlings vary in their productiveness, and while for a windbreak they may answer as well as any, yet when plants are wanted for fruit, they should be grown from cuttings or layers of the best kinds, or by grafting on seedling stocks. For this purpose, the cuttings should be made in the fall, about twelve inches long of the old wood, and be deeply planted in rich land, with not more than two buds above the surface. The branches root easily when layered, and if the earth is drawn up around the sprouts until they root they make good plants.

Varieties.—There are no named kinds offered by nurserymen, and it is necessary to depend on chance seedlings. However, if any large windbreak is looked over in the fruiting season one or more trees can generally be picked out that bear fruit of exceptional value, and such may readily be increased. The flowers are of two kinds; sometimes both staminate (male) and pistillate (female) are on one tree, and sometimes a single tree is limited to one sex. On this account some care is necessary in selecting a variety to get one with both kinds of flowers, or else plant the pistillate kind near a tree having staminate flowers.

The Cranberry.

Cranberry (*Vaccinium macrocarpon*).—This is the low trailing cranberry of the swamps of many of the northern states. The form and habit are well illustrated in Fig. 129. The so-called high bush cranberry (*Viturnum opulus*) is a tall shrub and much more widely distributed than the trailing cranberry. The

latter has one flat seed in each fruit, while the former is a many seeded berry. This plant is not adapted to general cultivation, and seldom, if ever, does well on the prairies of the West. It may be laid down as a general rule that it cannot be successfully cultivated except on the granitic soils of the northern states, and that it will be a failure on the limestone drift soils, such as are common to the prairies of Minnesota, Iowa and the Dakotas. In Wisconsin and eastern and northern Minnesota it is often very productive, either wild or cultivated, and is an article of much importance in the markets of those sections each year. Where this fruit can be cultivated it is often the most paying crop that can be grown.

Best location for cranberry beds.—In a wild state this plant is found at its best on moist land where the water level is within eighteen inches of the surface. It seems to be rather indifferent about the soil, sometimes growing on sand and then on peat mud or moss. As a rule the best locations are low meadow lands sloping down to ponds, or watered by brooks or creeks, somewhat sheltered but shaded. On uplands, it has been successfully cultivated, but in such situations it is generally unprofitable and frequently an entire failure. It may be laid down as a rule that the soil in which this plant is to thrive must be liberally supplied with water, and yet the land must be so drained that the water can be drawn off to at least ten inches below the surface. The best cranberry bogs are so ar-



Fig. 129.—Common cranberry. Foliage and fruit; about one-half size.

ranged that both the flowage and drainage can be controlled at will. Land that has been covered with stagnant water for a long time, as the bottom of ponds, is not fit for the growth of this plant until it has been cultivated and exposed to the air for a year or more.

Soil adapted to it.—Wherever the cranberry is growing naturally one may be sure that the land near by is adapted to its culture. If no wild plants are growing near the supposed proper location, it is a safe and good plan to plant a few rods of the most favorable portion of it as an experiment before spending much time or money on improvements which may prove to be futile. With a bog adapted to the growing of this plant, with control of the drainage and flowage, a good crop of fruit is assured for almost every year, if the work of preparation is properly done. Yet there are many wild and cultivated bogs that have yielded very profitable crops for many years where the flowage has not been controlled, and hence if that factor cannot be directed at will, it is not necessarily a sufficient reason why an attempt should not be made to plant suitable land, providing the work can be done at small cost. The returns from natural cranberry bogs may often be greatly increased by a little judicious expenditure.

Preparation of the land.—The first steps should be directed to destroying the vegetation growing on the land. The proper method of doing this will vary according to the location and condition of the land. It can sometimes be done by flooding the land for one year and then clearing it, or by summer fallowing, and it may occasionally pay to cut off the whole surface of the bog, with spade or turf ax, and remove it by hand. But in some way the surface of the land must be cleaned of its growth and made level, and fine and perfect as a garden. If it is to be flowed, it should be made perfectly level, as it will then take much less water for flowage than if uneven. This matter is especially important where the water supply is limited.

Supplying sand.—It is of great advantage to have the surface of the land covered with about four inches of clean sand, and this should be done even if at considerable expense. The sand used should preferably be rather coarse, but it must be free from clay or loam, as anything that encourages the baking

of the surface of the bed is injurious. This sand offers a good place for the plants to root, is easily cultivated, and experience shows that it is conducive to fruitfulness. Yet there are many very fruitful peat beds that have never been sanded. If a peat bed is to be used without sand, the surface should be exposed to frost one year before planting or it will be likely to bake hard, but after one season's frost it becomes loose and fine.

Drainage and flowage.—The method of securing these conditions will depend much on the situation of the land. The drainage is generally best accomplished by digging an open



Fig. 130.—Cranberry bog newly planted, showing ditch and dike; also portion of bed not yet covered with sand.

ditch four or more feet wide through the center of the land. A smaller ditch should completely enclose the land, which should be divided into beds by lateral ditches about five rods apart. Where springs are met with they must be connected with a ditch.

Importance of water.—The flowage may sometimes be controlled from a pond above the bog, or by a brook or creek running through it. Every reasonable effort should be made to secure and control water for flowage for the following reasons: (1) Without a good water supply bogs often get very dry in periods of protracted drouth, to the great injury of the plants, and occasionally peat or moss bogs get on fire and burn up, destroying all the work done. A bog once on fire can seldom be saved except by flooding. (2) The water kept over the

plants in the spring will serve to retard the blossoming until danger of frost is past, and will protect the fruit from early frosts in autumn. (3) Beds that are kept under water until late in the spring are seldom seriously injured by insects. (4) Beds do best when protected by a water covering in winter. If not thus protected they may be seriously injured.

When there is considerable fall in the bed it is customary to finish it at several grades and to put in as many dams, but where there is not more than two or three feet of fall one dam is quite sufficient. Dams should be made strong and have sluiceways large enough to let off all the water liable to drain through them.

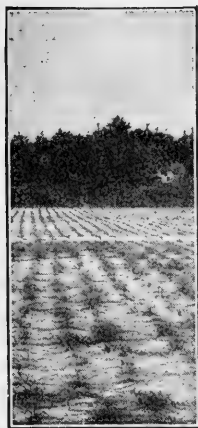


Fig. 131.—Cranberry plants, one, two and three years after setting.

About flowing.—All that is required in flowing a bog is sufficient water to cover the vines. They should be covered about the first of November, and as deep as they are to remain covered during the winter. The freezing of the vines in the ice does not hurt them, but raising the level of the water in the bed after they are frozen, and thus raising the ice and tearing the vines out of the ground, is where the great danger lies. To avoid this, the sluiceways should be kept sufficiently open to allow any surplus water to pass off.

The first two seasons the water should be kept on the vines until the last of April, but after that, or when the bog is in condition to bear, the water should be kept on until the last of May or first of June. The object of keeping it on so late is to prevent injury from late frosts, and to destroy the fruit worm and fire worm which are the worst foes of the cranberry. If the fruit is covered with water in warm weather, it is very liable to be ruined, but the vines are uninjured by such flowage. Throughout the growing season the water should be about twelve inches below the surface of the bed.

Plants and planting.—In selecting plants great care should be used to get them from fruitful beds, as some are almost barren. There are very many named kinds, and they vary greatly in size, growth, time of ripening and productiveness, but it is doubtful if any of the named kinds, the most of which originated in the East, are adapted to the climate of this section, and it is probably better for the present to depend on getting plants from the most fruitful wild cultivated beds near at hand. The kind most esteemed in the East is called the Early Black. It is very early and productive, though not a vigorous grower.

Propagation.—The cranberry plant grows very readily from cuttings, and on this account some growers cut the plants in a hay cutter, sow the pieces broadcast and harrow them in with a disc harrow, but that method of planting is not advisable. The most common way is to make cuttings of the younger parts of the vines about ten inches long, and plant one in a place,

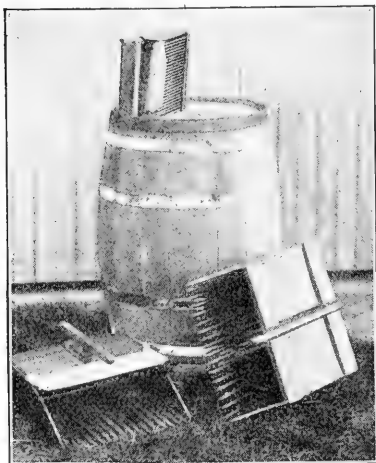


Fig. 132.—The two kinds of cranberry rakes in common use.

but sometimes longer cuttings are used which are doubled when planted. The cuttings may be carried over a whole season with good success if they are kept covered with running water, but in stagnant water they would be likely to spoil. On this account they may be set at almost any season of the year if the flowage is controlled, but the spring of the year is generally preferred, and if there is no chance to flow at will it is by far the surest time to plant.

Before planting is commenced, the bed should be marked off each way at about eighteen inch intervals. In planting, a

wooden dibber is used having an incurved or reversed wedge-shaped point, with which the cuttings are crowded through the sand down into contact with the bog beneath at one operation, without first making a hole as is customary in the ordinary use of a dibber. After the cuttings are planted the water should be raised in the trenches sufficiently to keep the surface land a little moist to encourage the rooting of the cuttings. The after-cultivation consists in keeping the soil moist and giving clean cultivation. Some of the best cranberry growers apply each year a coat of about one inch of sand to their bogs and find that it is profitable to do so as it acts much like a fertilizer.

Picking.—If the berries are allowed to fully ripen on the vine they will keep much better than if picked earlier, but where there is danger of frost before they are ripe the berries should be picked as soon as they commence to color, though when picked so early, they will seldom keep well after the middle of January. If severely frozen the berries are ruined, but they are not injured by a "white frost." Picking is generally done by hand, though some few growers "rake" them off the vines. The berries keep well in a dry, cool place, and are more easily kept if covered with water.

The Persimmon.

There are two distinct forms of the persimmon in cultivation, which are commonly known as the Native or American persimmon (*Diospyros virginiana*) and the Asiatic species (*Diospyros kaki*) which has been chiefly developed under cultivation in Japan, and is known commonly in America as the Japanese persimmon. The wood of most of the species of this tree is hard, close-grained and takes a light polish. Some of the tropical species give us the ebony of commerce.

The native persimmon is found growing wild in the Southern states and as far north as latitude 38, that is, to central Indiana. The tree, when grown in the forest, is sometimes 75 feet high but usually 20 to 30 feet high. It will ripen its fruit as far north as northern Indiana. Its use is largely local, although it is occasionally offered in the larger markets. The wild fruit varies in size from one-half to two inches in diameter, depending largely upon the number of seeds it contains. Seed-

less varieties an inch in diameter are known. The fruit is very astringent until ripe and some seedlings never lose this quality. There is a general impression that frost is necessary to sweeten this fruit but this is a mistake, as some varieties are sweet without being touched with frost and others are made more edible. It ripens from August 1st to December in the Central states. It is easily propagated by seeds which should be stratified over winter and planted in spring the same as the peach pits. The seedlings do not come true from seed. This is especially so with the selected kinds, which are propagated by budding and grafting when two or three years old at the collar in the spring, as soon as the bark will peel easily. This tree is very difficult to transplant and if its tap root is cut off, it is liable to die. The top should be severely pruned when the tree is transplanted. The persimmon will grow in any good agricultural soil, but thrives best on a good, rich, warm soil. As yet, little attention has been paid to originating good named varieties of this native fruit but some of those produced are of fine quality and destined to be widely grown in favorable localities.

The Japanese persimmons were introduced into America in the early history and have proven well adapted to the more southern states and parts of California, and are regularly to be seen in our markets and are growing in popularity. There is quite a difference in the hardiness of different varieties. Few of them can stand a temperature of zero and, as a rule, do best south of the 32nd degree of latitude. It is considered by the Japanese as their best pomological product.

The trees of the different varieties attain a height of ten feet while others are compact and dwarf in habit and do not grow more than 5 or 6 feet high. This latter class bears young, often a good crop at three years old. The fruit is very pretty, usually bright orange red or vermilion, and round or oblong in shape. They color up when far from being ripe and should not be gathered until just before the frost or when they become soft, as in the case of the early kinds. The round varieties ripen first and the oblong ripen later. The latter, if picked before being ripe, should be allowed to ripen in the house to remove the slight astringency.

Seedlings of the Japanese persimmon have a tendency to produce male flowers only during the first three years of flowering. After that, a few female flowers appear but they are few in comparison with the male flowers. A large proportion of the seedlings produce fruit that is small and too astringent to eat. There are a number of varieties offered by the nursery trade.

QUESTIONS—CHAPTER XIV.

SMALL FRUITS.

Strawberry.

1. From what species of strawberry have our cultivated varieties originated?
2. How may the strawberry be propagated?
3. What location and soil is best for strawberries?
4. How should the land be prepared?
5. When should strawberries be set out?
6. Explain the Hill system—the matted Row system.
7. How should the plants be trimmed and set?
8. What protection should be given strawberries in winter?
9. How may old strawberry beds be renewed?
10. Into what two classes may strawberries be divided?
11. What are nubbins?
12. How should strawberries be picked and marketed?
13. How may they be protected from frosts?

Currant.

1. What is the origin of the red currant? Of the black currant? Of Crandall's currant? Of the Missouri currant?
2. What soil is best adapted for currant growing?
3. How should they be planted?
4. How often and in what way should they be cultivated?
5. When do currants need mulching?
6. What is a good mulch for currants?
7. How often should currants be pruned?
8. What pruning is necessary?
9. What are "tree currants?"
10. How are they formed?
11. Of what value are they?
12. In what ways may currants be protected from winter injury?
13. How is the fruit marketed?
14. For what is it used?
15. What varieties are best for the home garden?

Gooseberry.

1. What is the origin of the American gooseberry? Of the European gooseberry?
2. What are the crosses of the two varieties?
3. How is the gooseberry propagated?
4. When is the best time to plant gooseberries?
5. What pruning is necessary?
6. How are gooseberries marketed?
7. What insects and diseases are injurious to the gooseberry?

Raspberry.

1. What varieties belong to the European raspberries?
2. What varieties belong to the American raspberries?
3. Into what two classes are raspberries divided?

4. How are they propagated?
 5. How are raspberries raised from seed? From root cuttings?
- From layers?
6. What location and soil is best adapted to each class of raspberries?
 7. How should the land be prepared for the raspberry?
 8. When should they be planted?
 9. How should the plants be selected?
 10. How far apart should the plants be set?
 11. How deep should raspberries be set?
 12. What cultivation is necessary for the raspberry?
 13. How much pruning and thinning is necessary the first year?
- The second year, etc.?
14. What mulching is best for the raspberry?
 15. How and when should it be applied?
 16. How can a good support be made for the canes?
 17. In what ways may the canes be winter protected?
 18. How are the canes laid down and covered?
 19. How are they taken up in the spring?
 20. What are the characteristics of the berries of the two classes?
 21. How are they picked and marketed?

Blackberry and Dewberry.

1. Into what groups may the blackberries be divided?
2. What are the characteristics of each?
3. How is the blackberry propagated?
4. How is the dewberry propagated?
5. What soils are best adapted to each?
6. How is the blackberry planted and cultivated?
7. What pruning does the blackberry require?

The Cranberry.

1. What are the characteristics of the high and low bush cranberries?
2. How is the trailing cranberry cultivated?
3. What is the best location for a cranberry bed?
4. What soil is best adapted for the growing of cranberries?
5. How should the land be prepared?
6. Why is sand important in the cranberry bog?
7. By what means can the bog be drained?
8. Why should the drainage and flowage be controlled?
9. How should the flowage be controlled in the fall?
10. What harm comes from freezing the plants in the ice?
11. How long should the water be kept in the bog in the spring?
12. What care is necessary in selecting the plants?
13. How are they propagated?
14. When should the plants be set? Why?
15. How should the beds be made?
16. What cultivation is necessary?
17. How are cranberries picked?

Juneberry, Buffalo Berry, Sand Cherry and Mulberry.

1. Where is the Dwarf Juneberry found most commonly?
2. What are its characteristics?
3. How are they propagated?
4. What cultivation do they need?
5. What are the characteristics of the varieties most commonly cultivated?
6. What is the distribution of the Sand Cherry?
7. What location and soil is best adapted to them?
8. What are the characteristics of the Sand Cherry?
9. How are they propagated?
10. How are they used in grafting?
11. What is the Dwarf Rocky Mt. Cherry?

12. Where is the Buffalo Berry commonly found?
13. What are the characteristics of the plant?
14. For what is the fruit used?
15. How is the plant propagated?
16. Into what classes may the Mulberry be divided?
17. What variety is best for the Northern states?
18. What are its characteristics?
19. What are the characteristics of the fruit?
20. How is the Mulberry propagated?
21. What care should be taken in selecting plants?

Persimmon.

1. Where is the American persimmon found native and what is its value for domestic use?
2. Of what country is the Japanese persimmon native and what is its value as a commercial fruit?

CHAPTER XV.

THE NUTS.

Comparatively little attention has been paid to the growing of any of the nut trees in this country, with the exception of the English walnut. Most of the American nuts, except the English walnut, that reach our markets are the chance productions of the wild groves. It is undoubtedly true that there is a large section of this country where nuts of some kind might be grown to advantage. This is especially true of rough land in some of the Middle and Southern states.

Nearly all of the cultivation of nuts in this country up to the present time has been done by the growing of seedling trees, and little attention has been paid to grafting, which for many years was regarded as a very difficult matter with all nuts. Now that successful grafting methods have been discovered, there is less excuse for planting seedlings. The leading nurserymen now offer named varieties of the principal nut trees, or else of trees grown from selected seed.

The Pecan.

The pecan (*Hicoria pecan*) is an important native nut that is used largely and gaining in popularity. It is a near relative of the hickories, several of which produce edible nuts. In its native habitat, the tree grows to a large size and the wood is highly esteemed for the same purposes as the hickory. It is native to a large part of the Mississippi Valley, Eastern and Central Texas and a portion of Mexico. It is cultivated throughout most of this section south of Central Illinois and also in the Southern states south of the Potomac river. Further north it is occasionally grown, but not profitably, and Central Iowa may be regarded as its northernmost limit.

The fruit of the pecan is borne on the new growth. The male flowers are at the base of the shoot and the female flowers near the end. The flowers appear with the leaves and are seldom injured by spring frosts. Trees from seed generally bear when

about ten years old, and at full bearing age they have been known to yield over twenty bushels to a tree.

Soil requirements.—The pecan does best on the open, porous clay loams of river bottoms and especially on those that are likely to overflow at high water. It is also grown successfully on the sandy soils of southern Georgia and northern Florida, and even on rich up-lands it frequently produces well. The most successful growers plant the trees from 40 to 50 feet apart. If the trees are grown from seed, it would be an advantage to put them nearer together and then remove the unprofitable ones. In transplanting the pecan it is desirable to save as much of the tap root as is possible, but it may be shortened somewhat without seriously interfering with its growth. The root is often very long and it will be found a great convenience in transplanting to have it somewhat shortened. Very often a one-year-old tree will have a root far longer than the stem. The soil should have the best of cultivation, as the trees are gross feeders and should be kept growing rapidly, especially when young and not fully established.

Harvesting and marketing.—It is common to harvest the nuts after they have fallen to the ground. When they are raked together the leaves are shaken out and the nuts dried off before being stored. The highly polished surface of nuts which are seen in our markets is attained by polishing them in revolving barrels where they are polished by rubbing against one another. The great demand today is for larger, thinner-shelled nuts, and there seems to be an almost unlimited market for them. Those who have pecan trees in good locations find them very profitable. Comparatively few of the best nuts are sold at present, as they are in demand by nurserymen for planting.

Insects.—There are a number of insects that injure the pecan trees. Perhaps the most serious of these is known as the shuck worm, which penetrates the hull and causes the young fruit to drop prematurely. The remedy is to gather and burn the infested nuts. A web worm is occasionally injurious to the foliage, but this may be destroyed in the same manner as recommended for the common web worm.

The twig girdler sometimes girdles the twigs of the pecan,

causing them to be blown off. The worm will be found in the part that falls. If these twigs are raked together promptly and burned soon after falling, this enemy is easily held in check.

Grafting the pecan.—The most successful method of grafting the pecan seems to be crown grafting of the seedlings, when they are only an inch or less in diameter, early in the spring with terminal bud cions and without wax. The stalks should be cut off smoothly, close to the surface of the ground, and a side cleft graft or whip graft used. When this is done, the earth should be drawn up to the top bud of the cion to prevent it drying out. In order to grow seedlings, the nuts are generally planted in autumn in well drained soil, which is sufficiently loose so that it does not bake badly; or, where mice and squirrels are abundant, a much better plan is to stratify them in the same manner as recommended for peach pits and plant out in the spring as soon as the ground can be worked, putting them about eight inches apart in rows four feet apart and covering three inches deep. Rich, deep garden soil should be used for the seedlings.

The Chestnut.

The chestnut is one of the most popular of our native nuts and is widely sought after. In some sections in Europe, where the nuts are especially abundant, they are ground into flour and used for bread making.

The American chestnut (*Castanea americana*) forms a large tree as far north as southern Vermont, and west into Indiana. North and west of this range, it is very uncertain. It has, however, been fruited in southeastern Minnesota and occasionally it is grown successfully in Illinois and Iowa. The wood of this tree is very durable in contact with the soil and of rapid growth, hence is in demand for railroad ties and telephone poles. It is one of the most promising trees for use in new timber plantings within its range. There are few varieties. Its nuts are the best in quality of all known species. The other species of chestnut graft readily upon it.

The European chestnut (*Castanea sativa*) is a native of the cooler portions of central and southern Europe, western Asia and northern Africa. The foliage of this tree is thicker and more

abruptly pointed than that of the American chestnut. Its burrs are very large and its nuts are larger but not so sweet as the American chestnut. The skin enclosing the nut is bitter and tough. This species is variously known as European, Spanish, French, Italian and Sweet Chestnut. Among the best of the European varieties are Numbo and Paragon. The latter is most widely planted and the most successful of all cultivated introduced chestnuts. It is sometimes classed as a hybrid. Both of these nuts originated in the United States and are of good quality.

Japan chestnut (*Castanea crenata*).—This tree is said to reach a height of fifty feet in Japan but the varieties that are grown for fruit are dwarfish in form and slender, with a close head. Its leaves are much smaller than those of the American or European chestnuts and the burrs are small with a thin, papery lining and short spines. The nuts are large and glossy, but inferior to the other chestnuts in quality as a rule, though good when cooked. A few varieties are of good quality when fresh. Among the best of the Japanese chestnuts are Parry and Reliance, both of which are of fair quality.

Chinquapin (*Castanea pumila*), (*C. alnifolia*).—The Chinquapins are dwarf chestnuts, extending, in their native range, from Massachusetts south to Florida and Texas. The fruit of the Chinquapins is edible and used in a local way throughout their range.

Propagation.—The different species of the chestnut are usually propagated from seed, which may be sown as soon as gathered in autumn, or stratified and sown in the spring in rich, porous soil. They may be whip-grafted in the nursery when one year old. This should be done by using dormant cions after the buds have swollen and covering with wax in the ordinary way.

Top-working of large trees has not been successful except where it has been practiced on the young sprouts. Great care should be taken to secure a good union, and if possible the cion should unite with the stock on both sides.

The flowers of the chestnut open in early summer and the long, conspicuous, light colored, male catkins are quite ornamental. The pistillate flowers are inconspicuous and grow from

the axils of the leaves on the new growth. Some growers think it necessary to have the pollen of different trees intermingle in order to get the best results. This idea is borne out by the fact that solitary trees often fail to set fruit.

Planting and care.—Ordinary seedlings of the American chestnut commence to bear when from eight to fifteen years old, while those that are grafted will frequently bear inside of five years. On account of this, some growers follow the practice of grafting all of their seedlings. It is probable that seedlings would bear as quickly as grafted trees if they were girdled as recommended for the grape. Where natural groves are used for growing nuts, the reproduction will often come from sprouts. If desired, these may be grafted and cared for the same as seedlings. In any case, however, the sprouts should be thinned out so that the trees can take on their natural form. Where the ground is overgrown with brush, it will be found a good plan, when the trees are once fairly started, and out of reach of stock, to pasture the land with sheep. This will destroy much of the brush and the lower leaves on the chestnut trees, giving them a healthy pruning. It will also have a tendency to prevent the spread of fire, as the sheep mix the fallen leaves with the soil and thus prevent the collection of large masses of leaves about the stems of the trees. If the trees are to be planted out, the American species should be set from 40 to 50 feet apart each way. The foreign kinds do not grow so large and they may be planted nearer.

The nuts are prepared for market by putting them in a suitable vessel and then pouring scalding hot water over them as soon as gathered. By this means the eggs and larvae of the insects in them are destroyed. The nuts should be gathered promptly after falling and the scalding done at once, otherwise the eggs of the weevil in the nuts will have a chance to develop and will injure their sale. The nuts should stand in the hot water for about fifteen minutes, after which they should be taken out and carefully dried.

There are several insects and diseases that affect the chestnut. The most harmful is probably the weevil, whose eggs are laid in the nut, but no satisfactory remedy has been found for it. The leaf diseases are subject to control by Bordeaux mixture.

English Walnut.

The English walnut (*Juglans regia*) is cultivated to some extent in the Eastern states south of Connecticut and west into Texas, but in the section east of the Rocky Mountains, it has not attained commercial importance. In southern California, however, it is grown very successfully within a short distance of the coast where the water table is near the surface of the soil. Back from the coast, it may also be grown in favorable locations, but the shucks do not separate from the nuts so well and hence the product is not nearly so valuable as the product from sections where the climate is somewhat humid.

The flowers of the walnuts are monoecious, the male flowers being produced in catkins and the pistillate flowers at the ends of the short branches appearing with the leaves.

Propagation.—Most of the trees in the Eastern states are grown from seed; the same is true of a large portion of the orchards in southern California, although in the last few years there has been a large number of grafted trees planted. When grown from seed, it is customary to select the largest, thinnest shelled nuts from trees that are hardy and productive, and that start late in the spring. These are stratified over winter in the same manner as peach pits. They are generally allowed to sprout in the spring before planting, when they are set about one foot apart in rows four feet apart. For this purpose rich, open, porous soil should be used. They are generally large enough for budding the first season. If they are to be planted in an orchard without budding, it is customary to leave them for two or three years in the nursery. The trees are generally budded by the shield or ring method. Cleft-grafting and whip-grafting have also been successfully used.

Harvesting and marketing.—In the best localities for the English Walnut, the shucks open on the trees and the nuts fall to the ground, where they are easily gathered once or twice a week, and taken to the drying house. Sometimes it is necessary to jar the trees in order to get the nuts in season. It is not desirable to beat the trees with poles, as it frequently destroys many of the fruit buds. The nuts are dried by exposure to sun or by artificial heat.

Japan walnut.—The Japan walnut (*Juglans sieboldiana*) is now cultivated in an experimental way and is much hardier than the English Walnut which it somewhat resembles, although not so hardy as the Black Walnut or Butternut. This tree gives promise of being productive even as far north as central Minnesota. The nuts are small and more like the Black Walnut than the English Walnut, and probably of little importance commercially.

The Black Walnut and Butternut are prized for their timber and shade as well as for their nuts. These are frequently gathered and marketed in considerable quantities and there is generally a good demand for them. The shucks should be removed and the nuts dried before they are marketed. Black Walnuts have been planted in considerable quantities in Minnesota and Iowa for fence posts and for their nuts.

The Almond.

The Almond (*Prunus amygdalus*) resembles the peach in habit of growth, flowering, etc. The nut is really a peach in which the flesh portion is obliterated. It is divided into two classes, the bitter and sweet almond. The sweet class is divided into the hard and soft shell types. The hard shell type is scarcely grown, but the soft shell type produces the edible almonds of commerce. The bitter almond has a hard shell and its chief use is as a stock for the cultivated kinds. It is also grown in the Mediterranean district for the bitter kernel, which is used in the manufacture of flavoring extracts and prussic acid. The Almond is cultivated in a very limited area confined mostly to a few small districts in California, Utah, Arizona and New Mexico. The tree is nearly as hardy as the peach, but on account of the flowers opening so very early, they are almost always destroyed by frost, except in a few favored districts. The tree comes into bearing from two to four years after budding, and is generally at its best when from six to nine years of age. Five pounds of hulled almonds per tree is reported as a good average crop in California orchards. The nuts begin to ripen about the middle of August. It is desirable to have varieties mixed in order to secure good pollination. Much disappointment has been occasioned by planting the almond in situations not suited for it, or possibly by the planting of only one variety in a large area.

Soil and planting.—The soil for almonds should be light, warm and well drained. The trees, like the peach, will stand much drought but will yield good crops only on rich, productive soil. It is, however, impatient of too much water in the soil. The trees are generally planted about 24 feet apart each way. It is customary to do considerable pruning to the tree in order to get it in good form while it is young, after which little pruning is done.

Propagation.—The almond is grown almost entirely by budding on seedlings of the sweet or bitter almond, though it is sometimes worked upon peach stocks. The seedlings are handled in very much the same way as those of the peach and the trees are planted in an orchard when one year old from the bud. The peach and the prune D'Argen are also successfully grown on the almond.

Marketing.—Where the summer air is very dry, the hulls open readily and the unstained nuts are in good condition for marketing and require no further care. In some sections, however, the nuts are more or less stained by rains and then recourse is had by bleaching them with sulfur fumes. As the sulfur fumes do not penetrate to the kernel, the nuts are not injured by this treatment. The only advantage is that it gives them a little better appearance. If the hulls do not separate readily from the nuts it is customary to use what is known as an almond huller, by means of which the hulls are pulled off. Nuts that are so badly stained that they cannot be made marketable are generally sold for confectioner's use.

The Hazel.

The European hazels are known botanically as *Corylus avellana*, *C. pontica* and *C. maxima*, and in Europe, are cultivated on an extensive scale and yield the most filberts of commerce. The species ordinarily grown in Europe have shown themselves quite liable to disease in this country and have not been successfully cultivated here. Our two native species have a wide range and are quite variable, some plants bearing fruit of very good size and quality.

The American hazels are known botanically as *Corylus americana*, *C. rostrata* and *C. californica*. They are of dwarf form and

can perhaps be cultivated to advantage on open, loose soils of moderate or poor fertility, in rows eight feet apart, although this has not proven encouraging in the few experiments tried. Some of the foreign species are quite large and grow to the height of 12 or 14 feet. The plants are generally propagated by seed layers and sometimes budding is practiced.

The flowers.—The flowers are monoecious and form on the new wood. The male flowers are grouped in the form of small catkins that may be seen on the bushes all winter. In the spring, these elongate and the pollen is distributed by the wind. The female flowers are inconspicuous and form a star-like tuft of crimson stigmas that push out from the rather large buds at the time the male flowers elongate. These flowers open early in the spring.

QUESTIONS—CHAPTER XV.

Nuts.

1. Of what country is the pecan a native?
2. What soil is best for pecan growing?
3. How should they be planted and cultivated?
4. How are pecans harvested and marketed?
5. What insects are injurious to the pecan?
6. How are pecans grafted?
7. How are they propagated from seed?
8. What are the characteristics and distribution of the American chestnut? Of the European chestnut? Of the Japanese chestnut?
9. To what extent are they grown?
10. What are the Chinquapins?
11. How are chestnuts propagated?
12. How should chestnuts be planted and cared for?
13. How should chestnuts be cared for before marketing?
14. What insects and diseases injure the chestnut?
15. Over what territory is the English walnut distributed?
16. How are they propagated?
17. How are the walnuts harvested?
18. How are they marketed?
19. What are the characteristics of the Japanese walnut?
20. What are the characteristics of the almond?
21. What soil is best adapted to it?
22. How should the almond be planted?
23. How is the almond propagated?
24. How is it harvested and marketed?
25. How is the hazel grown in Europe?
26. How is it propagated?
27. What are the characteristics of the Hazel flower?

APPENDIX.

SPRAYING CALENDAR.

This spraying calendar is taken almost entirely from Bulletin 89 of the Iowa Experiment Station, by Prof. S. A. Beach and E. E. Little. The changes made from the original are noted.

General Treatment For The Apple.

When to Spray.

What to Spray With and What For.

1. When the green tips of the first leaves burst the buds. May be omitted if insects and scab are not abundant.

Bordeaux mixture for scab, canker and leaf spot diseases with Paris Green or other arsenical poison for bud moths, case bearers, tent caterpillars, canker worms and other leaf-eating insects.

2. Just before the blossoms open.

Bordeaux mixture for diseases mentioned under 1. Paris Green or other arsenical poison for curculio and the insects mentioned under 1. The most important single treatment against the scab!

3. Just after the blossoms fall.

Bordeaux mixture for diseases mentioned under 1. Paris Green or other arsenical poison for codlin moth, curculio and leaf eating insects. The most important treatment in fighting codlin moth!

4. Ten to twenty days after 3.

Bordeaux mixture for scab, bitter rot and other diseases. Paris Green or other arsenical poison for codlin moth curculio and leaf-eating insects.

5. Late July or early August.

Bordeaux mixture for scab, bitter rot, fly speck, sooty blotch and other diseases. Paris Green or other poison for second brood of codlin moth. Important!

Special treatment early spring before buds break. Lime-sulfur wash for oyster shell scale and other scale insects.

POPULAR FRUIT GROWING.

General Treatment For Cherries.

When to Spray.	What to Spray With and What For.
1. Just before the blossoms open.	Bordeaux mixture for fruit rot.
2. Just after the blossoms fall.	Bordeaux mixture for fruit rot and leaf spot. Arsenate of lead for curculio.
3. Ten to fifteen days later than 2.	Ammoniacal copper carbonate for fruit rot and leaf spot.
4. Just after fruit is picked.	Bordeaux mixture for leaf spot.
5. From 2 to 3 weeks after 4.	Repeat 4.
6. When cherry slugs are first seen on leaves.	Dust or spray with Paris Green or other poison.

General Treatment For Plums.

When to Spray.	What to Spray With and What For.
1. About ten days before growth starts.	Copper sulfate solution (2 lbs. to 50 gallons of water) for Plum Pocket. (S. B. G.)
2. Just before the blossoms open.	Arsenate of lead for curculio. Bordeaux mixture for fruit rot on blossoms.
3. Just after the blossoms fall.	Bordeaux mixture for fruit rot and leaf-spot. Arsenate of lead for curculio. (Dilute the Bordeaux about one-half for Japanese varieties.)
4. About 15 days after the blossoms fall.	Repeat 2.
5. Soon after the middle of June.	Repeat 2.
6. Late July or early August.	Ammoniacal copper carbonate soap or eau celeste soap for fruit rot and leaf spot.
7. On first appearance of insects.	Arsenate of lead for web worms and other leaf-eating insects.

General Treatment For Peaches.

When to Spray.	What to Spray With and What For.
1. Before the buds swell; surely before April first.	Bordeaux mixture or lime-sulfur wash (or copper sulphate solution, S. B. G.) for leaf curl and fruit rot.

General Treatment For Pears.**When to Spray.**

Same as for the apple.

When twig blight first appears, and during the dormant season when the leaves are off.

What to Spray With and What For.

Treat same as for apple scab, leaf spot and insects.

Cut affected branches back to sound wood and burn them. Keep tools disinfected by wiping with cloth saturated with kerosene or other disinfectant after each branch is cut.

Before buds open in spring spray with lime-sulfur wash.

General Treatment For Grapes.**When to Spray.**

1. Just before growth starts.

2. When the leaves are one-third grown.

3. Just before the blossoms open.

4. Just after the fruit sets.

5. 10 to 20 days after 4.

6. 10 to 20 days after 5.

What to Spray With and What For.

Bordeaux mixture or sulfate of copper solution (1 pound to 25 gallons of water) for grape rot. (S. B G.)

Bordeaux mixture for mildews and black rot. **IMPORTANT!**

Repeat 2.

Repeat 2. **IMPORTANT!**

Repeat 2.

Repeat 2.

General Treatment For Currant and Gooseberry.**When to Spray.**

1. When worms first appear.

2. When fruit is about half grown.

3. After fruit is picked.

4. About 2 weeks after 3.

What to Spray With and What For.

Paris Green or other arsenical poison for the "worms." Bordeaux mixture for leaf spot.

Repeat 1.

Bordeaux mixture for leaf spot.

Repeat 3.

General Treatment For Strawberry.**When to Spray.**

When growth begins and later as often as necessary.

After picking the fruit.

At first appearance of the leaf roller.

What to Spray With and What For.

Bordeaux mixture for "rust" or leaf spot.

Cut and burn foliage on windy day.

Arsenical poison every week if necessary, but not after fruit is half grown.

General Treatment For Raspberry, Blackberry and Dewberry.**When to Spray.**

When orange rust appears. Note.—This disease is easily recognized by the bright orange color on the under side of the leaf. The whole cane looks sickly.

When anthracnose and other cane diseases are doing serious damage.

What to Spray With and What For.

Dig plants at once and burn.

After leaves drop in fall or in early spring, cut and burn over the whole affected patch.

General Treatment For Potato.**When to Spray.**

Begin when plants are about 8 inches high or when beetles first appear and spray at intervals of from 10 to 15 days till growth stops.

Spray more frequently in hot, damp weather and less often in dry weather.

Soak seed potatoes two hours.

What to Spray With and What For.

Bordeaux mixture combined with Paris Green or other poison for early blight and late blight and rot, also for flea beetles, blister beetles, and Colorado potato beetles. Make strong Bordeaux mixture, using at least one pound of copper sulfate to make 3 gallons of the mixture.

To prevent potato scab, use commercial formalin (40 per cent solution) 1 pint to 30 gallons of water. This is enough for twenty bushels of seed.

General Treatment For Cucumbers, Squashes and Melons.**When to Spray.**

When young plants come through the ground; repeat frequently.

About 1 month after planting. Repeat at intervals of 10 day

What to Spray With and What For.

Tobacco dust for striped beetle.

Spray with Bordeaux mixture for blight, flea beetles and striped beetles.

General Treatment For Cabbage and Cauliflower.**When to Spray.**

When "worms" appear. Repeat when necessary.

Lice or aphids.

What to Spray With and What For.

Paris Green or other arsenical poison in dust, or in resin-lime mixture. Do not apply poison after heading begins.

Bury the affected plants.

General Treatment For All Kinds of Plants.**What to Spray For.**

All leaf-eating insects, such as slugs, caterpillars, beetles, etc.

Sucking insects, such as plant lice and true bugs.

Scale insects, such as oyster shell scale, scurfy bark louse and San Jose scale.

What to Spray With and When.

Paris Green or other arsenical poisons when insects first appear.

Tobacco dust or tobacco infusion with whale-oil soap or kerosene emulsion. Small plants or ends of twigs are best treated by dipping.

Spray with the lime-sulfur wash in spring before the buds open.

FUNGICIDES AND INSECTICIDES.

Sprays are preventive and not curative and therefore must be applied before the injury becomes apparent. After a fungus has gained entrance to the fruit or foliage it cannot be reached, but the infection may be prevented by coating the parts with a fungicide such as Bordeaux Mixture, which prevents the germination of the spores of the fungus.

Fungicides.**Bordeaux Mixture:**

Copper sulfate (blue vitriol) 5 pounds.

Quicklime (not slaked), not less than $3\frac{1}{2}$ pounds or more than 5 pounds.

Water, 50 gallons.

Dissolve the copper sulfate and dilute to from 25 to 35 gallons. Slake the lime and add enough water to it to complete the required 50 gallons; then pour the two solutions together. Lastly, add any arsenical poisons which are to be combined with the Bordeaux mixture. This is a general fungicide for all fruit plants.

Testing Bordeaux Mixture. To determine if the Bordeaux mixture is safe to use on tender foliage, one of three simple tests may be used:

(a) Insert the tip of a knife for at least one minute, when if metallic copper forms on it, i. e., the tip is the color of copper, more lime should be added. If on the other hand the steel remains unchanged it is safe to conclude the mixture is all right.

(b) Pour some of the mixture into a shallow dish; then blow into it for at least one-half minute, when, if properly made, a thin scum-like oil will form on the surface.

(c) Pour a few drops of a solution of ferrocyanide of potassium into the Bordeaux mixture. If there is not enough lime present, a dark reddish-brown substance will form. Ferrocyanide of potassium is known as yellow prussiate of potash. It is a very deadly poison. To prepare it for use add about ten times its bulk of water.

Bordeaux mixture should always be well stirred before it is tested.

Bordeaux Dont's. Don't use iron or tin vessels for mixing; don't use air-slaked lime; don't pour in the coarser particles of lime; don't make more than can be used in one day—it should be mixed fresh every day.

Eau Celeste and Soap:

Copper sulfate, 1 pound.

Ammonia, strong (26° Baume), 3 pints.

Soap, 1 pound.

Water, 50 gallons.

Dissolve the soap in 10 gallons of water. In a separate vessel, not iron or tin, dissolve the copper sulfate in 40 gallons of water

and add the ammonia; stir well and add the soap. This is a good fungicide to use in place of Bordeaux mixture when the fruit is full grown.

Ammoniacal Copper Carbonate and Soap:

Copper carbonate, 6 ounces.

Ammonia, strong, 3 pints.

Soap, 1 pound.

Water, 50 gallons.

Dilute the ammonia with water and use as much of it as is necessary to dissolve the copper carbonate; add water to make 40 gallons. Dissolve the soap in 10 gallons of water and pour into the copper carbonate solution. The dissolved copper carbonate loses strength when left exposed to the air, but it may be kept all right in stopped bottles or jugs. This is used when the fruit is nearly ripe because it shows less than the Bordeaux mixture.

Potassium Sulfide or Liver of Sulfur:

Potassium sulfide, 3 ounces.

Water, 6 gallons.

Dissolve the potassium sulfide in the water. Apply at once. This mixture deteriorates rapidly and should not be prepared until ready for application. This is an effective spray for mildew on gooseberries.

Lime-Sulfur Wash:

Lime, 15 pounds.

Sulfur, 15 pounds.

Water, 50 gallons.

Place the lime in a kettle and slake it with hot water so that it forms an even white paste, then add water until it makes a thin whitewash. Blend the sulfur with water into a thin paste and add to the whitewash and mix thoroughly. Boil one hour, stirring frequently to keep from caking on the sides of the vessel, and adding water from time to time to replace that which has boiled away. Dilute to 50 gallons and bring to the boiling point again. Strain it boiling hot into the spray tank through wire screen and apply as hot as possible. It should be boiled until it is a brick red color and until the sediment, when it has settled, is brownish or yellowish green. Salt is recommended to be added to the sulfur pound for pound, but it may be omitted with no material disadvantage. Use good fresh stone lime which slakes free from grit and dirt. Either flowers of sulfur or light or heavy flour of sulfur may be used. The flowers of sulfur goes into solution most readily.

In orchard practice this wash is mostly used against insects which are found on the trees when they are dormant. It has proved very effective against the San Jose Scale, oyster shell scale, the scurfy scale, the case bearers and other insects which pass the winter on the trees. It was formerly customary to add salt to this wash in order to make the wash more adhesive, but later experience seems to show that is not effective.

Copper Sulfate Solution:

Copper sulfate at the rate of one pound to twenty-five gallons of water is used for the prevention of grape rot, plum pocket and peach leaf curl. Some experiments seem to show that good results will follow from an application of this kind on apples, cherries, and some other trees and plants. This solution should only be applied to dormant plants, and it is probably best to apply it early in the spring, at least two weeks before there is any sign of vegetation. If applied after the plants have started, injury will result. Its object is to destroy the spores of injurious diseases that may be on the plants.

Insecticides.

Paris Green:

Dry Paris Green—Flour, 20 pounds.

Paris Green, 1 pound.

Mix the two and dust the plants when they are moist from dew or rain.

Wet Paris Green—Paris Green, 1 pound.

Bordeaux mixture or water, 50-300 gallons.

For apples or pears use 1 pound to 150 gallons of Bordeaux mixture or water. If water is used add 2 pounds of fresh slaked lime to prevent injury to the foliage.

For cherries or plums use 1 pound Paris Green to 300 gallons of Bordeaux mixture or water.

For potatoes use 1 pound Paris Green to 75 gallons of Bordeaux mixture or water.

For cabbages and cauliflowers use 1 pound Paris Green to 80 gallons resin lime mixture after the plants begin to head.

Arsenite of Soda:

White Arsenic, 1 pound.

Sal Soda, 4 pounds.

Water, 1 gallon.

Mix and boil about 15 minutes or until the arsenic is all dissolved. Add just enough water to make up for that lost in boiling, then put in jugs or bottles until needed. Two quarts of this solution may be used in the place of 1 pound of Paris Green by adding about 4 pounds of fresh slaked lime or by combining with Bordeaux mixture in which there is an excess of lime. This spray forms a cheap substitute for Paris Green, but is liable to burn the foliage of tender plants.

Arsenate of Lead:

Lead acetate (sugar of lead), 22 ounces.

Sodium arsenate, 8 ounces.

Water or Bordeaux mixture, 100 gallons

Dissolve each separately; then mix the two together and pour this mixture into the required amount of water, or if it is to be used with the Bordeaux mixture, pour it into the lime wash before that is mixed with the copper sulfate solution.

The sodium arsenate dissolves in water quite readily. Dissolve it in about a gallon of water. Into it pour the dissolved lead acetate to the required amount and let it settle. Then take a small quantity of the liquid in a cup to test it. This is done by adding to it a little more of the lead acetate solution. If a white substance then forms, it signifies that not enough of the lead has been used to combine with all of the arsenic, and therefore more lead acetate should be added to the mixture. Then pour this mixture into the lime wash if it is to be used with the Bordeaux mixture.

While arsenate of lead may be made at home by the above formula, yet it is commonly purchased in a paste form in sealed packages. The home made article is more finely divided and stays in suspension longer than the commercial form; yet the difficulty of getting reliable materials with which to make it oft-times prevents its being a success.

Arsenate of lead has the merit of adhering well to and being harmless to the foliage. As a rule, about three pounds of arsenate of lead are required for fifty gallons of water, while of Paris Green, its most popular competitor, about one-third to one-half pound would be required. This would make the arsenate of lead cost for spraying purposes from two to two and one-half times as much as Paris Green. On the other hand, the arsenate of lead adheres so tenaciously to the foliage that less applications of it are usually necessary. This is especially true in rainy weather. This feature of it, together with its

harmlessness to the foliage, makes it a very desirable insecticide. It is especially effective against the codlin moth and the curculio.

Soap:

Whale Oil Soap, 1 pound.

Water, 6 gallons.

Whale oil soap or other cheap soap is used for plant lice and other soft bodied insects. When the leaves are off the trees it may be used as strong as 2 pounds to the gallon of water. It is sometimes used in treating scale insects.

Hellebore:

Hellebore, 1 pound.

Water, 25 gallons.

Hellebore may be mixed with three or four parts of flour and dusted on the insects, or it may be mixed with water and used as a spray. It is especially useful in combating worms on currants and gooseberries while the fruit is ripening, because it may be used without serious danger of poisoning the fruit.

Pyrethrum:

Pyrethrum powder, 1 ounce.

Water, 3 gallons.

For dry applications, mix thoroughly one part by weight of insect powder with four of cheap flour and keep in a closed vessel for twenty-four hours before dusting over the plants. Pyrethrum, if fresh and pure, can be made to do very effectual work. It should be kept in tightly sealed cans. If the best pyrethrum cannot be obtained it would be better to use some other insecticide.

Resin Lime Mixture:

Pulverized resin, 5 pounds.

Concentrated lye, 1 pound.

Fish oil or any cheap oil except tallow, 1 pint.

Water, 5 gallons.

Place oil, resin and a gallon of water in a kettle and heat until resin is softened; add lye solution made as for hard soap. Stir thoroughly, add remainder of water and boil for about two hours until the mixture will unite with cold water making a clear amber colored fluid. Replace the water which has boiled away by adding boiling water to make the 5 gallons. This gives a stock solution which may be kept until needed. In using it, add to the 5 gallons, 80 gallons of water, 15 gallons of thin whitewash, and 1 pound of Paris Green or its equivalent. Resin Lime mixture is used in spraying smooth leaved plants, like cabbage and cauliflower, to which other mixtures do not stick well.

Kerosene Emulsion:

Kerosene (coal oil), 2 gallons.

Rain water, 1 gallon.

Soap, $\frac{1}{2}$ pound.

Dissolve the soap in water by boiling. Take from the fire and while hot, turn in kerosene and churn briskly for five minutes. It can be easily churned by pumping. Dilute before using with 6 to 9 parts of water. For scale insects and all sucking insects.

Lime:

Dry slaked lime is often used in combating insects having soft, sticky bodies, such as those of the rose slug, cherry slug and asparagus beetle.

Tobacco Dust:

Tobacco dust may be obtained from large manufacturers at a comparatively small cost. In addition to its value as an insecticide, it has the advantage of acting as a fertilizer. It is useful in fighting striped beetles which infest cucumbers, squashes and melons,

and in keeping plant lice and other insects from the garden plants. It is also used against root lice, particularly the woolly aphids. For this purpose, it should be worked into the ground in liberal quantities.

Tobacco and Soap:

Tobacco (waste stems), 1 pound.

Boiling water, 4 gallons.

Add the hot water to the tobacco and let it stand until cold. Strain and add 1 pound of whale oil soap or 2 pounds of soft soap to each 50 gallons of infusion. Used for plant lice.

WAXES FOR GRAFTING AND FOR WOUNDS.

The following recipes for waxes are taken from the Horticulturist's Rule Book:

1. Common Resin and Beeswax Waxes:

a. Reliable wax.—Resin, 4 parts by weight; beeswax, 2 parts; tallow, 1 part. Melt together and pour into a pail of cold water. Then grease the hands and pull the wax until it is nearly white. One of the best waxes, either for indoor or outdoor work.

b. Resin, 4 pounds; beeswax, 1 pound; tallow, 1 pound.

c. Resin, 6 pounds; beeswax, 2 pounds; linseed oil, 1 pint.

d. 6 pounds resin, 1 pound beeswax and 1 pint linseed oil; apply hot with a brush, one-eighth of an inch thick over all the joints

2. Alcoholic Waxes:

Lefort's Liquid Grafting-Wax, or Alcoholic Plastic.—Best white resin, 1 pound; beef tallow, 1 ounce; remove from the fire and add 8 ounces of alcohol. Keep in closed bottles or cans.

3. Waxed String and other Bandages:

Waxed String for Root-Grafting.—Into a kettle of melted wax place balls of No. 18 knitting-cotton. Turn the balls frequently, and in five minutes they will be thoroughly saturated, when they are dried and put away for future use. This material is strong enough, and at the same time breaks so easily as not to injure the hands. Any of the resin and beeswaxes may be used. When the string is used it should be warm enough to stick without tying.

Waxed Cloth.—Old calico or thin muslin is rolled on a stick and placed in melted wax. When saturated it is allowed to cool by being unrolled on a bench. It is then cut in strips to suit.

Waxed Paper is used to a large extent in some nurseries for covering root grafts. It is made by painting tough paper with hot wax, which is then hung up to dry.

**LISTS OF FRUITS ESPECIALLY ADAPTED TO CERTAIN
TYPICAL STATES.**

The list of fruits given for different states must be looked upon as only directive. The states given are selected because they represent certain typical areas adapted to fruit growing. Lists of this kind, however, are often misleading to the beginner, and the inexperienced should be cautious how they follow such lists for the reason that soil and climate may change in some sections of the country within very short distances; for instance,

parts of California are well adapted for orange raising, and within a short distance, on a considerably higher elevation, the country may be well adapted to the growing of apples. Those who are intending to begin planting in any section should aim to get in touch with the Experiment Stations and obtain from them a list of fruits especially adapted to their location.

Varieties of Fruits Recommended for Planting in Alabama.

By R. S. Mackintosh, Professor of Horticulture and Forestry, Agricultural College, Auburn, Ala.

North half of state.

Apples—Red June, Red Astrachan, Early Harvest, Family, Wine-sap, Yellow Transparent, Horse, Yates, Terry.
 Apples, Crab—Not planted to any considerable extent.
 Apricots—Not planted.
 Blackberries—Dallas, Early Harvest.
 Cherries—Not planted.
 Currants—Not planted.
 Gooseberries—Not planted.
 Grapes—Bunch: Delaware, Niagara, Concord. Muscatine type: Eden, Memory and Scuppernong.
 Peaches—Greensboro, Carman, Hiley, Family Favorite, Belle, Elberta, Solway, White Heath.
 Pecans—Stuart, Van Deman, Pabst.
 Pears—Kieffer.
 Plums—Red June, Burbank, Abundance.
 Raspberries—Northern part of state: Gault, Springfield, Cuthbert, Cardinal.
 Strawberries—Lady Thompson, Klondike, Hoffman, Gandy, Dunlap.
 Figs—Celestial, Brown Turkey.
 Oranges—Coast region only: Satsuma.
 Japanese Persimmons—Hachiya, Okame, Hyakume, Tane-Nashi.
 Pomegranates—Sweet, Acid.

Varieties Recommended for Planting in California.

By E. J. Wickson, Dean of College of Agriculture, Berkeley, California.

There is practically no differentiation as yet between varieties for amateurs and commercial varieties. The leading varieties used commercially are selected by amateurs so far as their characters agree with individual desires. The following list of varieties is especially recommended for the coast region of California:

Apples—Newton, Pippin, Belle Fleur, Gravenstein, R. I. Greening, E. Spitzenberg, Mo. Pippin, W. Astracan, Red June.
 Grapes—Muscat, Tokay, Cornichon, Thompson, Emperor, Malaga, Rose of Peru, Zinfandel, Sweet Water, Verdal, Carignane, Black Prince, Alicante, Sultina.
 Peaches—Muir, Phillips, Solway, Lovell, Early Crawford, Tuskenia, Foster, Elberta, Late Crawford, Orange Cling, Susquehanna, Nichols, Sellers, Lemon, St. Johns, Henrietta, Mary's Choice, Hale, Alexander, Heath.
 Pears—Bartlett, Winter Nelis, Seckel, Easter, Du Comice, Doyenne D'Ete, Clapp's Favorite, Glout Morceau, Barry, Comet.
 Plums—Wickson, Hungarian, Kelsey, Yellow Egg, Tragedy, Washington, Satsuma, Burbank, Jefferson, Climax, Grand Duke, Clyman.

Blackberries—Crandalls, Mammoth, Lawton, Kittatinny.

Currants—Cherry.

Gooseberries—Berkeley, Houghton.

Quince—Apple, Orange, Paragon.

Raspberries—Logan berry. Phenomenal (Hybrids)

Black—None grown.

Red—Cuthbert.

Strawberries—Dallas, Arizona, Melinda, Thompson, Brandywine, Gandy.

Varieties Recommended for Planting in Colorado.

By W. Paddock, Professor of Horticulture, Agricultural College, Fort Collins, Colorado.

For Arkansas Valley.

Apples—Jonathan, Gano, Stayman, Winesap, Grimes, Colò. Orange. Wealthy, Duchess and Haas for early.

Apples, Crab—Whitney.

Blackberries—Early Harvest, Lawton, Snyder.

Cherries—Montmorency, Morello, Richmond.

Currants—Cherry, Fay, Red Cross.

Gooseberries—Smith, Downing, Houghton.

Grapes—Concord, Niagara, Moore's Early.

Peaches—Only grown by laying down in winter; Crawford, Elberta.

Pears—Not much grown. Bartlett, Kieffer, Seckel.

Plums—Wyant, Cheney, Pfeffer, Premium, Moore's Arctic in the north. Lombard, Bradshaw, Italian Prune in Arkansas Valley.

Quince—Not grown.

Raspberries—

Black—Kansas.

Red—Marlboro.

Strawberries—Capt. Jack, Jocunda, Bederwood.

Varieties Recommended for Planting in Iowa.

By S. A. Beach, Professor of Horticulture, Iowa Agricultural Experiment Station, Ames, Iowa.

Apples—In selecting stocks upon which to top-work less hardy varieties, much yet needs to be learned. In the light of our present knowledge of this subject, Hiberna and its kin appear to be suitable for the most northern parts of the state, while in southern Iowa, Plumb Cider and Haas appear to be especially desirable for this purpose.

Northern Iowa—Yellow Transparent, Lowland (Lowland Raspberry), Charlamoff, Oldenburg (Duchess), Patten Greening, Wealthy, Anisim, Longfield, Hutchin's Red, Northwestern (Greening), Salome, Black Annette, Iowa Blush, Windsor, Tolman Sweet, Allen Choice, Stayman, Delicious, Ben Davis or Black Ben Davis or Gano.

Central Iowa—Yellow Transparent, Lowland (Lowland Raspberry), Charlamoff, Oldenburg (Duchess), Wealthy, Anisim, Longfield, Fall Orange, Ramsdell Sweet, Hutchins Red, Grimes Golden, Jonathan, Roman Stem, Northwestern (Greening), Salome, Black Annette, Iowa Blush, Windsor, Tolman Sweet, Allen Choice, Stayman, Ralls Genet, Delicious, Nelson Sweet, Winesap, York Imperial, Ben Davis or Black Ben Davis or Gano.

Southern Iowa—Yellow Transparent, Lowland (Lowland Raspberry), Red June, Oldenburg, (Duchess), Dyer, Wealthy, Benoni, Fall Orange, Ramsdell Sweet, Hutchins Red, Grimes Golden, Jonathan, Roman Stem, Iowa Blush, Windsor, Allen Choice, Stayman, Ralls Genet, Delicious, Nelson Sweet, Winesap, York Imperial, Ben Davis or Black Ben Davis or Gano.

Pears—On account of the prevalence and great destructiveness of pear blight in Iowa, pear culture is precarious in all parts of the state. The varieties named below have shown a good degree of hardiness and resistance to blight in some localities in Iowa: Fluke, Bloodgood, Warner, Seckel, Flemish Beauty, Bezi de la Motte, Longworth, Kieffer, Anjou.

Peaches—Because of their lack of hardiness peaches are seldom fruited north of central Iowa and only the hardier varieties can be recommended for planting in any portion of the state. The varieties named below are among the best of those which have been fruited successfully in different portions of central and southern Iowa: Sneed, Greensboro, Champion, Lone Tree, Russell, Hill Chili, Crosby.

Plums—Northern Iowa—Forest Garden, Ocheeda, De Soto, Cheney, Wolf, Wyant, Hawkeye, Stoddard, Brittlewood (?), Hammer (?), Miner.

Central Iowa—Forest Garden, Ocheeda (?), De Soto, Wolf, Wyant, Hawkeye, Stoddard, Brittlewood, Hammer, Miner.

Southern Iowa—Forest Garden, Ocheeda (?), De Soto, Wolf, Wyant, Hawkeye, Stoddard, Brittlewood, Hammer, Miner.

Varieties Recommended for Planting in Michigan.

By Prof. L. R. Taft, East Lansing, Mich., Superintendent of Farmers' Institute.

Apples—Red Astrachan, Duchess, Wealthy, Baldwin, Maiden Blush, Jonathan, Hubbardston, Grimes, Wagener, Red Canada, Golden Russet.

Apples, Crab—Transcendent, Hyslop, Martha, Whitney.

Blackberries—King, Wilson, Snyder, Eldorado, Taylor.

Cherries—Early Richmond, Montmorency, English Morello, Gov. Wood, Black Tartarian.

Currants—Victoria, Red Dutch, London, White Dutch, Perfection.

Gooseberries—Downing, Smith Improved, Keepsake, Industry.

Grapes—Moore, Worden, Concord, Delaware, Niagara, Diamond, Brighton.

Peaches—Triumph, Dewey, Engle, Elberta, Kalamazoo, or New Prolific.

Pears—Clapps, Bartlett, Howell, Seckel, Anjou, Kieffer, Lawrence.

Plums—Abundance, Burbank, Bradshaw, Lombard, Grand Duke, Monarch.

Quince—Orange, Rea and Champion.

Raspberries—

Black—Kansas, Gregg, Cumberland.

Red—Miller, Marlboro, Eaton, Cuthbert.

Strawberries—Excelsior, Haverland, Clyde, Sample, Dunlap, Aroma, Pride of Michigan, Dornan, Brandywine.

Varieties of Fruits Recommended for Planting in Minnesota.

By Minnesota State Horticultural Society.

Apples—First degree of hardiness—Duchess, Hibernial, Charlamoff, Patten's Greening, Okabena. Second degree of hardiness—Wealthy, Tetofsky, Malinda, Peerless, Anisim. Most profitable for commercial planting in Minnesota—Wealthy, Duchess, Patten's Greening, Okabena, Anisim. Varieties for trial—Salome, Eastman, Yellow Sweet, Brett, Milwaukee, University, Lowland Raspberry, Iowa Beauty, Jewell's Winter, Gilbert. Valuable in some locations—Wolf River, McMahon, Yellow Transparent, Longfield, Northwestern Greening.

Crabs and Hybrids—For general cultivation—Florence, Whitney, Early Strawberry, Minnesota, Sweet Russet, Virginia, Transcendent. Varieties for trial—Lyman's Prolific, Faribault, Shields.

Plums—For general cultivation—DeSoto, Surprise, Forest Garden, Wolf (Freestone), Wyant, Stoddard. Most promising for trial—New Ulm, Brittlewood, Compass Cherry, Terry.

Grapes—First degree of hardiness—Beta, Janesville. Second degree of hardiness—Moore's Early, Brighton, Delaware, Worden, Agawam, Concord, Moore's Diamond.

Raspberries—Red Varieties—King, Turner, Marlboro, Miller, Brandywine, Loudon. Black and purple varieties—Palmer, Nemaha, Gregg, Older, Columbian, Kansas.

Blackberries—Ancient Britain and Snyder.

Currants—Red Dutch, White Grape, Victoria, Long Bunch, Holland, North Star, Pomona, Red Cross, Perfection, London Market.

Gooseberries—Houghton, Downing, Champion, Pearl.

Strawberries—Perfect varieties—Bederwood, Enhance, Lovett, Splendid, Glen Mary, Clyde, Senator Dunlap. Imperfect varieties—Crescent, Warfield, Haverland.

Native Fruits—Valuable for trial—Dwarf Juneberry, Sand Cherry, Buffaloberry, High Bush Cranberry.

Varieties recommended for Planting in Missouri.

By J. C. Whitten, Professor of Horticulture, Columbia, Mo.

Apples—Ben Davis, Gano, Jonathan, Grimes, York, Winesap, Ingram, Rome Beauty, Maiden's Blush, Wealthy, Early Harvest.

Apples, Crab—Florence, Whitney, Hyslop.

Apricots—Alexander and Budd (Even these do not thrive, and I know of none that are well adapted).

Blackberries—Snyder, Taylor, Lawton, Early Harvest.

Cherries—Early Richmond, English Morello, Montmorency.

Currants—Red Dutch, White Dutch, Red Cherry.

Gooseberries—Downing, Smith, Houghton.

Grapes—Moore's Early, Worden, Concord, Woodruff Red, Wyoming Red. For wine—Cynthiana, Elvira.

Peaches—Champion, Carman, Family Favorite, Elberta, Crosby, Salway.

Pears—Kieffer, Garber, Dwarf Duchess, Anjou, Keull.

Plums—Wild Goose, Wayland, Gold, Dawson, Chabot, Burbank.

Quince—Missouri Mammoth, Orange.

Raspberries—
Black—Evans, Kansas, Hopkins, Gregg.
Red—Turner, Cardinal, Loudon.

Strawberries—Aroma, Excelsior, Warfield, Bubach, Haverland, Gandy.

Varieties Recommended for New York.

By S. D. Willard, Geneva, N. Y., leading nurseryman and fruit grower.

Apples—Garden Royal, Gravenstein, Oldenburg, McIntosh, Esopus, Spitzenburg, Northern Spy, Boiken.

Apricots—Acme, Montgamet.

Blackberries—Early Bagnard, Eldorado.

Cherries—Sour: Richmond, Morello, Montmorency.
Sweet: Rockport, Windsor, Schmidt.

Currants—White Imperial, Wilder.

Gooseberries—Downing, Columbus.

Pears—Bartlett, Anjou, Lawrence, Washington.

Plums—Reine Claude, Burbank, German Prune. The varieties especially valuable for home use are very few.

Raspberries—
Black—Diamond, Gregg, Cumberland.
Red—Cuthbert, Loudon, Golden Queen.

List of Fruits for Northern New England.

By W. M. Munson, Professor of Horticulture, Agricultural College, Orono, Me.

Apples—Oldenburg, Gravenstein, Baldwin, Spy, Hubbardston, Stark, Tolman, Fameuse. For home use, add—Astrachan, Williams, Mother, Paradise, Winter Sweet, Mackintosh. For extreme northern parts of Maine and Vermont, except Grand Isle County, hardier sorts are required; for example—Wealthy, Dudley, Oldenburg, Alexander, Rolfe, Arctic and some local varieties, like Stowe and Hayford.

Apples, Crab—Hyslop, Martha, Transcendent.

Blackberries—Agawam and Snyder.

Cherries—Richmond, Windsor, English Morello.

Currants—Fay, Wilder, White Imperial.

Grape—Moore's Early, Campbell's Early, Green Mountain, Worden, and possibly, King.

Gooseberries—Downing.

Peaches—Not commercially grown.

Pears—Angouleme, Anjou, Bartlett, Bosc, Clapp, Diel, Lawrence, Sheldon, Vermont Beauty.

Plum—Bavay, Burbank, Bradshaw, Grand Duke, Imperial, Gage, Moore's Arctic.

Quince—Not commercially grown.

Raspberries—

Black—Cumberland, Gregg.

Red—Cuthbert, Loudon.

Purple—Shaffer.

Strawberries—Dornan, Dunlap, Glen Mary, Warfield.

List of Fruits Recommended for New Jersey.

By M. A. Blake, Horticulturist, Experiment Station, New Brunswick, N. J.

Apples—I would suggest Early Harvest, Early Ripe, Red Astrachan, William's, Starr, Summer Rambo, Wealthy, Maiden's Blush, Fall Pippin, Jonathan, Stayman's Winesap, Winesap, York Imperial and Rome Beauty. These varieties are recommended for south Jersey. North Jersey has practically the same conditions for fruit growing as New York State, and such varieties as Northern Spy, R. I. Greening, Baldwin and Mackintosh can be included in the list. All varieties that are adapted to New York state can be grown in northern Jersey. Such varieties as Baldwin and R. I. Greening are practically fall apples in southern Jersey.

Crab Apples—Hyslop and Transcendent.

Apricots—Harris Hardy and Moorpark.

Blackberries—Ward.

Cherries—

Sweet—Governor Wood, Yellow Spanish, Black Tartarian, Windsor.

Sour—Early Richmond and May Duke.

Currants—Wilder, Fay and Cherry.

Gooseberries—Downing, Columbus and Red Jacket.

Grapes—Commercial varieties for south Jersey—Concord and Ives. Some grapes are sold from south Jersey for eating purposes, but the larger quantity is now made into grape juice. The two varieties named are the ones almost exclusively grown. Green Mountain, Niagara, Brighton, Worden, Moore's Diamond, Delaware and others can be grown for dessert and home use, however.

Peaches—Greensboro, Hiley, Carman, Waddell, Mountain Rose, Early Crawford, Niagara, Reeve's Favorite, Elberta, Late Crawford, Belle of Georgia, Old Mixon, Steven's Rareripe, Salway.

Pears—Kieffer and La Conte for market. Bartlett, Clairgeau and such varieties can be recommended for the home orchard, but are likely to be severely attacked by blight. Clapp's Favorite is especially susceptible.

Plums (European)—Lombard and Fellenburg. (Japanese)—Red June. Quinces—Champion and Orange.

Raspberries—

Black—Cumberland and Kansas.

Red—Herbert and Cuthbert.

Hybrids—Columbian and Haymaker.

Strawberries—Gandy, Tennessee Prolific, Nettie, Glen Mary, William Belt, Success.

The conditions for fruit growing in northern Jersey are about the same as those of New York and New England. Some of the soils there are well adapted to apples. Some of the high quality varieties of pears could be recommended for this section in addition to those given. Pear blight is very severe in south Jersey, however, and Kieffer and La Conte are becoming the varieties most grown. Southern New Jersey has much the same conditions for fruit growing as Delaware and parts of Maryland.

Varieties Recommended for Planting in North Carolina.

By W. N. Hutt, Horticulturist, Agricultural College, West Raleigh, N. C.

Apples—In Mountains—Red June, York, Stayman, Winesap, Grimes and Bonum. In Cotton Belt—Horses, Winesap, Stayman, Shockley, Ben Davis.

Apricots—None grown.

Blackberries—Dewberries in sandy region only Lucretia.

Cherries—Little grown. Sour type grown in mountains.

Currants—In Mountains, Red Dutch and Fay.

Gooseberries—Downing and Houghton.

Grapes—Niagara, Concord and Delaware. Scuppernong and James on coast.

Peaches—Greensboro, Carman, Salway.

Pears—Kieffer, La Conte, Seckel, Early Harvest.

Plums—Abundance, Red June, Burbank, Wild Goose.

Quince—In mountains, Meech.

Raspberries—

Black—In mountains—Gregg.

Red—In mountains—Loudon, Cuthbert and Miller.

Strawberries—Lady Thompson, Heflin, Gandy, Bubach, Clenoa.

Figs—In coast and lower Piedmont—Brown Turkey, Celestial.

Pecans—In coast and lower Piedmont—Stewart, Van Deman, Frotschen, Schley.

Mulberries—White English, Black English, New American.

Varieties Recommended for Planting in Ohio.

By W. J. Green, Professor of Horticulture of Experiment Station, Wooster, O.

Apples—Yellow Transparent, Oldenburg, Sweet Bough, Maiden's Blush, Grimes Golden, Jonathan, Hubbardston, York Imperial, Rome Beauty, Northern Spy.

Apples, Crab—Transcendent.

Blackberries—Early Harvest, E. King, Eldorado, Snyder.

Cherries—Dyhouse, Early Richmond, Montmorency, English Morello.

Currants—Victoria, Wilder, White Dutch.

Gooseberries—Downing, Pearl, Portage, Josselyn.

Grapes—Worden, Green Mountain, Niagara, Brighton.

Peaches—Mountain Rose, Greensboro, Champion, Elberta, Smock.

Pears—Wilder, Bartlett, Angouleme, Seckel.

Plums—Bradshaw, Field, Reine Claude, Lombard, Grand Duke.
Quince—Orange.

Raspberries—

Black—Cumberland, Munger, Conrath.

Red—Cuthbert, King, Loudon.

Strawberries—Fairfield, Dunlap, Haverland, Bubach, Latest.

Varieties Recommended for Planting in Oregon.

By C. J. Lewis, Professor of General Horticulture, Agricultural College, Corvallis, Ore.

Apples—E. Spitzenburg, Yellow Newtown, Jonathan, Baldwin, Ben Davis, Gano, Yellow Imperial, Gravenstein.

Apples, Crab—Martha, Transcendent.

Apricots—Blenheim, Moore Park, Royal.

Blackberries—Lawton, Kittatinny.

Cherries—Royal Anne, Lambert, Bing, Black Republican.

Currants—Fay, Cherry, White Grape.

Gooseberries—Champion, Downing, Industry.

Grapes—Concord, Niagara, Tokay, Malaga, Muscat.

Peaches—Alexander, Crawford, Foster, Muir, Salway, Hale's Early, L. Cliny.

Pears—Bartlett, Anjou, Bosc, Howell, W. Nelis, Comice, E. Beurre.

Plums—Italian, Petite.

Quince—Champion, Apple or Orange, Rea's Mammoth.

Raspberries—

Black—Gregg, Cumberland, Kansas, Mammoth Cluster.

Red—Cuthbert, Marlboro, Loudon.

Strawberries—Clark's Seedling, Niagara, Warfield, Clyde, Hopkins, Oregon Everbearing, Excelsior, Dunlap.

List of Fruits Recommended for the State of Washington and Adjoining Fruit Districts; Revised and Corrected by Professor W. S. Thornber, Pullman, Wash.

Varieties recommended for western Montana, Idaho, eastern Washington, eastern Oregon, Nevada, eastern California and adjacent parts of British Columbia:

Apples—

Early—Bough (sweet), Early Harvest, Red Astrachan, Jefferis, Oldenburg, Yellow Transparent, Maiden Blush, Gravenstein.

Midseason—Fall Pippin, Fameuse, McIntosh Red, Rambo, Wealthy, Tompkins King, Bailey.

Late—Grimes Golden, Arkansas Black, Blue Pearmain, Esopus Spitzenburg, Jonathan, Monmouth, Northern Spy, Wagener, White Winter Pearmain, Rome Beauty, Staymen Winesap, Yellow Bellflower, Winesap.

Crab Apples—Hyslop, Transcendent, Grant.

Pears—

Early—Bartlett, Tyson.

Midseason—Beurre d'Anjou, Flemish, Seckel, **Howell**.

Late—Sheldon, Easter Beurre, Winter Nelis.

Plums—

Early—Columbia, Bradshaw.

Midseason—Agen or French, Peach Golden Drop, Imperial Gage.

Late—Shropshire, Damson, Italian Prune.

Peaches—

Early—Alexander, Early York, Greensboro, Mountain Rose.

Midseason—Early Crawford, Foster, Lemon Cling, Muir, Susquehanna.

Sweet Cherries—Napoleon (Royal Anne), Lambert, Black Republican, Windsor.

Sour Cherries—Late Duke, May Duke, Morello, Olivet.

Apricots—Moorpark, Royal, Gibb.

Grapes—

Early—Moore, Brighton, Winchell.

Midseason—Worden, Delaware, Concord.

Late—Niagara, Iona, and Alexandria or Muscat and Black Hamburg in warm valleys only.

Currants—Cherry, Red Dutch, White Grape.

Gooseberries—Industry, Houghton, Pale Red.

Strawberries—

Early—Dubach, Crescent, Excelsior, Warfield.

Midseason—Hood River, Parker Earle, Sharpless.

Late—Gandy.

Red Raspberries—Marlboro, Cuthbert, Shaffer.

Black Raspberries—Gregg, Kansas, Palmer.

Blackberries—Ancient Britton and Kittatinny.

Quinces—Mech and Missouri.

Dewberries—Lucretia.

The following varieties are recommended for the Coast region of western Oregon, western Washington, and adjacent parts of British Columbia.

Apples—

Early—Early Harvest, Yellow Transparent, Red Astrachan, Benoni.

Midseason—Gravenstein, Fall Pippin, Fameuse, McIntosh, Rambo.

Late—Baldwin, Belmont, Esopus Spitzenberg, Jonathan, Northern Spy, Talman Sweet, Grimes Golden, Yellow Bellflower.

Crab Apples—Hyslop and Transcendent, Whitney.

Pears—

Early—White Doyenne, Clapp, Bartlett, Tyson.

Midseason—Beurre D'Anjou, Bosc, Louise, Seckel, Gray Doyenne and Sheldon.

Late—Easter Beurre, Comice, Winter Nelis, Dana, Hovey and Lawrence.

Plums—

Early—Columbia, Jefferson.

Midseason—De Soto, French, Golden Drop, Peach Golden Prune, Sugar, Imperial Gage.

Late—Shropshire, Damson, Italian.

Peaches—

Early—Alexander, Charlotte, Mountain Rose, Triumph, Hale.

Midseason—Early Crawford, Foster, Muir, Oldmixon Free.

Late—Late Crawford, Heath.

Sweet Cherries—Bing, Republican, Royal Anne, Lewelling, Lambert, Tartarian.

Sour Cherries—May Duke, Richmond, Morello, Olivet.

Apricots—Moorpark, Royal, Gibb.

Varieties Recommended for Planting in Saskatchewan.

By Angus Mackay, Superintendent Experimental Farm, Indian Head, Saskatchewan.

Apples, Crab—Siberian Crab (*P. baccata*) and crosses on this variety. Cherries—*Prunus tomentosa*.

Currants—

Red—Fay's Prolific, Victoria, Red Dutch.

White—White Grape, White Imperial.

Black—Lee's Prolific, Black Naples.

Gooseberries—Smith's Improved, Houghton.

Plums—Manitoba Native, Aitken, Weaver.

Raspberries—

Black—Older Black and Hilborn Black.

Red—Dr. Reider, Marlboro, Turner, Herbert.

Yellow—Caroline.

Strawberries—South Dakota No. 1 (Seedling of Jessie fertilized with pollen from Manitoba Wild Strawberry).

RULES FOR NAMING FRUITS.

In the naming and describing of new sorts, there is chance for much confusion by duplication of names and in other ways. In order to simplify this matter, rules have been adopted by the American Pomological Society as follows:

Rule I. No two varieties of the same kind of fruit shall bear the same name. The name first published for a variety shall be the accepted and recognized name, except in cases where it has been applied in violation of this code.

(a) The term "kind" as herein used shall be understood to apply to those general classes of fruits that are grouped together in common usage without regard to their exact botanical relationship; as, apple, cherry, grape, peach, plum, raspberry, etc.

(b) The paramount right of the originator, discoverer or introducer of a new variety to name it, within the limitations of this code, is recognized and emphasized.

(c) Where a variety name, through long usage, has become thoroughly established in American Pomological literature for two or more varieties, it should not be displaced nor radically modified for either sort, except in cases where a well-known synonym can be advanced to the position of leading name. The several varieties bearing identical names should be distinguished by adding the name of the author who first described each sort, or by adding some other suitable distinguishing term that will insure their identity in catalogues or discussions.

(d) Existing American names of varieties, which conflict with earlier published foreign names of the same, or other varieties, but which have become thoroughly established through long usage, shall not be displaced.

Rule II. The name of a variety of fruit shall consist of a single word.

(a) No variety shall be named unless distinctly superior to existing varieties in some important characteristic nor until it has been determined to perpetuate it by bud propagation.

(b) In selecting names for varieties, the following points should be emphasized: distinctiveness, simplicity, ease of pronunciation, and spelling, indication of origin or parentage.

(c) The spelling and pronunciation of a varietal name derived from a personal or geographical name should be governed by the rules that control the spelling and pronunciation of the name from which it was derived.

(d) A variety imported from a foreign country should retain its foreign name subject only to such modification as is necessary to conform to this code or to render it intelligible in English.

(e) The name of a person should not be applied to a variety during his life without his expressed consent. The name of a deceased horticulturist should not be so applied except through formal action by some competent horticultural body, preferably that with which he was most closely connected.

(f) The use of such general terms as seedling, hybrid, pippin, pearmain, beurre, rare-ripe, damson, etc., is not admissible.

(g) The use of a possessive noun as a name is not admissible.

(h) The use of a number, either singly or attached to a word, should be considered only as temporary expedient while the variety is undergoing preliminary test.

(i) In applying the various provisions of this rule to an existing varietal name that has, through long usage, become firmly imbedded in American Pomological literature, no change shall be made, which will involve loss of identity.

Rule III. In the full and formal citation of a variety name, the name of the author who first published it shall be given.

Publication.

Rule IV. Publication consists (1) in the distribution of a printed description of the variety named, giving the distinguishing charac-

ters of fruit, tree, etc., or (2) in the publication of a new name for a variety that is properly described elsewhere; such publication to be made in any book, bulletin, report, trade catalogue or periodical, providing the issue bears the date of its publication and is generally distributed among nurserymen, fruit growers and horticulturists; or (3) in certain cases, the general recognition of a name for a propagated variety in a community for a number of years shall constitute publication of that name.

(a) In determining the name of a variety to which two or more names have been given in the same publication, that which stands first shall have precedence.

Revision.

Rule V. No properly published variety name shall be changed for any reason, except conflict with this code, nor shall another variety be substituted for that originally described thereunder.

Usual Distances Apart for Planting Fruits.

Apples	25 to 40 feet each way
Apples, Dwarf	10 to 15 " " "
Pears	20 to 30 " " "
Pears, Dwarf	10 to 15 " " "
Plums	16 to 20 " " "
Peaches	16 to 20 " " "
Cherries	16 to 25 " " "
Apricots	16 to 20 " " "
Nectarines	16 to 20 " " "
Quinces	8 to 14 " " "
Mulberries	25 to 30 " " "
Japanese Persimmons	20 to 25 " " "
Pecans	35 to 40 " " "
Grapes	8 to 12 " " "
Currants	4 x 5 " " "
Gooseberries	4 x 5 " " "
Raspberries, Black	3 x 7 " " "
Raspberries, Red	3 x 7 " " "
Blackberries	4x7 to 6x8 feet
Cranberries	1 or 2 feet apart each way
Strawberries	1 to 3x3 to 4 feet
Oranges and Lemons	25 to 30 feet each way

Number of Plants Required to Set an Acre of Ground at Given Distances.

1 ft. x 1 ft.	43,560	12 ft. x 20 ft.	181
1 ft. x 2 ft.	21,780	12 ft. x 24 ft.	151
1 ft. x 4 ft.	10,890	12 ft. x 30 ft.	121
1 ft. x 6 ft.	7,260	12 ft. x 36 ft.	86
1 ft. x 7 ft.	6,223	15 ft. x 15 ft.	193
2 ft. x 2 ft.	10,890	15 ft. x 20 ft.	145
2 ft. x 3 ft.	7,260	15 ft. x 24 ft.	121
2 ft. x 4 ft.	5,445	18 ft. x 20 ft.	121
2 ft. x 6 ft.	3,630	18 ft. x 24 ft.	100
3 ft. x 3 ft.	4,840	20 ft. x 20 ft.	108
3 ft. x 6 ft.	2,420	20 ft. x 24 ft.	90
4 ft. x 4 ft.	2,722	20 ft. x 30 ft.	72
4 ft. x 5 ft.	2,178	20 ft. x 42 ft.	51
4 ft. x 6 ft.	1,185	30 ft. x 30 ft.	48
4 ft. x 8 ft.	1,361	30 ft. x 36 ft.	40
5 ft. x 6 ft.	1,452	30 ft. x 42 ft.	34
5 ft. x 8 ft.	1,089	40 ft. x 40 ft.	27
12 ft. x 12 ft.	302	40 ft. x 50 ft.	21
12 ft. x 15 ft.	242	50 ft. x 50 ft.	17
12 ft. x 18 ft.	201	100 ft. x 100 ft.	4

HORTICULTURAL PUBLICATIONS.

The following list of books, papers and bulletins on fruit growing is appended as suggestive material for supplementary reading for the student and fruit grower.

BOOKS.

- William Briggs, Toronto, Ont.
 The Canadian Apple Growers' Guide.
 Dewey & Co., San Francisco, Cal.
 California Fruits and How to Grow Them, E. J. Wickson.
 Doubleday, Page & Co., Garden City, N. Y.
 How to Make a Fruit Garden, S. W. Fletcher.
 Orchard and Fruit Garden, E. P. Powell.
 The Fruit Grower, St. Joseph, Mo.
 The Fruit Grower's Guide Book, E. H. Favor.
 Ginn & Co., Chicago, Ill.
 Fungous Diseases of Plants, B. M. Duggar.
 Orange Judd Co., New York, N. Y.
 The American Apple Orchard, F. A. Waugh.
 The American Fruit Culturist, J. J. Thomas.
 Foundations of American Grape Culture, T. V. Munson.
 Fruit Harvesting, Storing and Marketing, F. A. Waugh.
 Grape Growing and Wine Making, Geo. Husmann.
 Plums and Plum Culture, F. A. Waugh.
 Systematic Pomology, F. A. Waugh.
 J. B. Lippincott Co., Philadelphia, Pa.
 Insects Injurious to Fruits, Wm. Saunders.
 Macmillan Co., New York or Chicago.
 Cyclopedia of American Horticulture, edited by L. H. Bailey.
 Bush Fruits, F. W. Card.
 Farm and Garden Rule Book, L. H. Bailey.
 Fruit Growing in the Arid Regions, Paddock and Whipple.
 The Nursery Book, L. H. Bailey.
 The Principles of Fruit Growing, L. H. Bailey.
 The Pruning Book, L. H. Bailey.
 The Spraying of Plants, E. G. Lodeman.
 W. T. Seibels, 242 N. Clark St., Chicago, Ill.
 Produce Markets and Marketing.
 John Wiley & Sons, New York, N. Y.
 American Horticultural Manual, two vols., Budd and Hansen.

PERIODICALS.

The following periodicals are devoted wholly or in part to horticultural subjects:

- Better Fruit, Hood River, Ore.
 The Country Gentleman, Philadelphia, Pa.
 The Chicago Packer, Chicago, Ill.
 The Fruit Belt, Grand Rapids, Mich.
 The Fruit Grower, St. Joseph, Mo.
 The Fruit Magazine, Vancouver, B. C.
 The Fruitman and Gardener, Mt. Vernon, Iowa.
 The Fruit Trade Journal, New York, N. Y.
 The Market Growers' Journal, Louisville, Ky.
 The National Horticulturist, Council Bluffs, Iowa.
 The Rural New Yorker, New York, N. Y.

The various local farm papers usually maintain horticultural columns or publish more or less matter relating to fruit growing.

The reports of the state horticultural societies contain many valuable suggestions, and as they are based very largely on the actual experience of local growers, they are usually very practical and useful.

BULLETINS.

The U. S. Department of Agriculture has published a number of bulletins on fruit growing which may be obtained free of charge by writing to the Division of Publications, Department of Agriculture, Washington, D. C. The bulletins which are now available include the following:

- Farmers' Bulletin 113, The Apple and How to Grow It.
- Farmers' Bulletin 118, Grape Growing in the South.
- Farmers' Bulletin 154, The Home Fruit Garden, Preparation and Care.
- Farmers' Bulletin 156, The Home Vineyard, with Special Reference to Northern Conditions.
- Farmers' Bulletin 157, The Propagation of Plants.
- Farmers' Bulletin 176, Cranberry Culture.
- Farmers' Bulletin 181, Pruning.
- Farmers' Bulletin 198, Strawberries.
- Farmers' Bulletin 213, Raspberries.
- Farmers' Bulletin 238, Citrus Fruit Growing in the Gulf States.
- Farmers' Bulletin 245, Fungicides and Their Use in Preventing Diseases of Fruits.
- Farmers' Bulletin 284, Insect and Fungous Enemies of the Grape East of the Rocky Mountains.
- Farmers' Bulletin 291, Evaporation of Apples.
- Farmers' Bulletin 293, Use of Fruit as Food.
- Farmers' Bulletin 332, Nuts and Their Uses as Food.
- Farmers' Bulletin 401, The Protection of Orchards in the Pacific Northwest from Spring Frosts by Means of Fires and Smudges.
- Farmers' Bulletin 404, Irrigation of Orchards.
- Farmers' Bulletin 426, Canning Peaches on the Farm.
- Farmers' Bulletin 440, Spraying Peaches for the Control of Brown Rot, Scab and Curculio.

The various state experiment stations have issued a large number of publications on fruit growing. Those published in your own state can be obtained from the Director of the Experiment Station free of charge. These bulletins are also usually sent free to applicants outside the state as long as the supply lasts.

INDEX

A

Accessibility to market, 13
Adventitious buds, 20
Age of trees for planting, 35
Agitation in sprayers, 124
Alabama, Varieties for, 312
Alcoholic waxes, 311
Almond, 300
Altitude and frosts, 182
Analysis of fruit, 48
Anthracnose, 115, 120
Aphis, 83, 93, 100
Apparatus, Spraying, 123
Apple, 178; blight, 106; classifica-
tion, 178; curculio, 81; descrip-
tion of varieties, 179; diseases,
106; forming the tree, 56, 188;
grading, 146; grafting, 173;
insects, 79; mulching, 189;
origin of, 178; packing, 140, 144;
picking, 132; planting, 185;
propagation, 180; scab, 108; soil
for, 182; species of, 178; spray
calendar, 303; stocks, 181; tree
borer, 84; varieties, 190.
Apricot, 217
Arsenate of lead, 309
Arsenite of soda, 309
Assimilation, 26
Associations, 137

B

Bagging grapes, 244
Bark, 19
Bark louse, 86
Barrels, 143
Barrel press, 145
Baskets, 139
Beeswax, 311
Beneficial insects, 78
Birds, Injuries from, 64
Bitter rot, 106
Blackberry, 274; diseases, 119;
insects, 100; propagation, 274;
spray calendar, 306
Black knot, 112
Black rot, 107, 111, 116
Blight, 106, 110

Books on horticulture, 322
Bordeaux mixture, 105, 307
Borer, 84; currant, 99; flat-head-
ed, 84; peach, 90; peach twig,
89; raspberry, 100
Brown rot, 113
Buds, 20
Buds, Winter injury to, 66
Budding, 157; forms of, 163;
June, 163; time for, 158
Budstick, 158
Buffalo berry, 280; propagation,
281
Buffalo tree hopper, 85
Bulletins on fruit growing, 323
Bushel basket, 139
Bushel box, 139
Business aspect, 16
Butternut, 300
Buying trees, 35, 184

C

California, Varieties for, 311
Callousing, 154
Cane rust, 120
Caterpillar, Tent, 81
Cedar apples, 107
Cellars, 150
Chart of frost, 71
Chemical elements in fruit, 48
Cherry, 204; classification, 204;
cultivation, 205; diseases, 115;
grafting, 174; insects, 95; mar-
keting, 208; planting, 205;
propagation, 207; soil for, 205;
spray calendar, 304; varieties,
209
Chestnut, 296
Chinese sand pear, 191
Chinquapin, 297
Choice of locations, 18
Cion, 156, 164, 168
Classification of fruits, 28
Clay soils, 15
Cleft grafting, 166
Clogging of spray nozzles, 127
Codlin moth, 79
Cold storage, 147
Collar, 19
Colorado, Varieties for, 313
Commission dealers, 135

Cooling rooms, 147
 Copper carbonate and soap, 308
 Copper sulfate solution, 308
 Cordon pruning, 59
 Corn in orchards, 45
 Cover crops, 43, 45
 Cranberry, 283; drainage, 286;
 location of beds, 284; picking,
 289; planting, 288; soil for, 285
 Cricket, Snowy tree, 101
 Cropping the orchard, 45
 Crossing, 24
 Crown, 19
 Crown gall, 113, 114, 119
 Cultivation, 40, 188
 Curculio, 81, 91
 Currant, 258; borer, 99; cuttings,
 260; diseases, 120; insects, 97;
 origin, 259; propagation, 259;
 spray calendar, 305; worm, 97
 Cuttings, 153, 154
 Cut worm, 84

D

Dewberry, 274
 Diagonal pack, 140
 Digging the holes, 38
 Direction of the slope, 16
 Diseases of fruits, 105
 Distances for planting, 321
 Downy mildew, 116
 Dust spraying, 123

E

Eau celeste, 307
 Effect of pruning, 53
 English walnut, 299
 Espalier pruning, 59

F

Fall web worm, 83
 Fillers, 46
 Fire blight, 106
 Flat-headed apple borer, 84
 Flower, 21
 Foot rot, 114
 Forming the apple tree, 56
 Forming the head, 54
 Frost, 68; foretelling, 69; killing,
 68; protection, 68, 71
 Fruit, 23; analysis, 48; classifi-
 cation, 28; diseases, 105; grades,
 145; laws, 137; lists, 311; pack-
 ages, 135; plants from seed, 25;
 propagation, 25, 151; scald, 109;
 rules for naming, 320
 Fungicides, 105, 307

G

Girdling, 21, 245
 Gooseberry, 263; diseases, 120;
 insects, 97; spray calendar, 305
 Gouger, Plum, 92
 Grading fruit, 141, 145
 Graftage, 156
 Grafting, 164; cleft, 166; root,
 168; side, 171; tools, 165; wax
 formula, 166, 311; whip, 168
 Grain in orchards, 45
 Grape, 220; bagging, 244; culti-
 vation, 228; cuttings, 223; dis-
 eases, 115; flowers, 222; gird-
 ling, 245; grafting, 175; hybrids,
 221; insects, 95; Kniffen method
 of training, 237; layers, 225;
 location for, 227; Munson meth-
 od of training, 239; origin, 220;
 phylloxera, 96; planting, 228;
 propagation, 222; pruning, 229;
 soil for, 227; species of, 220;
 spray calendar, 305; thinning,
 243; training, 229; trellis, 230;
 vine leaf hopper, 95
 Growing trees in sod, 41
 Grub, White, 102

H

Hardwood cuttings, 154
 Harvesting, 132
 Hazel, 301
 Heeling in, 186
 Hellebore, 310
 Hexagonal system, 38
 Hogs in orchards, 80
 Holes for trees, 38, 185
 Hopper, Leaf, 95
 Horticultural publications, 322
 Hose for spraying, 128
 Humus, 41
 Hybrids, 24

I

Inarching, 175
 Injuries, 64; frost, 68; spraying,
 110
 Insecticides, 309
 Insects, 75; beneficial, 78; chew-
 ing, 76; parasitic, 78; preda-
 ceous, 79; sucking, 77; on the
 roots, 78
 Inspection laws, 76
 Iowa, Varieties for, 313
 Irrigation, 51

J

- Juneberry, 275; cultivation, 276; propagation, 276; varieties, 276
- June budding, 163

K

- Kerosene emulsion, 310
- Kniffen system for grapes, 237

L

- Ladders for picking, 133
- Layers, 153
- Laying out the orchard, 37
- Leaf blight, 110
- Leaf curl, 111, 114, 119
- Leaf hopper, 95
- Leaf lice, 83
- Leaf roller, 101
- Leaf rust, 107, 118
- Leaf slug, 88
- Leaf spot, 118, 119, 121
- Leaves, 21
- Lice, 83, 100
- Lime, 310
- Limestone soil, 14
- Lime-sulfur wash, 308
- Liquid spraying, 123
- Loam, 14, 15
- Location for fruit growing, 13, 18
- Loess loam, 14
- Louse, Woolly apple, 87
- Low-headed trees, 54

M

- Manures, 47, 50; application, 49
- Marketing, 132
- Methods of packing, 140
- Micc, 65
- Michigan, Varieties for, 314
- Mildew, 109, 116, 120
- Mineral substances, 28
- Minnesota, Varieties for, 314
- Missouri, Varieties for, 315
- Moisture loss, 26
- Mountain ash as stock, 194
- Mulberry, 281; groups, 281; propagation, 283; varieties, 283
- Mulching, 42

N

- Naming fruits, Rules for, 320
- Nectarines, 217
- New England, Varieties for, 316
- New Jersey, Varieties for, 316

- New York, Varieties for, 315
- North Carolina, Varieties for, 317
- Nozzles, Spray, 127
- Number of plants to the acre, 321
- Nursery inspection, 76
- Nursery selection, 35
- Nursery stock, 35
- Nuts, 294

O

- Offsets, 152
- Ohio, Varieties for, 317
- Open-headed trees, 54
- Orange rust, 120
- Orchard cultivation, 40
- Orchard protection, 61
- Oregon, Varieties for, 318
- Outlook for fruit growing, 17
- Overproduction, 17
- Oyster shell bark louse, 86

P

- Packages, 136, 139, 143
- Packing, 135, 140
- Painting wounds, 55
- Papers, Horticultural, 322
- Parasites, 78
- Paris green, 309
- Parts of the flower, 22
- Peach, 209; borer, 89, 90; classification, 212; diseases, 113; distribution, 209; grafting, 175; insects, 89; leaf curl, 111; location and soil, 216; origin, 211; planting, 214; propagation, 213; protection, 210; pruning, 215; rosette, 115; spray calendar, 304; thinning, 216; varieties, 216; yellows, 115
- Pear, 191; Chinese sand, 191; diseases, 110; dwarf, 192; insects, 88; psylla, 89; spray calendar, 305; standard, 192; tree slug, 88
- Pecan, 294
- Peddling, 135
- Periodicals, 322
- Persimmon, 289
- Phylloxera, 96
- Picking fruit, 132
- Plant food, 46, 48
- Plant growth, 19
- Planting, 34, 37
- Plum, 198; classification, 200; cultivation, 203; curculio, 81, 91; diseases, 111; gouger, 92; grafting, 173; insects, 91; leaf aphid, 93; marketing, 204; mixing varieties of, 202; planting,

Plum—Cont'd.

201; picking, 203; pocket, 111; propagation, 200; pruning, 203; soil, 201; species, 198; spray calendar, 304; stocks, 201; thinning, 203; varieties, 204
 Pollen, 24
 Pollination, 24, 32
 Pome fruits, 178
 Potassium sulfide, 308
 Powdery mildew, 109, 117
 Preparing the land, 33
 Pressure in spraying, 124
 Press, Barrel, 145
 Principles of plant growth, 19
 Propagation, 151
 Protection, Orchard, 61, 68
 Pruning, 39, 53; effect of, 53; how to make cuts in, 55, 58; method of, 55; reasons for, 53; the young tree, 54; tools, 56
 Publications, 322
 Psychrometer, 70
 Psylla, Pear, 89
 Pumps, Spray, 126
 Pyrethrum, 310

Q

Quince, 195; as stock, 192; diseases, 110; insects, 196; propagation, 195
 Quincunx system, 38

R

Rabbits, 65
 Raffia, 160
 Raspberry, 265; classification, 265; diseases, 119; flat-headed borer, 100; insects, 100; marketing, 273; mulching, 271; picking, 273; propagation, 266; protection, 271; pruning, 270; rust, 120; soil, 268; spray calendar, 306; support, 271; thinning, 270
 Rate of seeding cover crops, 44
 Reasons for cultivation, 40
 Reasons for pruning, 53
 Red orange rust, 120
 Renewing old trees, 50
 Resin lime mixture, 310
 Rest period of plants, 28
 Return package, 142
 Root cuttings, 153
 Root galls, 65, 107
 Root grafting, 168
 Root killing, 67
 Rose chafer, 97

Rot, Bitter, 106
 Rot, Black, 107, 111, 116
 Rot, Brown, 113
 Rules for naming fruits, 320
 Runners, 19, 152
 Rust, 107, 118, 120

S

Sand cherry, 277; distribution, 277; propagation, 279
 Sandy soils, 15
 San Jose scale, 86
 Saskatchewan, Varieties for, 319
 Scab, 108, 113, 115
 Scald, Fruit, 109
 Scale insects, 86
 Scurfy bark louse, 86
 Seed, 25, 151
 Seedlings, 25, 184
 Selection of trees, 35
 Selection of varieties, 31
 Shape of trees, 35
 Shot hole fungus, 113
 Side grafting, 171
 Slope, Direction of the, 16
 Small fruits, 247
 Smudger, 73
 Snowy tree cricket, 101
 Soap, Whale oil, 310
 Sod culture, 41
 Soils, 14
 Solar pit, 155
 Sorting table, 143
 Sprayers, 124, 129
 Spraying, 123; calendar, 303; injuries, 110; outfits, 129
 Square system, 37
 Stems, 19, 139
 Stock, 156, 181, 201
 Storage buildings, 146
 Storing, 132, 146
 Stratification, 151
 Strawberry, 247; diseases, 118; hill system, 251; insects, 101; marketing, 257; origin of, 247; picking, 257; propagation, 248; renewing beds, 254; row system, 251; rust, 118; setting plants, 252; sexuality of plants, 255; soil, 248; spraying calendar, 305; time of planting, 249; varieties, 258; weevil, 102; winter protection, 253
 Stone fruits, 198
 Success in fruit growing, 17
 Suckers, 19, 189
 Sunburn, 118
 Sunscald, 61
 Systems of planting, 37

T

Tent caterpillar, 81
 Thermometer, 70
 Thinning fruits, 203, 216
 Thorns, 19
 Thoroughness of spraying, 128
 Time to apply manures, 50
 Time to pick fruit, 133
 Time to plant, 34
 Time to prune, 54
 Tobacco dust, 310
 Tobacco soap, 311
 Tools for pruning, 56
 Topography, 16
 Top-working, 173
 Transpiration, 26
 Tree currants, 262
 Tree hopper, Buffalo, 85
 Trellis for grapes, 230
 Twig borer, 85, 89

V

Varieties, 29, 31
 Varieties for various states, 312

W

Walnut, 299, 300
 Washington, Varieties for, 318
 Waxed string bandage, 311
 Waxes, Grafting, 311
 Web worm, 83
 Weevil, Strawberry, 102
 Wet and dry bulb, 70
 Whale oil soap, 310
 When to prune, 54
 Whip grafting, 168
 White grub, 102
 Windbreaks, 182
 Wind injury, 64
 Winter injury to roots, 67
 Winter killing, 65
 Woolly aphis, 87
 Woolly apple louse, 87

Y

Yellow, Peach, 113

STANDARD AGRICULTURAL BOOKS

Published and Sold By
WEBB PUBLISHING COMPANY,
ST. PAUL, MINNESOTA

AGRICULTURAL.

- POPULAR FRUIT GROWING**, by Samuel B. Green. This book covers the factors in successful fruit growing, with list of fruits adapted to each state; orchard protection, injurious insects, diseases injurious to fruits, spraying, harvesting, propagation of fruit plants, etc., etc. It is prepared especially for beginners and as a text book for schools and colleges. 309 pages, 120 illustrations. **Price, postpaid..\$1.00**
- AMATEUR FRUIT GROWING**, by Samuel B. Green, a practical guide to the growing of fruit for home use and the market, written with special reference to a cold climate. **Illustrated. 134 pp. Price, 12 mo.....Paper, 25 cents; cloth, 50 cents.**
- VEGETABLE GARDENING**, by Samuel B. Green. 10th edition. A manual on the growing of vegetables for home use and the market, **profusely illustrated. 252 pp.**
Price, 12 mo.....Cloth, \$1.00; paper, 50 cents.
- ELEMENTS OF AGRICULTURE**, by J. H. Sheppard and J. C. McDowell, a complete treatise on practical agriculture covering plant and animal breeding, thoroughly illustrated. A complete text book adopted in public and agricultural schools throughout the Northwest. **12 mo., cloth, 100 pp. Price, \$1.00**
- GRASSES AND HOW TO GROW THEM**, by Thomas Shaw, covering name and character of all the principal grasses in America; temporary and permanent pastures; methods in making hay, etc. **Illustrated, 453 pp.**
Price, 12 mo.....Cloth, \$1.50
- WEEDS AND HOW TO ERADICATE THEM**, by Thomas Shaw, giving the names of the most troublesome weed pests east and west and successful methods of destroying them.
Price, 16 mo., 210 pp.Cloth, 50 cents; paper, 25 cents.
- EVERGREENS AND HOW TO GROW THEM**, by C. S. Harrison. A complete guide to selection and growth of evergreens for pleasure and profit, from seed and nursery, to wind-breaks, and hedges. **Illustrated, 100 pp.**
Price, 12 mo.Paper, 25 cents; cloth, postpaid, 50 cents.

STANDARD AGRICULTURAL BOOKS.

- FARM WIND-BREAKS AND SHELTER BELTS**, by Samuel B. Green. A manual of tree planting for wind-breaks and shelter with description of the most suitable trees hardy enough to stand Northwestern conditions. Practical cultural directions from seed to maturity. Illustrated, 69 pp.
 PricePaper, 25 cents.
- HARDWOOD LANDS**, by D. A. Wallace, describes the characteristics of Minnesota and Wisconsin cut-over timber lands heretofore overlooked as suitable for agriculture. Illustrated. PricePaper, 25 cents.
- THE GOLD MINE IN THE FRONT YARD**, by C. S. Harrison. A book about flowers, both for ornamentation and commercial culture, written with special reference to Northwestern conditions. Illustrated, 280 pp. Price, 12 mo....Cloth, \$1.00

POULTRY.

- POULTRY MANUAL**, by Franklane L. Sewell and Ida E. Tilson. A safe guide to successful poultry culture in all its branches, fancy and practical; breeding and feeding; diseases and remedies; how to make farm poultry pay, etc., etc. (40th Thousand. Revised Sept. 1, 1908.)
 12mo., 148 pp. Price50 cents; paper, 25 cents.
- EGG MONEY, HOW TO INCREASE IT**, by H. A. Nourse. A book of complete and reliable information on the more profitable production of eggs on the city lot, the village acre and the farm. The instruction in this book will make the "200 eggs a year hen" a reality for the intelligent poultryman. 128 pp., completely illustrated. Price, paper, 25 cents.
- POULTRY HOUSES, COOPS AND EQUIPMENTS**, by H. A. Nourse. A book of newest plans for building practical, up-to-date poultry houses, with description of coops, fixtures and poultry utensils for the farm or village poultry keeper. Profusely illustrated, 100 pp. Price.....Paper, 25 cents.
- CHICKS: HATCHING AND REARING**, by H. A. Nourse. A manual of dependable instruction in incubating, brooding, housing and developing winners and layers, fattening, killing and marketing broilers and roasting chickens. 126 pp., fully illustrated. Price.....Paper, 25 cents.
- SIMPLE POULTRY REMEDIES**, by competent authors; describes the symptoms of the leading diseases of poultry and tells how they may be cured or prevented by simple methods. This book should be in the hands of every poultry man. 80 pp., fully illustrated. Price, postpaid....25 cents.
- TURKEYS, DUCKS, AND GEESE**, by H. A. Nourse, latest and most complete and reliable information on breeding, hatching, rearing, fattening, developing, showing, and selling for pleasure or profit. 128 pp., fully illustrated.
 Price, postpaid.....50 cents.

STANDARD AGRICULTURAL BOOKS

LIVE STOCK.

FEEDING AND MANAGEMENT OF LIVE STOCK, by Thomas Shaw. A series of lectures on the principles covering selection, feeding, breeding, management and marketing of cattle, sheep and swine. 100 pp.

Price, 8 mo.Cloth, \$1.00; stiff cover, 50 cents.

FIVE HUNDRED QUESTIONS ANSWERED ABOUT SWINE, by L. H. Cooch. This manual is practically a complete veterinary book for swine breeders. Not only does it contain answers to questions concerning diseases of swine, but it also fully and carefully compares the different breeds, treats of breeding, feeding and pasturing. Price, paper, 25 cents.

THIRTY DAIRY RATIONS. Thirty complete balanced dairy rations. Treats also of the feeding and care of dairy cows, by H. C. Carpenter. Illustrated. Price, paper, 25 cents.

MISCELLANEOUS.

FARM BLACKSMITHING, a complete treatise on blacksmithing by J. M. Drew, written for farmers who want a workshop where they can profitably spend stormy days. Illustrated, 100 pp. Price, 12 mo.Cloth, 50 cents.

STANDARD BLACKSMITHING, HORSESHOEING AND WAGON MAKING, by J. G. Holmstrom, author of "Modern Blacksmithing," gives practical instructions by a successful blacksmith. The latest and most complete book on the subject published. Thoroughly illustrated.

Price, 12 mo.Cloth, \$1.00

THE FARMER'S TANNING GUIDE, by G. E. Stevens, gives all the quick ways of tanning in from ten minutes to six weeks. Also complete receipts for making your own solutions. Prepared especially for farmers. PricePaper, 25 cents.

VACANT GOVERNMENT LANDS, locates all available government lands that can be secured free by entry and tells how to get them. All about irrigated lands and how obtained free. (1908 Edition.) 112 pp. Price.....Paper, 25 cents.

THE DOMINION OF CANADA, by Moses Folsom. All about free government land in Canada and how to get it. 155 pp. Price, 12 mo.Cloth, 50 cents; paper, 25 cents.

THE COUNTRY KITCHEN. Nine hundred tried and tested recipes suited to the country and contributed by readers of The Farmer. The most popular and practical cook book on the market. 154 pp.

Price, 12 mo.Cloth, 50 cents; paper, 25 cents.

THE "BUCKEYE" COOK BOOK, by Mrs. Wilcox. A careful compilation of tried and approved recipes for all branches of the household. 1288 pp. with complete index.

Price, postpaid\$2.50

STANDARD AGRICULTURAL BOOKS.

FARM BOOKS.

SHORT TITLE LIST.

Farmers' Account Book and Farm Record, net.....	\$2.25
Bookkeeping for Farmers. Clark Atkeson.....	.25
Barn Plans and Out Buildings	1.00
Cottage Houses. S. B. Reed	1.00
Homes for Home Builders. D. W. Wing.....	1.00
A. B. C. and X. Y. Z. of Bee Culture. A. I. Root.....	1.50
Mysteries of Bee Keeping Explained. L. C. Root.....	1.00
Veterinary Elements. Arthur G. Hopkins.....	1.50
Diseases of Horses and Cattle. D. McIntosh.....	1.75
Feeds and Feeding. W. A. Henry.....	2.00
Diseases of Swine. D. McIntosh	2.00
Swine in America. F. D. Coburn, net.....	2.50
Farm Live Stock of Great Britain. R. Wallace, net.....	5.00
Profitable Dairying. C. L. Peck.....	.75
Judging Live Stock. John A. Craig, net.....	1.50
Creamery Accounting. J. A. Vye, net.....	1.00
Cattle Breeding. William Warfield.....	2.00
Practical Forestry. A. S. Fuller.....	1.50
Beautifying Country Homes. J. Weidemann.....	10.00
Garden Making. L. H. Bailey.....	1.00
Practical Floriculture. Peter Henderson.....	1.50
Spraying Crops. C. M. Weed.....	.50
Spraying of Plants. E. J. Lodeman, net.....	1.50
Agriculture with Some of Its Relations with Chemistry. F. H. Storer (3 volumes), net	5.00
Pruning Book. L. H. Bailey, net	1.50
Field Notes on Apple Culture. L. H. Bailey, net.....	2.00
The Potato. J. J. H. Gregory30
Gardening for Profit. Peter Henderson.....	1.50
The Soil. Franklin H. King	1.00
Principles of Agriculture. L. H. Bailey, net.....	1.50
Physics of Agriculture. F. H. King, net.....	1.75
How To Make a Garden Pay. T. Greiner.....	1.00
Soiling Crops and the Silo. Thomas Shaw.....	1.50
Forage and Fibre Crops in America. Thomas Hunt.....	1.75
Fertility of the Land. I. P. Roberts, net.....	1.50
Farm Machinery and Farm Motors. J. B. Davidson and L. W. Chase, net	2.00
Manual of Corn Judging. A. D. Shamel.....	.50
Cereals in America. T. F. Hunt.....	1.75
Alfalfa, Book of. F. D. Coburn.....	2.00

WEBB PUBLISHING COMPANY,
ST. PAUL, MINNESOTA



FEB 12 1912

1912 FEB 12

One copy del. to Cat. Div.

FEB 12 1912

LIBRARY OF CONGRESS



00009293140

