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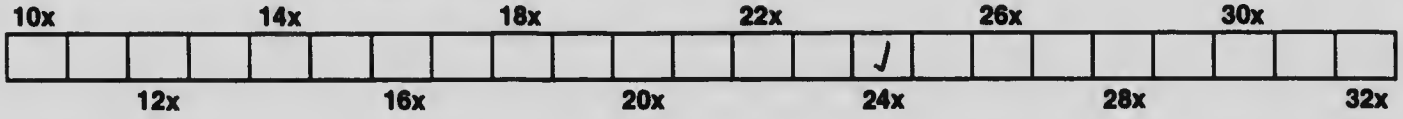

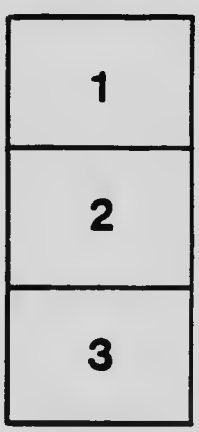

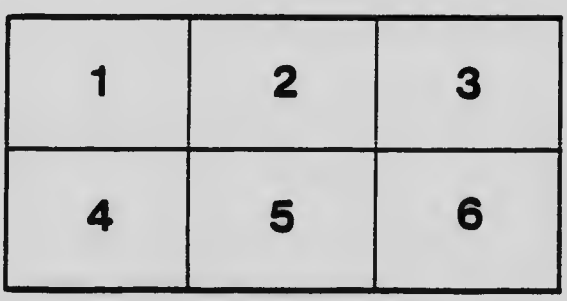

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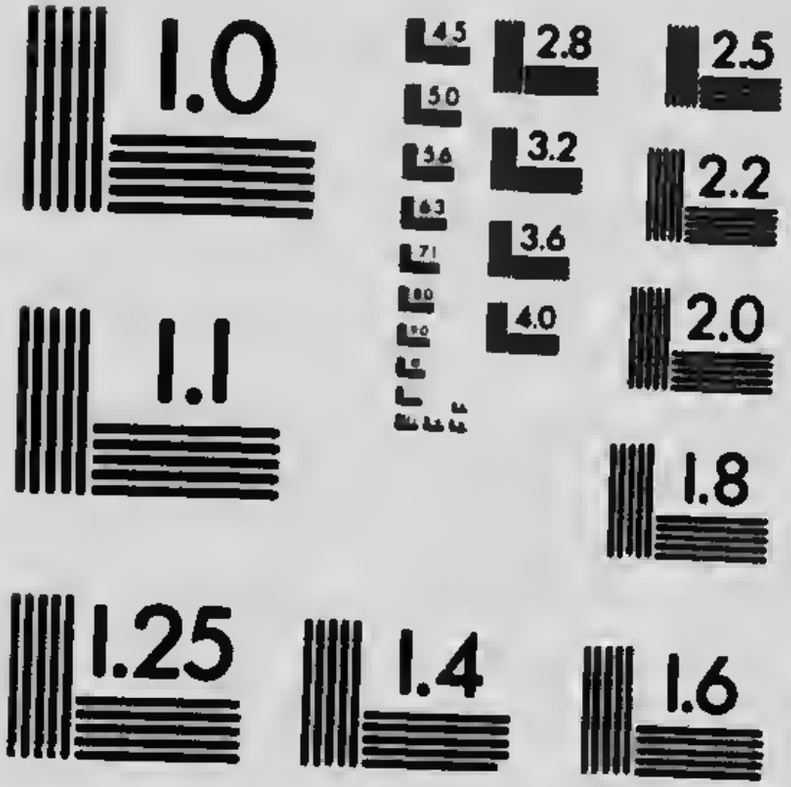

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BULLETIN 248] [APRIL, 1917

Ontario Department of Agriculture

FRUIT BRANCH

PRUNING

F. M. Clement, B.S.A., and F. S. Reeves, B.S.A.

PRUNING FRUIT TREES, VINES AND BUSHES*

In submitting the following pages it is requested that it be borne in mind that an attempt is made to present general facts only. At no time are variations of varieties dealt with specifically. It is felt that the basis of intelligent pruning is a thorough knowledge of the fruiting habit of the tree. The point of view that is kept in mind always is perhaps somewhat distant from the popular opinion. Pruning as generally discussed by practical men throughout the Province is primarily a special operation performed on the tree regularly or irregularly to make it produce fruit abundantly. The point of view accepted by the writers is that the natural habit of the tree is to produce fruit abundantly, and that pruning is a special treatment intended to aid the tree in its natural habits. The fruit for market purposes must possess a certain degree of (1) color, (2) quality, (3) freedom from blemishes, (4) size, (5) uniformity. Pruning is to assist in the development of these qualities to the greatest possible degree. It is desired to emphasize this fact. Fruiting is natural for the tree. The object of pruning is to assist in making the fruit merchantable. Pruning may not accomplish the desired objects. It alone may be carried to excess in which case the results are as disastrous as no pruning at all.

Pruning should be carefully distinguished from training. During the first few years of its life a tree is largely trained. It is desired to construct a framework that will carry the maximum amount of fruit with merchantable qualities. At the same time in the construction of this framework the main purpose of the tree—that of fruit production—must not be lost sight of. Training also includes putting and keeping the tree within manageable bounds. It must be kept under the absolute control of the operator. Such terms as "heading in," "cutting back," and "dehorning" are not fully understood. These operations are largely for purposes of "training" and only partly for purposes of fruit bearing control. Such operations are sometimes recommended for certain "ills" or "bad habits" to which the tree is subject, for instance—biennial bearing. Pruning is not a specific for the various ills but rather a treatment along with other treatments, cultivation, spraying, fertilizing and thinning, to keep the tree in its natural habits.

No definite rules can be laid down. Pruning, though one of the oldest of orchard practices, has been studied very little scientifically. Only a few generalities can be given, such as (1) heavy winter pruning tends to the production of wood growth, (2) heavy summer pruning tends to the reduction of excessive wood growth. And even these statements are made only generally especially for the latter case. Pruning studies are still in their infancy.

*The material for this Bulletin was prepared by the joint authors while F. M. Clement was the Director of the Horticultural Experimental Station at Vineland.

Of the various operations practiced by the fruit grower, pruning is placed first and is considered of most importance. Color in a variety is the best evidence possible denoting that the fruit is mature and has matured in the sunlight. Of late years, spraying has been emphasized most emphatically and pruning though not neglected has for its importance been overshadowed. Spraying is a special practice for the control of fungus and insects, and to stimulate the general health and vigor of the tree. Fungus, the greatest enemy of tree fruit, thrives in shadows, darkness and moisture. Spraying is only an artificial means that must be practiced to make more complete the results. Spraying is to augment sunlight not to take the place of it. For insects, poisons, food and contact, must be applied in order that it may reach the insects or the insects may be able to reach it. Judicious pruning is one of the foundation stones of success in spraying.

Fruit bearing should be uniform and regular. In practice, however, especially with pears and apples, the ideal is not always obtainable. But, keeping in mind the objects of the various operations of production, can it be said from experience that the operations are as uniform and regular as they should be? The main point to emphasize is this. Regularity of pruning, regularity of cultivation, regularity of spraying, fertilizing and thinning tend to retain the regular natural habits of the tree. The extreme of any one operation is advisable only when it is desired to throw the tree out of balance, or if it is already out of balance to throw it in some direction with the hope that it may be the right and proper thing to do.

But little is known about the whole subject and the field of study is very large. As a basis of general study, however, the following pages are offered. It is hoped that the various fruits may be dealt with more specifically and in detail at a later date.

FRUITING HABITS IN RELATION TO PRUNING

The nature study idea has in recent years been much talked of in educational circles. Probably nature study in its truest sense was designed for children, but any of us might profit if our faculties for observation been quickened by such study. Much of our knowledge is gained through observation, and many of us are such poor observers that two or three good educations might be overlooked in a lifetime. It is observation that will teach us to answer such questions as these: How many flowers will a single fruit bud of the peach, plum or cherry produce? Do these fruit buds produce leaves as well as flowers? Are the fruit buds axillary or terminal? Yet the formation is important in order to understand the aim and objects of pruning in relation to fruit bearing. The moral is, we should be better observers and if this bulletin does no more than encourage a better observation of our fruit trees and plants the time and effort will have been well spent.

Anyone who has had any great experience in pruning the common fruit trees and plants realizes that they bear their fruit in certain positions, each kind of fruit tree or bush having a fruit bearing habit more or less its own. Great variation in detail may be noticed between varieties of the same fruit, but in general their fruiting habits are similar. This bulletin deals with general fruiting habits only.

The pruning operation is one of the most important in the fruit plantation, and the ideas here advanced are based on observations and a study of the buds from the dormant stage until buds are produced again and the fruit is ripe. Though the details of pruning every kind of fruit are not fully discussed, it is hoped that the fundamental principles to be observed in pruning in relation to the fruiting habits of these plants have been clearly set forth.

TYPES OF FRUIT BEARING.—Among our common deciduous fruit trees we have two types of fruit bearing: from axillary buds, and from true terminal buds. The axillary buds are borne in the axils of the leaves along the side of the spur or branch and the terminal buds, at the end or tip of the branch. When applied to buds the last term is confusing for not every bud terminating the growth of the season is a true terminal bud. Each axillary bud is developed in the axil of a single leaf, while the true terminal bud is usually subtended by two leaves, and in the latter case a continuance of the spur growth will be produced from a lateral

Fig. 1. Greensboro.

Fig. 2. St. John.

bud. The plant which bears its fruit from axillary buds is naturally more productive than the one that bears only from terminal buds. The stone fruits as a class bear from axillary fruit buds, and they are recognized as more fruitful than apples and pears, which bear mostly from terminal buds. For this reason the stone fruits require more vigorous pruning. But a fruit bearing habit may mean more than bearing from axillary or terminal fruit buds. Fruit buds may also be said to appear on certain ages of wood or certain types of branches. But each kind of fruit has a fruit bearing habit more or less peculiar to itself, and must be considered separately.

PEACHES

The fruit buds of the peach are normally axillary, and only very rarely is one found terminating a twig. They are borne always on one-year-old branches and short twigs the latter sometimes very much resembling tree fruit spurs. These buds open and produce a single flower but no leaves. They are borne single in the axils of single leaves or in pairs, one on either side of a leaf bud, the three buds being borne in the axils of as many leaves.

The first type of flowering is found in trees very lightly pruned or on weak shoots in well pruned trees with certain variations depending upon variety. Some of our best varieties bear a large percentage of their buds singly. Fig. 1 shows the two types of buds, the single buds on the smaller and weakest grown shoot and a

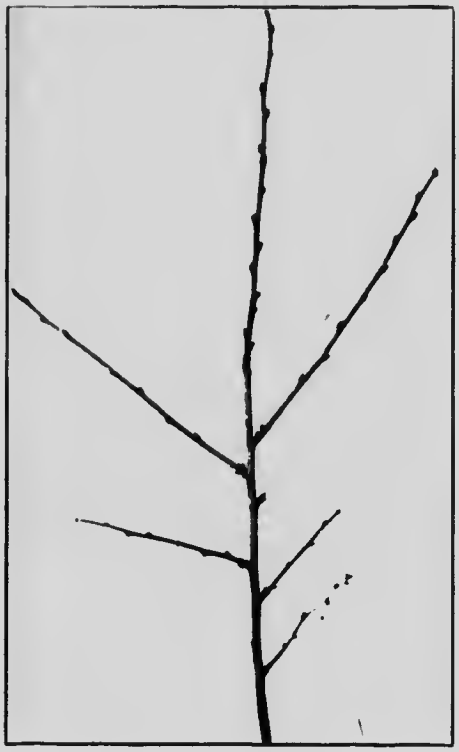


Fig. 3. Greensboro.

Fig. 4. Crawford.

majority in the three bud formation on the strongest shoots. The stronger type with the triple buds is most desirable. However, some of the best varieties bear their fruit buds mostly singly even on strong twigs as a reference to Fig 2 shows.

In Fig. 2 most of the buds are leaf buds and the fruit buds may be noted as being more rounded at the apex and a little stouter throughout. In most varieties shoots that do not make a growth of over ten or twelve inches bear their fruit buds singly. The triple buds are found on the stronger one-year-old wood.

In reference to Fig. 3 it will be seen that the centre shoot which is the strongest grown, bears far more of its buds in the triple formation than the laterals which are shorter and weaker and have most of their buds borne singly. Fig. 4 shows a branch in which all buds are single and but few of which are fruit buds.

Fig. 5. Greensboro.

Fig. 6. St. John.

Fig. 7. Greensboro.

wford

Figs. 5 and 6 show the buds of the two types at the opening stage. Fig. 5 is triple bud formation in which the centre is a leaf bud supported by the fruit buds on either side. This is the large flowering type of peach while Fig. 6 is of the small flowering type. The latter shows the single buds opening and the uneven distribution of leaf surface while there is a good percentage of fruit buds. This

Fig. 9. Greensboro.

Fig. 10. Crawford.

point is well to remember as it has considerable significance in "heading in" fruiting wood for the purpose of thinning the fruit.

Fig. 7 shows the triple bud flowering type—two blossoms, one leaf bud—where there is an abundance of bloom and an even distribution of foliage, also even bloom on short laterals or spurs on two-year-old wood. In this illustration the branch at the right was cut from the branch at the left and all parts are one-year-old wood except the heavy portion of the branch on the left. Fig. 8 shows the type with the single bud formation and consequently a scarcity of leaves along

that portion of branch where most of the fruit is borne. petals of the flowers have fallen. In this latter case it is impossible to thin the fruit by heading in the fruiting wood because a large percentage of leaf surface is lost with the consequent poor nourishment of the fruit. Where the tree has made poor growth and where the fruit buds are borne singly, pruning can be employed as a means of thinning the fruit only in so far as whole branches can be spared. With the triple bud formation, heading in may be resorted to, for fruit thinning purposes without fear loss of leaf surface. The fruiting wood with its fruit buds in pairs with a branch bud between—that is the triple bud formation—may be cut back to even its last pair of fruit buds. The branch bud will continue the growth of the twig. Such a type of fruiting wood can only be developed by severe pruning. Some of these strong twigs will grow in the tops of poorly pruned trees, but to grow them in the centre of the tree the top must be pruned back severely. It is almost impossible to maintain a fruiting depth of more than four to six feet. Little is gained by growing a peach tree fifteen feet in height when the bottom seven feet is barren. It is better to keep the trees down to a height of ten feet with fruiting wood within three feet of the ground. A well pruned tree will grow thirty inches or more of new top each year, but if the tree is to continue productive, a very large portion of this must be removed each year. It is safe to say that in a well pruned peach tree from one-third to three-quarters of the one-year-old growth is removed each pruning season.

Figs. 9 and 10 show the two types of bud bearing wood in fruit. Fig. 9 is that of the triple bud formation, and shows that while it bears an abundance of blossoms very close together the fruit that sets has ample room and will develop normally, although some of them are very close and may require thinning. Fig. 10 shows the fruit well scattered from the single bud formation. The leaves of this branch had wilted before it was possible to photograph it.

PLUMS

The different species of plums vary considerably in their fruiting habits. Only the Triflora and the Domestica groups are dealt with here. The fruit buds are borne mostly in groups on short spurs on two and three-year-old wood and singly on one-year-old wood. Most of the plums bear no true terminal buds and weak spurs are objectionable as frequently they bear no leaves and after producing their fruit die and become thorns. The Japanese or Triflora group bears its blossoms and fruit somewhat like the peach, a large percentage of their buds being borne singly on one-year-old wood. Occasionally the triple bud formation of the peach is found. Most of the fruit is, however, borne on short spurs on two and three-year-old wood. On older wood short spurs are found which bear buds in clusters. The Domestica group bear the fruit mostly on short spurs on two or three year-old wood and very few fruit buds may be found on one-year-old wood. The latter seldom set fruit. In pruning these two groups of plums the point to bear in mind is that most of the fruit is borne on wood ranging from one to four years old. Each fruit bud may produce four or five flowers. They bear no leaves or at best only rudimentary leaves. The larger number of buds indicates more vigorous growth. Generally speaking, the best types of fruiting wood are the spurs that are also vigorous enough to bear some branch buds. This type of fruiting wood is supplied with means of continuing its growth, and will develop fruit buds for another year.

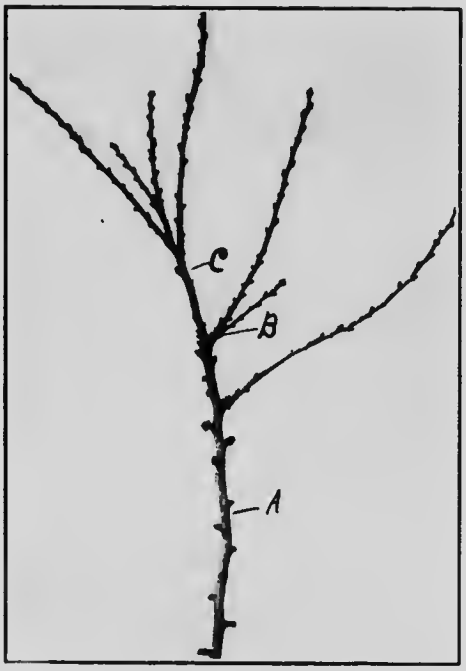


Fig. 11. Burbank.

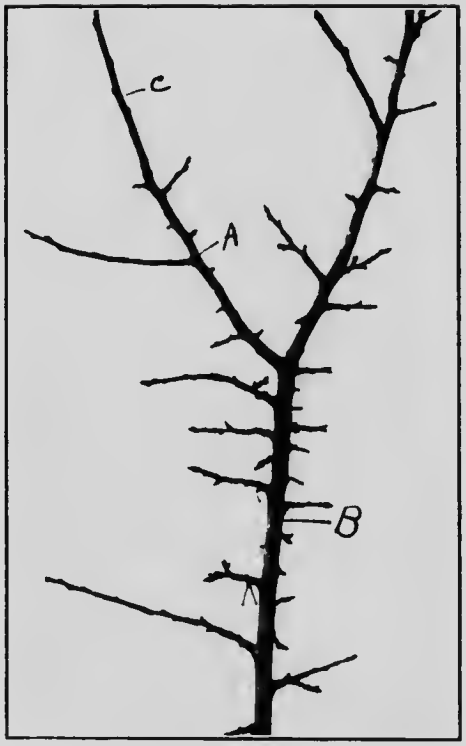


Fig. 12. Reine Claude.

Fig. 13. Reine Claude.

Fig. 14. Burbank.

The spurs, however, cannot be depended upon for very long service. The best of these are one year old. To keep an annual supply of these one-year-old spurs a good supply of new twigs must be grown each year from twelve to eighteen inches in length. In most varieties these twigs will bear some fruit the following year and will also develop from axillary branch buds strong spurs that may be depended upon for the next year's crop. Nearly every cluster of buds will have one branch bud which may be depended upon to continue the growth of the twig.

Fig. 11 shows a branch of one, two and three-year-old wood of one of the Japanese varieties. It will be noted that the best buds are on the spurs on the three-year-old wood (A) and around the base of the one-year-old twigs (B). The two-year-old wood (C) in this case is very short and bears very few buds. The stout round buds are fruit buds whereas small and pointed buds are leaf buds.

Fig. 15. Burbank.

Fig. 16. Burbank.

The manner of pruning this type of tree will differ from the Domestica on account of the different habit of growth. The principle of maintaining a supply of comparatively young wood for the production of fruit buds is, however, the same.

Fig. 12 shows a branch of two (A) and three-year-old wood (B) of the Domestica group with an abundance of fruit spurs along the length of the stem. The smaller twig (C) is one year old. In this case there is not so much difference in appearance between fruit and leaf buds, but a reference to Fig. 13 will show the abundance of bloom on these spurs. Position laterally rather than terminally is a fair indication of the denomination of the bud. Notice also the absence of bloom on the one-year wood (a). Fig. 13.

Figs. 14 and 15 show fruit spurs up to three and four years old which are found growing on the main branch of a plum of the Japanese group and in the

case of open headed trees will bear a fair crop with the minimum of wood growth. Notice the very heavy grouping of the buds on old spurs in Fig. 15. The two central cuttings of Fig. 15 illustrate an attempt to continue growth even in a partially shaded position on the main limbs.

Fig. 16 shows the same type of spurs in bloom.

Fig. 17 shows a branch of the Japanese plum in bloom. This branch consists of one, two and three-year-old wood. The main stem is three years old, while the two-year wood is a short growth at the fork of the branches. The topmost shoot

Fig. 17. Burbank.

Fig. 18. Keiffer.

is one-year-old wood. If shaded, the spurs on the two and three-year-old wood will gradually die, and others on the younger and newer wood will take their places. It is essential some new wood be produced each year.

PEARS

Pears, unlike the stone fruits, bear their fruit from terminal buds on short spurs. These spurs are found on two-year-old and older wood, and sometimes, but very seldom, fruit buds may be found terminating the growth of one-year-old wood. Such buds, however, as the latter, seldom set fruit, and are of little im-

portance to the fruiting habit of the tree. In a young and fast-growing tree the spurs may become well developed on two-year-old wood, and as the tree increases in age continue to develop. They do not die out after one, two and three seasons of fruiting as in the case of plums.

Pruning, therefore, develops itself into a method of keeping these spurs in a healthy and vigorous state with an ample supply of sunlight and air, to prevention of overbearing and the encouragement of growth. On young trees, the long, one-year-old growth may be shortened back and thinned out and so give the spurs

Fig. 19. Keiffer.

Fig. 20. Keiffer.

full opportunity to develop. Too severe cutting, however, tends to produce wood growth at the expense of spur development. On an older and more mature tree, the annual growth becomes less rapid. The branches which are from twelve to fourteen years of age will bear a mass of fruit spurs. Each fruit bud will bear from four to five flowers and as many leaves and the spur as long as it is maintained healthy and vigorous will continue to produce fruit and leaves annually or biennially.

Fig. 18 shows a two-year-old branch of a young, fast growing tree with short fruit spurs up the stem. The twigs at the top are one year old. The illustration

shows where the two-year-old branch had been shortened the previous year to encourage spur development. The branch, however, indicates extreme wood growth and indifferent spur growth caused by too severe cutting back.

Fig. 19 shows the same type of branch in blossom. Notice that each spur has an ample supply of leaves to develop its fruit. This branch was much more "mature" for its age than Fig. 18. Notice also some terminal bloom on the new wood. This latter bloom by chance may develop fruit. Notice also that no blossoms are found on the new or one-year wood.

Fig. 20 shows the same type with its crop of fruit. Here it will be noticed that the development of each fruit seems to be in proportion to the amount of leaf surface growing on the spur.

Fig. 21 is an old and well-branched fruit spur found on the older branch of a tree. The exact history can be read owing to its habit of producing fruit from

Fig. 21. Bartlett.

Fig. 22. Bartlett.

terminal buds. The bud that continues the growth of the spur arises from below the fruit during the year the fruit is being borne and so causes the spur to have a zigzag appearance. Growth never continues from the scar where the fruit was attached. A, B, C and similar scars show where fruit has been borne. Each bud will ordinarily produce four or five blossoms and as many leaves, and at the time of opening will grow out an inch or more. These buds are not always fruit buds, as reference to Fig. 22 will show. This is a similar spur and shows only two of these buds as being fruit buds. This condition on the individual spurs is largely controlled by the condition of the tree at the time these buds are formed the previous year. Where there is an extra crop of fruit to call largely on the resources of the tree, nature has made provision that only a few fruit buds will be developed, and the remainder will be leaf buds. This creates a tendency towards the biennial habit of bearing.

Fig. 23. Bartlett.

Fig. 24. Bartlett.

Fig. 25. Bartlett.

Fig. 26. Bartlett.

Fig. 23 shows a spur similar to Figs. 21 and 22 in fruit. In this case most of the leaves have been cut away and the buds may distinctly be seen. Notice the continuation of the spur in the long new wood at the right.

Figs. 24, 25 and 26 each shows a branch of a mature tree. It is obvious that such branches will need no pruning excepting for purposes of thinning the fruit. Here again every spur does not produce a cluster of blossoms. In some cases they may be seen to produce a small branch one or two inches long in the season; such a one for instance may be seen in Fig 23 above the fruit at the right. The fruitfulness of each spur is controlled by conditions of the previous season for if it could not then produce a fruit bud, none but leaves can arise the following season; in this season, however, it will make a very short growth of an inch or two and set good strong fruit buds.

Study Figs. 24 and 25 together. They are excellent illustrations of the general fruiting habit of the average mature but thrifty pear tree. Though the two illustrations are not from the same branch, Fig. 25 will illustrate where blossoms would have formed on Fig. 24.

CHERRIES

The cherries develop most of their fruit buds in the axils of leaves on short spurs on two and three-year-old wood. Some fruit buds are borne singly on one-year-old wood in the sour cherries, but very few buds are borne on wood over three years of age on either sweet or sour varieties. The spurs after bearing two or three crops usually succumb to adverse conditions of intense shade and poor air circulation. Only on well-pruned trees do they continue to bear good crops for several years, and even on such trees the great quantity of the fruit is borne on newer spurs on the two- and three-year-old wood.

Such a branch of the sweet cherry is shown in Fig. 27. The branch at the left was cut from the other for photographic purposes. This shows one, two and three-year-old wood. (A) shows the point of union between the one and two-year-old wood and (B) shows the point of union between the two and three-year-old wood. It will be noticed that the most of the fruit spurs are near the top of the two and three-year-old wood. This is not quite so pronounced as is seen in the case of one of the Duke variety shown in Fig. 28. In this case the second year's growth is shown in the cluster of spurs at D.

Figs. 29 and 30 are taken from a sour variety.

In Fig 29 the two centre branches have fruit spurs right to the top. This quite often happens. The whole strength of the branch has gone to the production of fruit buds at the tip instead of continuing the growth. This type of wood cannot be considered desirable, as no new wood has been made for the continuation of fruiting wood. Notice also some fruit spurs at the base of the one-year wood. Fig 30 is also a sour cherry branch showing the desirable type of wood. Wood of this type bears heavy annual crops and continues to produce fruiting wood regularly. The branch at the right was cut from the stub on the larger branch. Branches of this type are generally found only in the tops and over the surfaces of poorly pruned trees. They can only be developed throughout the entire tree by vigorous pruning or thinning out to allow growth to develop from the main branches. The sour varieties bear more fruit on the one-year-old wood than either the Duke or Sweet varieties. Consequently "heading-in" is very apt to remove a large number of fruit buds.

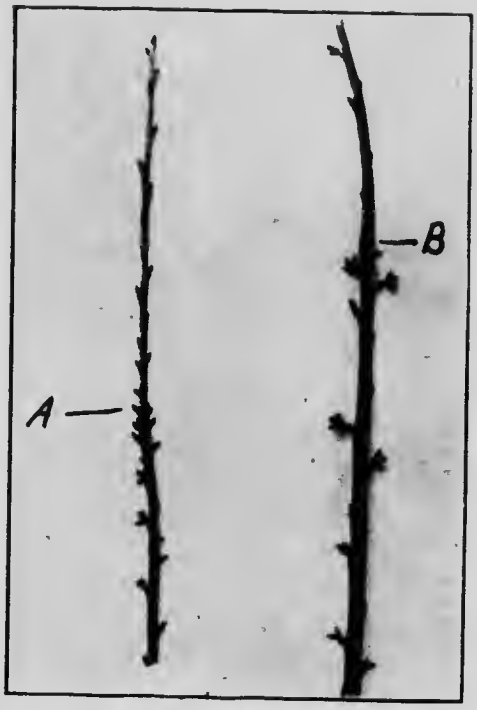


Fig. 27. Sweet Cherry.

Fig. 28. Duke Cherry.

Fig. 29. Sour Cherry.

Fig. 30. Sour Cherry.

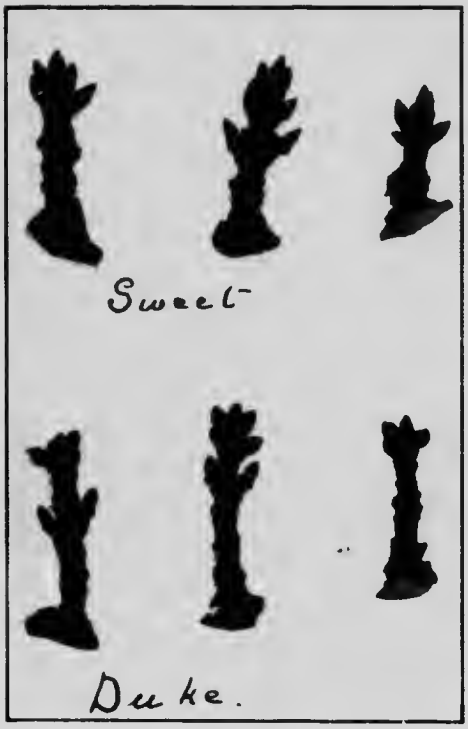


Fig. 31. Cherries.

Fig. 32. Cherries.

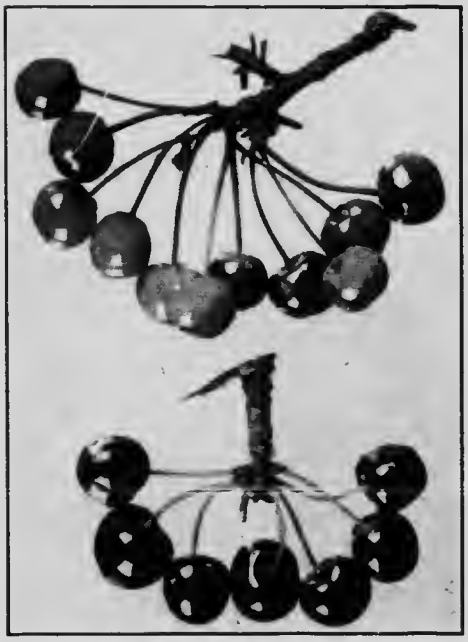


Fig. 33. Duke and Sweet Cherries.

Fig. 34. Sweet Cherry.

Each bud may produce from one to five or more flowers but no leaves. The spurs are provided with leaf buds and a terminal branch or leaf bud which continues the growth of the spur in a straight line.

Figs. 31 and 32 show spurs in the dormant stage and in bloom. Notice which are the leaf buds and which are the flower buds. In both cases the upper spurs are of a Sweet variety and the lower a Duke. Both have the same fruiting habits. Notice the difference in shape of buds between the Sweets and the Dukes.

Fig. 33 shows the same type of fruit spurs with their load of fruit. The leaves have been cut away. The buds which will continue the growth of the spur and

Fig. 35. Sweet Cherry.

Fig. 36. Duke Cherry.

produce the next season's crop are borne in the axils of the leaves, but at the fruiting stage are not far enough developed to show in the illustration. After the crop is off they develop quite rapidly, and extend the length of the spur a half inch more or less. This amount of growth varies according to the general vigor of the tree. Spurs on poorly pruned trees may not grow over a quarter of an inch, and under such conditions of growth are inclined to bear only on alternate years. Spurs that grow three-quarters of an inch are the most desirable type and will produce annual crops of vigorous blossoms and large fruit. But it is a question if it is wise to depend upon old spurs. It is better to prune the tree enough

Fig. 37. Duke Cherry.

Fig. 38. Sour Cherry.

Fig. 39. Sour Cherry.

Fig. 40. Sour Cherry.

to secure each year some new growths of from four to twelve inches long. These new twigs will bear a few lateral fruit-buds near the base and those nearer the tip will be leaf buds. The following year these leaf-buds will develop vigorous and productive young fruit spurs. If the new growths are long and produce many lateral buds it is best to reduce the number of leaf-buds to five or six by heading-in during the dormant season. If many buds are left the resulting spurs will be weak and the best ones will be too far removed from the main branches of the tree.

The cherries then produce their fruit on short spurs and at the base of some one-year-old twigs. Fig. 34 shows the sweet cherry in bloom and Fig. 35 the same is one, two and three-year-old wood. In this particular case the two-year-old wood. Bloom similarly is borne along the older branches but not in so great profusion. The shoots with leaves only at the top are one year old. In Fig. 35 the leaves have been cut away to show the fruit. Here is shown the quantity of fruit borne along five different season's growth. The branch was taken from a mature, well-grown tree where the annual wood growth was short. The tree had been well pruned. The new wood at the top has no fruit. The one-year wood just below it has the greatest quantity, gradually decreasing [illegible] fifth year is reached at the base. A few spurs must be developed each [illegible] take the place of the older ones.

A Duke variety is shown in bloom in Fig. 36. [illegible]nch which is in bloom is one, two and three-year-old wood. In this par[illegible] case the two year-old wood is very short, being only an inch or two in leng[illegible] the densest part of the bloom. In Fig. 37 the leaves have been cut away to [illegible] the fruit, which is near the terminus of the two-year-old part of the branch.

Fig. 38 shows branches very similar to Fig. 36, except that the buds have burst into bloom. Compare the two figures.

Fig. 39 shows a sour cherry in bloom with blooms on spurs of two and three-year-old wood, and from lateral buds on one-year-old wood.

Sour cherries in fruit are shown in Fig. 40. The leaves are removed to show the position of the fruit. The portion of the limb on which the greater quantity of fruit hangs is two years old. That above the union of the three twigs at A and B on the larger branch is only one year old, and shows comparatively only a few fruits. The sour cherries then produce the most of their fruit on spurs found on two and three-year-old wood, with a small percentage from axillary buds on one-year-old wood. The more the trees are opened to the [illegible] the longer will the old spurs survive, and the more numerous will the [illegible] main limbs and stronger branches.

APPLES

The apples, like the pears, generally speaking, bear their fruit from true terminal buds on short spurs. Sometimes fruit is produced from the terminal bud on new wood. Each bud may produce from one to five or more flowers and as many leaves. This condition is shown in Fig. 41. The position of each fruit borne in former years is also shown at A, B, and C. The reasons the spurs grow crooked are the same as in the case of the pear; the fruit bud is always terminal and the bud that continues the growth of the spur arises from below the fruit. Note also the central blossom from each spur. It has opened a little in advance of the other blossoms in the cluster.

Fig. 41. Baldwin.

Fig. 42. Apple Spurs.

Fig. 43. Spy.

Fig. 44. Spy.

In Fig. 42 is shown the bud (a) for the continuation of the spur which may be found situated below the stem of the two apples. The rate of growth of each fruit-bearing spur depends largely upon its situation on the tree, and the health and vigor of the tree. Pruning, to admit sun and air, is not the least factor in the development of spurs. Very often, owing to lack of vigor in the tree, or possibly sunlight, the terminal bud remains a leaf-bud. When pruned too heavily this continues growth in the form of a twig. If allowed to remain shadowed, it cannot possibly grow into either fruit spur or twig.

Fig. 43 illustrates the effect of too heavy pruning. These two twigs bore one or two fruits each near the junction at the main stem, then for several years produced no fruit. One fruit was produced on each branch, but owing to the vigorous growth of the tree instead of only the spur and bud or a short twig a branch has been produced. Notice the long, slender, new growth starting from below the fruit and continuing upward. This can scarcely be expected to bear fruit the next year, though it may after the plan illustrated in Fig. 44. Apples have at various times been produced along this branch, but the growth being rapid gave the limb the appearance of a small branch rather than a fruit spur. These small branches are very often found growing along the main limbs of the tree. On insufficiently pruned trees they succumb to darkness, leaving the fruit to be produced on short spurs on younger wood over the outer surface of the tree. When the top is sufficiently open to admit sunshine, they produce fruit regularly.

Fig. 45 shows the spurs on two, three and four and five-year-old wood. The one-year-old wood is seen at the top of branch A. The branch A is cut from branch B. In young trees very seldom are fruit buds found terminating the season's growth, and the lateral buds are always leaf-buds. No exception is known to this. A few varieties set fruit terminally on new wood on young trees. The fruit spurs with their terminal fruit buds are found on two-year wood and older. On mature trees many of the small branches bear flowers along their whole length from short spurs, and also carry terminal flower buds. In this case the small branches may be looked upon as overgrown fruit spurs. Figs. 46 and 47 in bloom illustrate this. The blossoms appear to be coming from lateral buds on new wood, when really they are very short spurs on two-year and older wood. The marks between the various season's growth do not show in the illustration.

Two years at least are required to produce a fruit spur. Observation shows that a part of the lateral buds on one year wood, under proper conditions of growth, light and air, grow out into short spurs the second year. These may or may not set fruit buds the second year. Under average conditions, they do not. The following year, the spur grows a little longer and sets a fruit bud. The following year the fruit may be produced, i.e., first year, lateral bud; second year, short spur; third year, fruit bud; fourth year, fruit. With normal growing conditions in well pruned trees, the growth given above as second and third year may be produced in one year.

Why are many apple trees biennial bearers? From a "fruiting habit" point of view, the question might be answered this way. The fruit bud is the terminal bud on the spur. While the fruit is maturing on the spur, a bud, or a short growth and a bud, is being produced below it. This is to continue the wood growth of the spur. The best effort of the tree seems to be put forth to mature the apple and ripen the seeds it contains. The bud on the new growth is the reserve bud that may be called on if needed. When once the fruit is ripened the food supply may be used to develop more fruit buds. And that is what really happens, but it cannot be

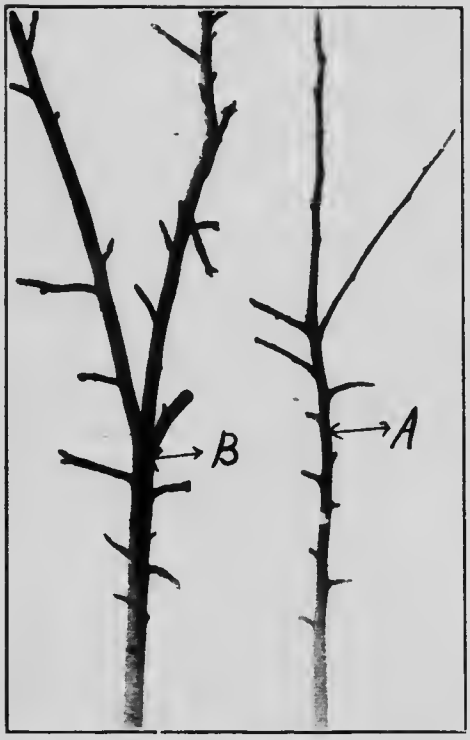


Fig. 45. Baldwin.

Fig. 46. Baldwin.

Fig. 47. Transcendent Crab.

Fig. 48. Transcendent Crab.

done before the following year, as the apple did not ripen till fall. The year is required to once more fill the tree with fruit buds, which in turn produce a crop the following year.

Fig. 48 shows fruit on short spurs on two and three-year-old wood the way it is produced on comparatively young trees. Notice the new rapid growth beyond the fruit.

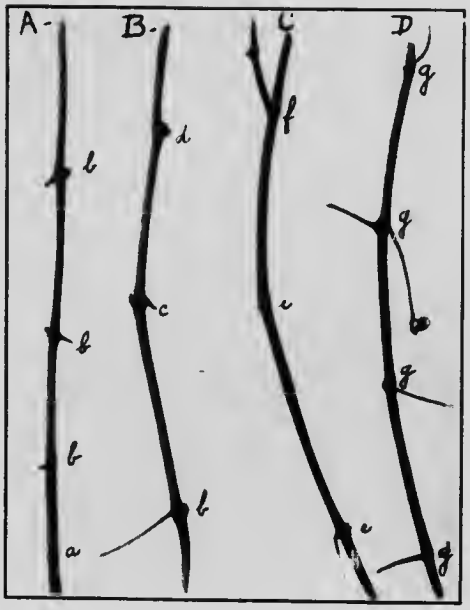
Fig. 49 shows the fruit on a small limb, which contains many fruits spurs and small branches found throughout the head of well pruned trees.

Fig. 49. Baldwin.

GRAPES

Grape vines bear their fruit entirely on wood of the current season's growth. The varieties may vary in extent of growth, but the fruit is usually borne in about the same position no matter what the variety.

An examination of the old fruit canes in the dormant season will illustrate what has taken place at each node of the cane. In Fig. 50, the four branches are all one, cut for purposes of photography, (a) the first node produced a leaf and bud in its axil, the next four nodes (b) produced a bunch of fruit each with a leaf opposite and buds in their axils, the next produced a tendril and leaf (c) and the next node a leaf and bud only (d), the next two nodes produced tendrils and leaves opposite and buds in their axils (e), the next one a side shoot and leaf (f) and the remaining nodes produced leaves and tendrils at each node alternating the position of each on the side of the cane with buds in the axils of leaves to the end (g). The cane was sixteen feet long, and is not all included here. One side shoot is usually



F' 50. Lindley.

Fig. 51. Concord.

Fig. 52. Concord.

Fig. 53. Lindley.

produced on a strong cane and sometimes two or even three. These produce fruit, leaves and tendrils on the same system as the main cane, but the fruit is usually small and the bunches loose. Usually they are late in ripening.

Fig. 51 is a similar cane of a different variety. It shows a cane bearing five side shoots (a) which should be pruned in any summer pruning that may be attempted. In their effort to produce bunches of fruit these absorb energies of the vine that should go to develop the first set of fruit on the main cane. Almost every bud produced in the axil of a leaf will, if the vine is allowed to grow, produce fruiting canes the following year on the same system as this fruit was produced. Hence, the reason the vine must be pruned annually back to a certain number of buds. It concentrates the fruit on a certain number of canes.

Fig. 54. Concord.

Fig. 55. Lindley.

Fig. 52 shows the growing shoot as it comes from the bud on the old cane early in the season. Three bunches of fruit are forming, and the illustration shows clearly the sub-laterals (a) which spring from the axils of the leaves subtending the next season's bud. This is the right stage to remove these sublaterals. They are of no value. Any fruit that may be produced on them will be small of bunch, and will not likely mature.

Fig. 53 shows the same formation, but on a different variety. Sub-laterals are attempting to grow at nearly every node. The usual formation of a bunch of fruit with a leaf opposite at the first three or four nodes will be noted, the leaves and fruit alternating on the side of the cane. Leaves and tendrils alternate in a similar manner.

Figs. 54 and 55 show ripened fruits of the same varieties. Notice the extent to which the sub-laterals have grown.

Fig. 56. Raspberry.

Fig. 57. Red Raspberry.

Fig. 58. Black Raspberry.

Fig. 59. Black Raspberry.

RED RASPBERRIES

Red raspberries bear their fruit in loose clusters and singly from the axils of the leaves on the short laterals of the current season's growth. This growth is borne on one-year-old canes. Raspberry canes usually grow straight, although sometimes they throw off one, two or a number of branches. Some growers advocate pinching back at the top when it has reached the height of three or four feet to induce branching. It is questionable if this operation is advisable, as the laterals produced cannot possibly be the most vigorous, and may easily succumb to the rigors of winter. Canes allowed to grow straight, and cut back in the spring, will bear all the fruit they can mature.

Fig. 56 shows a branched cane in the dormant stage. The buds shown here are those which produce the laterals on which the fruit is borne.

Fig. 57 is an upright unbranched cane with its crop of fruit. All the laterals here are of the current season's growth, and the fruit is borne at their terminals in clusters and singly, and also to a lesser extent, in the axils of the leaves. Fruiting wood of this nature has served its purpose after one crop has been picked, and must be removed. Another cane will grow up from the roots the same season to replace it.

BLACK RASPBERRIES

The black raspberries have the same fruiting habits as the reds, but are much stronger growers.

Fig. 58 shows the cane in the dormant season. The pruning practice has been to cut off the cane when it has reached the desired height. This has caused it to throw out laterals. When this is done early enough in the season, the laterals will make a strong growth and develop vigorous buds. These in turn produce laterals the following spring on which is produced the season's crop. The fruit is borne in clusters at the extremities, and singly in the axils of the leaves on short sub-laterals. Each lateral comes from single buds as seen in this illustration.

In Fig. 59 the manner of fruit production is distinctly shown. All the buds on the lateral branches have produced fruiting wood right back to the main cane as well as the buds along the stem of the cane. In the dormant season, or very early in the spring, the laterals of the last season's growth may be pruned back leaving only a sufficient number to produce fruit in quantity. The whole cane after once fruiting, is of no more value. The new growths which have come up during the season and been pinched back in midsummer, will fill the place and produce a crop the next season.

BLACKBERRIES

The blackberries bear their fruit in clusters at the ends of short sub-laterals of the current year's growth, and also to a small extent in the axils of the leaves. In Fig. 60 is shown the method of pinching back the single cane during the growing season, in order to cause it to branch. When the cane has reached the desired height, it is pinched back, and then two, and sometimes as many as four or five lateral branches spring out from the buds below. In this case, two laterals only develop, but one of these was pinched back a second time, causing it to branch. The buds which are borne in the axils of the leaves will give rise to short sub-laterals the following season, and on these the crop is produced.

Fig. 60. Blackberry.

Fig. 61. Blackberry.

Fig. 62. Blackberry.

Fig. 61 is a view of the blackberry in bloom. In this case, three lateral branches arose after the main cane was pinched back. Near the ends of these are seen the sub-laterals in bloom. It will be noted here that the first three or four buds on each lateral have produced no bloom. The varieties of blackberry differ somewhat in this respect, and a knowledge of this controls the subsequent method of pruning during the dormant season.

The same variety in fruit is shown in Fig. 62. Here it will be noticed six fruiting laterals were produced after the cane was pinched back. It will also be noticed that each lateral is comparatively weaker than those in Fig. 61. The whole cane, after having once fruited, is of no more value as in the raspberries, and must be replaced with a new cane, which has come up from sucker growth during the growing season.

CURRANTS

The black and red currants do not bear fruit in quantity similarly, hence the pruning of the one is a little different from the other. The black currant bears most of its fruit on new growth, on two-year-old, and on wood of the previous

Fig. 63. Red Currant.

Fig. 64. Red Currant.

Fig. 65. Red Currant.

Fig. 66. Red Currant.

Fig. 67. Red Currant.

season's growth. The red currant produces most of its fruit on spurs, which develop from wood of two or more years old; but as the fruit on older wood gradually becomes inferior, it is best to depend upon wood of not more than three years old for the crop. For this reason, a supply of young wood must be maintained to replace the old, which is removed after having borne a second crop. The black currant, on the other hand, produces it most and best fruit on one and two-year-old wood. It is best to remove the branch after it is two years old, or at most three years old, and to permit a supply of young wood to grow to take its place.

Fig. 68. Black Currant.

Fig. 69. Black Currant.

Each bud produces from one to three or four bunches of fruit and as many leaves. The fruit spurs with their buds in groups are usually terminated with a leaf bud, which continues the growth of the spurs.

Fig. 63 shows a branch of the red currant of one, two and three-year-old wood. The fruit buds are in groups on short spurs on the two and three-year-old wood. Such a branch as this after producing its crop might profitably be removed. Although it may continue to produce fruit, it does so in diminishing quantities, and will not be as productive as younger wood. Cutting back tends to produce side shoots and spur growth. Fig. 64 shows a long shoot which will take the former's

place. A and B are one growth. This shoot is two years old, and will develop lateral branches during the season, as well as produce considerable fruit, as is shown in Fig. 65. This is a one-year-old branch, which has been shortened in pruning, and has developed a little fruit on the one-year-old wood. It is also developing several laterals, which will make strong fruiting branches for the two seasons following.

The red currant in bloom is shown in Fig. 66, and another type of branch with its crop of fruit in Fig. 67. In Fig. 66 all the lateral branches are two years

Fig. 70. Black Currant.

Fig. 71. Black Currant.

old, while the main stem to about half its length is three years old. There is a good show of blossoms here throughout the entire length of the laterals, but they are mostly on two-year-old wood. The one year old growth is very short at the terminals. Such a branch as this will produce a good crop again the next year, as most of the spurs, where the fruit is borne, will continue to develop and set a plentiful supply of fruit buds for the following season. Following this season if it can be replaced with such a branch as is shown in Fig. 65, it will be profitable to replace it.

Fig. 67 shows a main branch, the lower part of which is three years old, and the top part two years old. The lateral branches are one year old, and will be seen to be bearing a fair crop of fruit. They are really fruiting laterals on three-year-old wood.

The black currants produce a greater proportion of their fruit on the one-year-old wood than do the reds.

The type of long one-year-old shoot such as comes from the centre of the bush, is the shoot to replace the old fruiting wood. This is shown in Fig. 68. The portion at the left was cut from the portion at the right. In Fig. 69, the same type of wood is seen in blooming time. Notice the large percentage of bloom near

Fig. 72. Black Currant.

Fig. 73. Blac' rrant.

its top. The portion at the right was cut from the portion at the left. It be noticed also that this cane is commencing to form lateral branches. Fig. 70 shows a similar type of cane which had been shortened back during the dormant season and has branched. It is bearing no fruit. This is a good type of branch to replace the older fruiting branch, and will bear a heavy crop the following season.

The branch shown in Fig. 71, is an ideal type of fruiting branch. The main portion of the branch is two years old, and produced a crop of fruit during its first year, as can be seen by the old fruiting stems still adhering. It also developed short fruiting spurs on the two-year-old wood. It will also produce a fair

quantity on the one-year-old portion at the top. Fig. 72 shows a similar type of fruiting wood in bloom. Here it will be noticed that the main stem of the branch, which is three-year-old wood, is practically barren, while an abundance of fruit is produced higher on the one and two-year-old wood. The portion at the left was cut from the other. Fig. 73 shows the same type of fruiting wood carrying its crop of fruit. The three-year-old portion of the branch is not shown in this case. It was practically barren of fruit.

GOOSEBERRIES

The fruiting habit of the gooseberry is practically the same as the red currant. It produces the most and best of its fruit on short spurs on two and three-year-old wood, and a similar proportion from lateral buds on one-year-old wood. It

Fig. 74. American Gooseberry.

bears fruit on all wood except the very old. After the wood becomes three years old, its productive power is diminishing. Long one-year-old shoots, which grow from the centre of the bush, should be left to replace the older branches when they are removed. Each fruit spur bears a cluster of three or four buds, and on the one-year and two-year-old wood the fruit buds are usually borne singly in the axils of the thorns. Each bud produces from one to three or four fruits with as many leaves. The fruit buds in the dormant stage can usually be distinguished, as they are larger and plumper than the leaf-buds.

Fig. 74 shows the long shoot which grows from the centre of the bush, and which will, during its second season, throw out lateral branches to replace the older branches, which have been removed after their period of greatest productiveness.

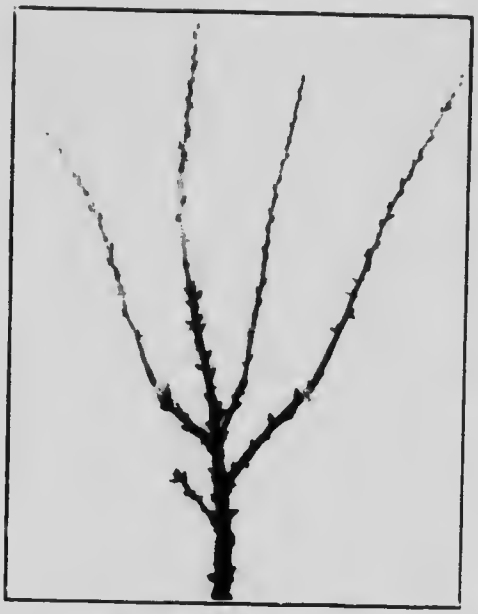


Fig. 75. American Gooseberry.

Fig. 76. American Gooseberry.

Fig. 77 American Gooseberry.

Fig. 78. American Gooseberry.

The portion at the right was cut from the other. Fig. 75 shows the type of branch in the dormant stage, which bears the heaviest crops of fruit. The lower portion of the main stem is three years old. The lower portions of the laterals are two years old, and the remainder is one-year-old wood. Fruit will be borne all along these laterals and down the main stem to near its end. A reference to Fig. 76 will show this. This is a similar type of branch in the blooming stage. It will be noticed that bloom extends throughout the branch, and that almost every bud has produced two or three flowers.

Fig. 77 shows on the right the long cane which will replace the old fruiting wood. There are only a few blossoms near its apex. This shoot should be shortened to induce it to produce laterals. It will however, produce medium, strong laterals similar to the branch on the left without being headed back.

Fig. 78 illustrates the fruiting type of one, two and three-year-old wood, showing the crop of berries. Particular attention is drawn to the fact that the largest and best fruits are on the one and two-year-old wood, with perhaps the very largest on the one-year-old laterals.