THE
FRUIT GROWER'S GUIDE

BY
JOHN WRIGHT, F.R.H.S.
EDITOR OF THE "JOURNAL OF HORTICULTURE"; EDITOR OF "GARDEN WORK"
MEMBER OF THE FRUIT COMMITTEE OF THE ROYAL HORTICULTURAL SOCIETY
AUTHOR OF "PROFITABLE FRUIT CULTURE," THE GOLD MEDAL PRize ESSAY OF THE FRUITERERS' COMPANY
AND LECTURER ON HORTICULTURE FOR THE SURREY COUNTY COUNCIL.

WITH ILLUSTRATIONS BY MISS MAY RIVERS

AND

NUMEROUS ILLUSTRATIVE DIAGRAMS BY WORTHINGTON G. SMITH AND GEORGE SHAYLER

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are intact. The cut was an upward one, and the roots resulting proceeded from the upper side of the cut, stimulating the fibres on that side as shown in the figure. The consequence is they bear any reasonable weight or strain in lifting, and the advantages are well defined in the dotted lines showing them spread near the surface in planting.

Root-pruning with the spade answers very well when the trees are young, but there is a practice of using it which disastrously affects fertility, for digging the ground over and among roots only causes them to penetrate deeper. This kind of root-pruning cuts off the fruit-producing portions, and leaves those unpruned which form the fruitless growths. This is contrary to correct root-pruning principles. The intelligent pruner does not destroy but seeks the manufacture of fibres for the substantial reasons above indicated.

Fruit trees do not require systematic root-pruning until they exhibit a tendency to depart from a healthy fruit-bearing condition into excessive wood production. They are apt to do this in deep rich soils, especially when they have little or no fruit to support for a year or two through frost destroying the blossom. When too luxuriant, root-pruning must be had recourse to as a means of insuring moderate growth and productiveness. The proper mode is to remove the soil outwards from the stem as far as the main roots extend, then shorten the long ones and those that have the fewest fibres the most, the smaller and most fibrous the least; but a sufficient number in all cases ought to be left for forming fresh roots, and they should not be shortened to an even length, but left of different lengths so that the fibres may push equally from the stem. Vertical roots should be cut off, but in no case must their severance be carried to extremes, nor done in a reckless manner. It usually suffices to detach one-third from the roots, but the condition of the tree will determine the extent of shortening needed. Regard must also be had to the space set apart for the trees. If this is limited the roots must be correspondingly restricted, the strong as a rule requiring severe, and the others light, pruning. All detached roots should, as far as practicable, be removed from the soil, and a little fresh compost placed under and over those retained, making it firm, and finishing by mulching the surface with partially-decayed littery manure.

The operation of root-pruning is not in itself desirable, but the natural habits of trees on the free stock in favourable soils is to defer bearing, particularly in the pear, the roots being nearly all perpendicular; therefore in root-pruning trees of this character
they must be well supported with stakes afterwards, for at least two years. Severe root-pruning requires great care. Taking out a circular trench a yard from the stem, and cutting one-third, half, or two-thirds of the roots off a tree, is not the practice we have found successful. When trees, pears for instance, become large and produce nothing but luxuriant shoots in summer, that are cut out in winter, root-pruning may be practised with great advantage, provided it be done cautiously yet effectively. The soil should be removed from over the roots as far outwards as they extend strongly, say a yard and a half away in the case of trees against a 10-feet wall, more if the trees are higher; or if in the open, quite that distance or more with trees fifteen to twenty years old; but it is safer to keep well away from the stem than to operate too closely. Cutting off one-third the roots at a yard, two-thirds at a yard and a half, and the remaining third at two yards from the stem is a good principle to follow, varying the distance in accordance with the strength of the trees and the character of the roots. Sometimes root-pruning has no material effect, through the fangs which form near the bole and go straight down having been overlooked. See page 160 ante, and proceed as directed.

Indiscriminate root-pruning must not be practised. The condition of trees should be accorded due weight, and thought must govern action. The special requirements of each kind will have due consideration in the proper place. As a rule October and early November are the best months for pruning, because the ground is warm, and, if also moist, the cut-back roots soon heal over; then, if the soil is suitable, they quickly form a network of fibres, without which firm, fruitful growth cannot be expected.

**Shaping and Training.**

**Shaping Trees.**—Pruning is essentially a shaping process. Trees naturally assume forms that do not render them the most profitable, and the art of the cultivator may be displayed to great advantage by the intelligent use of the knife. Fanciful modes of shaping have never been popular in Britain. Lost in antiquity is the origination of the cup-shaped gooseberry bush, yet it prevails with singular uniformity all over the world. Its advantages are accessibility of every part to climatic influences, which promote fruitfulness, and affording facilities for pruning and gathering the crops. This form, more or less modified, is applicable to trees of the larger fruits as well as bushes. The process of forming a cup-shaped head is the same in both standard and dwarf trees. A fruit tree left to itself becomes a wilding, in poor soil stunted, in generous soil making long growths incapable of supporting the fruit eventually produced, and the branches are
either broken or have to be secured with props and cord, whereas trees ought to be formed sufficiently strong to carry all the first-class fruit they are able to perfect. Symmetry in form with productiveness is, to a large extent, the outcome of systematic pruning.

Fig. 45. Forming Cup-shaped Trees.

References:—D, maiden tree; E and F, first pruning; G, second pruning; H, third pruning; I, tree formed; J, cup-shaped bearing tree. (For details, see text.)

Cup Form.—The inexperienced cannot be taught how to secure the ancient British shape without illustrations, but with them they ought to succeed. The weak tree in D (Fig. 45) is a maiden marked for cutting back to a few buds of its base. The following
year it produces a leading shoot strong enough for heading at the right height, as shown by the bar (1) in $E$. If a tree is gross or more than a year old, and has formed laterals, three or four of those, properly placed, may be chosen to form main branches, shortening each to a sound bud nearest the stem, as represented by the four upper bars in $F$, other growths to be removed; but to form a cup-shaped tree with a short stem it must be shortened to the bar (2). A yearling tree, however, which has not branched and has good buds all along the stem, is preferable. When these push select three or four of the strongest and best-situated shoots, removing the others; and allow those retained to extend, pinching any side-shoots that may issue at the second or third leaf. A tree treated as described is shown with four branches in $G$. These are cut back to outside buds 6 inches from their base, as indicated by the bars. The cutting to outside buds is to counteract the semi-erect habit of the tree and cause it to spread and thus provide more space between the branches.

The following season two shoots are encouraged from the upper buds of each branch, all others being stopped. Allow the leading branches to extend unless some are excessively strong; then they may be pinched to ensure equality of vigour and to strengthen their base. Suppress side-growths by pinching to four good leaves. In the autumn or early spring shorten the eight main branches to 6 or 8 inches of the base of the summer growth, cutting back all side-shoots to one or two buds, and they will probably form spurs, and, if not, will assist the thickening of the branches and not prejudice the naturally-formed spurs.

A tree marked for its third pruning is represented in $H$—a tree with eight branches. From each of these two shoots are taken, the treatment being a repetition of that of the preceding season on corresponding growths. Early-bearing trees afford fruit the fourth year, but care must be taken not to overcrop them. By the autumn we have a sturdy example of the cup form, with a succession of branches as nearly as possible of equal vigour, as shown in $I$—a tree with sixteen branches about 9 inches apart, which is a sufficient distance, for the branches spread as they get older, and the framework of the tree is now secured. If the leading shoots are not more than 15 inches in length they are left entire, as shown in the engraving, but if longer they are cut back about the height named, and the following season one of the best growths from each cut-back leading branch is selected as leader; the rest must be pinched. In the fifth autumn a tree treated as described presents a promising aspect, as represented in $J$.

**Forked Form.**—This is simple and useful. A substantial tree is attained by starting
Fig. 46. Forming Fork-branched Trees.

References:—K, upright habit; L, spreading habit; M, characteristic form; N, advanced tree; O, complete specimen.

(For details, see text.)
three to five branches from the stem on different sides and varied levels. No hollow or basin for holding water is then formed between the branches, as occurs when they start from nearly the same level, as is shown at 1 in the tree K (Fig. 46). Each of the four branches is cut back in winter at 2, leaving a length of 6 inches. From these it is usual to allow eight growths the following year, two from each branch, but six branches so near the stem are quite enough. The six branches are pruned to outside buds one foot above their base to cause the tree to spread as shown by the dotted lines emanating from buds below the upper bars (4). By pruning to inside buds, as shown by the lower bars (3), upright growths issue, crowding and thus spoiling the tree.

Another tree of an entirely different stamp is shown in the engraving L. Its four branches originating at different levels give much more space between the principal arms, which become stronger in consequence and more fruitful. After heading at 1, all growths on the stem but the four branches are rubbed off, these four branches being kept as nearly as possible equal in vigour by pinching. They are shortened in winter at 2, leaving them 10 or 12 inches long, cutting in this case to inside buds as the habit of the tree is spreading. The following year two growths are encouraged to extend from each branch, all others being pinched in summer and cut back in autumn as shown by the bars across the small shoots. The extremities of the branches are cut back to 12 or 15 inches, as shown at 3, and the tree becomes furnished with stout branches and fruitful spurs. As a rule the greater the number of branches a tree has when planted the less it is pruned, on the assumption that the more numerous the branches the greater the weight of fruit. That is a grievous mistake, for too many branches, as has been previously shown, crowd the tree and prevent the formation of fruit buds.

A characteristic tree is shown in M, with a clean stem and three branches emanating at different but not greatly distant levels. The shortening of these to 6 inches (2) gives rise to six branches. These cut back in due time where marked (3) to outside buds 12 to 15 inches from their base, twelve branches are secured, which is a proper number for the framework of either a dwarf or standard tree. A forked tree marked for a fourth pruning is shown in the illustration N; but it is not usual to fork the branches more than twice, unless the annual growths exceed 15 inches; then their points are cut off. The natural propensity of all fruit trees is to branch at the extremity of the annual growth, two branches emerging from one without pruning, as depicted in the engraving (r), instead of pushing a single growth in continuation of
the branch, as shown by the faint lines. Natural forking is generally sufficient after the second or third pruning (2 and 3, $M$) to produce a satisfactory tree.

In a tree started with five or more branches emerging from the stem and trained in an outward direction inclining upwards, they do not fork so soon as those which are stronger and more erect. The central and upper part of the tree becomes much more forked than the lower. This is considered a not undesirable form, and is represented in $O$. The lower branches are those of the cup-shaped tree, whilst the upper part possesses the advantages of the forked form.

Training.—The main object of training fruit trees is to secure such disposal of their

![Fig. 47. Laying the Foundation of the Future Tree.](image)

... growths within certain limits as insures the best results in their crops. The natural inclination of a young tree is to mount upwards and spread as much as possible, and it is for the cultivator to train and mould the growths into usefulness. To effect this it is necessary to—1, lay a broad, strong foundation in the lower parts of the tree; 2, to furnish the whole of the tree from base to summit with fruitful wood. Pruning alone secures in some trees the desired form, but in others training plays the most important part, pruning only being had recourse to for originating growths and to regulate those not amenable to training.

In $P$ (Fig. 47), a tree one year from the bud or graft is shown in the dormant

...
state in the dark part of the figure. This, if left entire, only pushes at the top the following season, as is seen in the leafy growths corresponding to the buds, those growths being the strongest in the upper and weakest in the lower breaks. That is nature. To the cultivator wanting a dwarf, not a standard tree, it is growth in the wrong place; therefore, the maiden tree is made to push growths where required by cutting off its head at a sound bud, as indicated by the bar (1). This insures good growths from the buds left, sturdy and well matured by the autumn of the following year, as seen in the dark parts of Q. These, if left their full length, start the top buds only the succeeding season, as shown in the foliate growths, the buds at the lower part of the branches remaining dormant. This is of frequent occurrence in training. Leaving stems and young branches unshortened causes half of their length to be devoid of bearing wood, but by cutting them back the branches are furnished with fruitful growths from the stem throughout their whole length. The cultivator’s aim in this case is to change the natural place of the branches and induce them to start lower down; therefore the growths are shortened, as shown by the marks across them (2). The result is well represented in R, namely, the foundation of the future tree is broad, strong, and firm.

When a tree is to be trained either obliquely or horizontally instead of grown in bush form, the sketches S and T (Fig. 48) will show the right method of procedure. If
the tree $S$—one year from the maiden headed the previous season at $i$—is intended to be trained in fan fashion, the branches must be cut back at the bars (2) for originating the foundation growths, as indicated by the dotted lines, from their corresponding buds.

If a horizontal-trained tree is desired, the central branch only is shortened back where shown by the dotted bar (3); the two side branches having their laterals cut back to a sound bud nearest the base, as indicated by the bars, are trained in their full length. The result is as seen in $T$, which clearly demonstrates the difference between cutting growths away and retaining them in positions favouring fruit-bud formation. The side branches should be brought down so as to have a slight curve upwards from the stem, the depression of the branches being sufficient to arrest the sap in flowing round the bend so as to cause the buds there to break. After the branches are set the sap flows freely round the curve, which is all important to the growths on the horizontal branches, for insuring adequate vigour with productiveness. The horizontal position of the branches causes all the buds along them to push, a point of much importance, because buds remaining dormant are alike fatal to symmetry and a loss of productive force; indeed, bare branches represent a waste of space, time, and produce.

To ensure equal vigour in the side shoots last originated (4) as in the central leading growth (5), they are trained with a gentle curve from the stem upwards, and if one is stronger than the other, it is depressed so as to cause the sap to flow less freely to it, thereby invigorating the other. The central shoot may be treated similarly, but bending leaders or pinching out their points usually results in a quantity of spray. Therefore, instead of balancing growth in the leader by depression, cut it boldly off at the bar (5), when sufficiently vigorous and advanced, say from midsummer to mid-July, and thus secure two side-growths and a leader, as indicated by the dotted outlines, which results in two pairs of branches in one year. The side-shoots (4) should be brought into a horizontal position when the leader is cut back, which prevents their becoming gross and pushing laterals, and the sap being concentrated on the leaves throughout the whole length of the branches, spur or blossom bud formation takes place the sooner. Indeed, the transformation of wood buds to blossom buds is in that way rendered complete in all stone fruits, and often in apple and pear trees under favouring climatic and cultural conditions. Some enlargement of the embryonic formation always occurs in the buds, through depression of the branches; this is shown in the detached horizontal branches (6). These, in the following season, if not in the year of formation, are sure in the case of the apple and pear to form spurs with blossom buds, as represented in the first tier of
horizontals (7). Upright growths, as a rule, are noticeable for wood formation, and inclined or horizontal ones for fruit production.

**Disbudding.**

This may be regarded as a form of pruning, as it removes needless shoots, and it certainly is an essential condition of good training. Shortening branches to originate growths, and bending them to secure form and fruitfulness, necessarily causes more shoots to be made than are required, and if all were left, confusion would be created and a disorderly fruitless tree. No growth should be allowed where there is not sufficient space for the leaves to develop under full exposure to light, and when two or more shoots are produced where one only is wanted, the superfluous growths must be removed at an early stage, reserving the most promising and best situated. This work requires to be done gradually, for every bud that is being developed maintains the sap in circulation, and removing a number at once, especially in ungenial weather, when vegetation is languid, may cause stagnation of the fluids and prove injurious to the health of the tree. On the other hand, if the sap is active and there are four buds pushing where one only is wanted to grow, removing three of them at the same time will divert more sap into the one left than it is well prepared to receive; but if two are taken off, and those the smallest, the two left will not be prejudicially affected, as the sap liberated readily finds other channels, and in the course of a few days the other shoot may be removed without check to the roots or unduly flushing the growth left. Growth in the branches stimulates the action of the roots; consequently deferring disbudding until the shoots are sufficiently long to be taken hold of with the finger and thumb, aids the collecting of food from the soil, and gives the cultivator the advantage of selecting the strongest or most perfectly-developing growths in the best positions. The shoots then removed leave no wound of consequence, but if left until they become somewhat woody at their base, the bark is liable to be torn. This induces gum in stone-fruit trees, and canker in apples and pears. In all cases of removing woody growths the knife should be used, a clean wound always healing better and more quickly than an uneven one. All growths retained that must afterwards be cut out deprive those that ought only to have been left, not only of vigour, but of the light and air that are essential to their solidification and fruitfulness.

The process of disbudding, and the practical results of it, can only be made clear to the uninitiated by the aid of illustrations. On a careful glance at Fig. 49 it will be seen
that some of the pushing buds are detached from the stems, while others are adherent. All that remain to grow through the summer produce branches similar to those fore-

![Tree Diagram]

**Fig. 49.** Disbudding for growths and clean stems.

*References:*—*U,* a young apple or pear tree, showing—1, the results of leaving all the growths on a branch; 2, the effect of disbudding; 3, a shortened side-branch pushing all the buds to the base. *V,* part of a plum branch, showing—4, three growths from the pruning bud; and 5, the result in shoots. *W,* part of a plum branch pruned to a triple bud, showing—6, vigour imparted to the central bud growth by the detachment of the two side-buds; 7, the result in matured wood and blossom buds. 8 represents a smooth knife-wound that will heal; 9, a torn wound made by tearing off the shoot roughly.

shadowed in a leafless state. A second glance will show that the branches on the right side of the tree are much superior in character, and more thinly disposed, than are
those on the left. This is because a number of pushing buds were detached on one side and not on the other. The left side of the tree represents mismanagement—a confusion of irregular growths, which must be barren because crowded. The right displays cultural attention, the certain precursor of fruitfulness. A close examination of the reference matter and figures will enable the subject to be comprehended.

Clean, sturdy, thoroughly-solidified growth in young trees is essential to their after health and capability for fruit production. It is a mistake to crowd the lower parts with side-growths or spurs with a view to early produce, because their removal at a later period causes a number of wounds to be made; these impede the flow of sap, and produce more or less knotted stems at the very point where their sap channels should be straight and clear. Trees with clean stems always produce the most perfect fruits. It is equally important that the young tree be induced to grow freely, and to effect this is one of the objects of disbudding. Instead of leaving all the young shoots issuing from a cut-back branch, as portrayed, U 1, page 187, and getting nearly a dozen of varied lengths and strengths as there figured, the young shoots not required for the framework of the tree should be rubbed off early, leaving the three growths shown in dotted outline. The condition of the growths when disbudding should begin is seen in the side-branches, U 3. Those to be removed are shown detached in the branches—U 2, and W 6, and the effect is seen in the stronger, firmer, and more fruitful wood represented. With the object of making the important subject of disbudding still more clear, further examples from practice are introduced.

When a branch inclines obliquely upwards and is left its full length, the buds at its base do not break; but by bending it, as indicated by the curved dotted outline in Y, Fig. 50, when the buds commence swelling, the basal buds start into growth. The branch may be depressed more if needed, and eventually raised, when the whole of the buds start equally from the base to the extremity. Removing half of these growths when they have fairly started, makes in most cases all the difference between a full crop of fruit either the following or third season, and none. This is apparent in the blossom spurs forming on the disbudded branch, A.

A branch not breaking at the base represents permanent loss, and if the side-growths, Z 2, had been removed, and every alternate growth from that part downwards, the base buds would have started, and a branch have been produced, well furnished with spurs, wide enough apart to cause them to form perfect blossom buds and strong extension growth, as depicted in the branch (A) above cited.
Fig. 50. Disbudding for Wood and Fruit.

References:—Y, branch which has been depressed, causing it to make growths equally throughout its length, Z, branch trained obliquely, neither depressed nor disbudded, showing—1, basal buds dormant; 2, extension and side growths (pinched). A, a similar branch disbudded. B, originating growth from the base of a branch, whilst continuing extension by disbudding; 3, basal growths retained; 4, extension growth; 5, foreright growths; 6, upper side of branch growths; 7, lower side of branch growths, all removed. C, shoots on an undisbudded branch. D, shoots resulting from disbudding; 8, basal growths with wood and blossom buds; 9, part of extension growth, for bearing and subsequent removal.
Sometimes growths must be originated at the base as well as extremity of a branch, alike for filling vacant space and for furnishing a succession of wood for bearing, as in the Morello cherry, nectarine, and peach. This is effected by removing the foreright shoots, $B\ 5$, and back-growths corresponding on the opposite side of the branch; then those on the upper side, $B\ 6$; last those on the under side, $B\ 7$. Thus the eighteen would-be branches are reduced to three in the length of a foot—namely, the two basal shoots, $B\ 3$, $3$, and the extension, $B\ 4$; the result will be stout, short-jointed, well-matured wood, and perfectly-formed buds on them, as shown in $D\ 8$, $8$, and part of the extension, $D\ 9$. The energy and substance of the twenty-one shoots shown on the branch, $C$, are concentrated in the three growths of the branch, $D$. The one-year-old branch generally produces fruit, as represented in the detached bunches of cherries, as well as affords shoots for successional bearing and extension, but it is not customary to originate two shoots at the base, the upper one usually suffice, and when the lower is dispensed with, the fruit is better nourished, growth only being allowed on the fruiting branches for attracting the sap to assist the crop swelling to maturity.

**Protection.**

*Birds and Buds.*—Fruit crops are more or less endangered by bud-eating birds. The Bullfinch (*Pyrrhula vulgaris*) is most assiduous in its attentions to fruit trees in winter and spring, feeding on the buds, for which its strong bill is well adapted. It commences its depredations on gooseberry bushes, alternating its dietary with plum buds, and finishes on apple trees. A pair only of these birds do immense mischief, and we have known all the trees and bushes in a large garden and orchard rendered practically fruitless through bullfinches taking the buds. The bullfinch is remarkable for the facility with which it is caught in a trap cage with a “call” bird, or it may be secured with birdlime. Captured in either of those ways, the beautiful plumage of the birds assures for them a ready sale, particularly as they are easily tamed, taught to pipe, and even to articulate words. When accomplished in those respects they are sold at high prices, as much as £4 or £5 being demanded for a single bird. It is better to sell the birds than shoot them, especially as shooting among fruit trees damages them seriously.

The Common Sparrow (*Passer domesticus*) is active and fearless. The food of the birds consists of grain, vegetable substances, and insects; therefore, they are useful to the fruit grower in their raids on destructive insect larvae when rearing their young.
When numerous, however, the adult birds sometimes do considerable mischief to fruit trees and bushes in denuding them of buds. They are the most destructive because most numerous near towns and farmsteads. Thinning their number is the wisest course. In some localities the sparrow-catcher with a purse net captures sufficient birds to pay him for its employment at night against ivy-clad buildings, hay or corn stacks, or over evergreen bushes, and in most cases clears these useful creatures quite fast and close enough to serve the best interests of the fruit grower.

The Greenfinch (Coccothraustes chloris) frequents gardens and fruit plantations, and feeds on grain, seeds, or insects. Its depredations on fruit buds are, in our experience, confined to plum trees, and it is rarely injurious. The Great Titmouse (Parus major) takes a few fruit buds; and the Blue Titmouse (Parus caeruleus), though having a bad character, feeds mainly on insect larvae, thus rendering service to fruit growers; yet it also does injury in dissecting buds in the search for insects. The undue increase of birds in certain localities should be prevented, and their wholesale and indiscriminate destruction serves no useful purpose, but, on the contrary, may be attended with serious consequences, and is, therefore, strongly deprecated.

Preserving Buds.—As a preventive of birds taking fruit buds, Mr. Taylor, a successful fruit grower and exhibitor, recommends the following dressing as quite harmless to fruit trees, and obnoxious to birds. "The ingredients are a quarter peck or more of quite fresh quicklime, a pint of sulphur, and 1 1/2 pounds of soft soap. Choose lime that weighs very lightly, dip a few of the lumps in or sprinkle with water (hot water is the quickest in action) and place in a bucket or other vessel, sprinkle a little of the sulphur thinly over it, then add more lime, just damp enough to slake, then add more sulphur on the top of it, repeating this process till all the sulphur is used. When the lime is slaked it will be seen that the sulphur is quite dissolved, and is scarcely visible except in the darker colour it has given to the lime. The quantity of lime used is not important so long as there is sufficient to dissolve the sulphur. The soft soap should be dissolved separately, and afterwards mixed with the lime and sulphur, and sufficient water added to make three gallons in all. If the mixture is not thick enough to apply with a brush, clay or more lime may be added. If the glaring white is objected to, mix soot with it. If mixed in the way I have described and applied in dry weather, no amount of rain will wash it off, but if lime is used that has been some time exposed to the air, the sulphur will not properly dissolve, and the first shower will wash it off. It is necessary to caution my readers against dissolving the sulphur in
a house containing plants in a growing state, as the gas emitted will burn up every leaf just as completely as if fire had been used. I have, however, never found trees injured from being painted with this mixture; it is only the sulphurous gas that is dangerous, and that probably would not injure plants in a dormant state.” In using the foregoing mixture, care must be taken that whilst smearing the buds they are not injured or dislocated. It may be dashed amongst bushes with a whitewash brush, or made thin enough to be passed through a syringe. Birds will not touch buds that are well coated with the mixture.

The following wash is effectual for the same purpose; it also destroys lichen and moss:—Quicklime 5 pounds, choosing the lightest lumps; flowers of sulphur 10 pounds; water 10 gallons. Boil these half an hour, kept stirred; then slake 7½ pounds of quicklime and dissolve 7½ pounds of common salt in boiling water, adding thereto the lime and sulphur mixture, and enough water to make 30 gallons. Strain the whole through a hair sieve, and spray over the trees when dry. The wash is the most efficacious as an insecticide and fungicide when applied at a temperature of 120° to 140°, but it must only be used when the fruit trees are dormant.

Still another mixture may be named for syringing over fruit trees to prevent birds taking the buds. “Boil a pound of quassia chips in four gallons of soft water twenty minutes, and dissolve in it, as it cools, a pound of soft soap, adding a wine-glassful of petroleum or kerosene. Strain, and spray or syringe over the trees when dry; but, being liable to be washed off by rain, it is necessary to repeat the application. This mixture destroys various kinds of insects and caterpillars.

**Fruit Cages.**—Leaving gooseberry and other bushes unpruned until spring as a means of saving some buds from the birds is a common practice, but rarely satisfactory, because the birds take the most promising buds. There is but one safe means of securing the finest crops of fruit, namely, to preserve the buds from the depredators. This can be done and birds preserved at the same time, by covering fruit quarters with 1-inch wire netting. For supporting the netting 1½-inch iron pipes should be set perpendicularly 4½ to 6 feet apart, letting them into the ground 2 feet, and if 10 feet out of the ground, strawberries, fruit bushes, raspberries, pyramid pears and cherries, also dwarf apple and plum trees, will be accommodated. Upright tubes should be fixed at intervals about 9 feet apart or half the distance of those at the ends and sides; and to keep the netting from “sagging” ½-inch tubing should be run along the top of the pillars, and these should have a socket where they cross each
GENERAL PRACTICE.—PROTECTION.

upright pipe for slipping into it. This will keep the whole firm, and with the material galvanised, the cage will last for a number of years. Where walls or close fences exist they can be utilised for fastening the netting along the top in enclosing fruits that may be grown in the borders. At each end provide a door. Close the doors as soon as the buds commence swelling, open them when the fruit is set; once more close as the fruit shows indications of ripening, and exclude birds till all is gathered. They then have access when they can do good only, and the netting saves the fruit considerably from the "pitting" effects of hailstorms. Any desired extent of ground may be enclosed in the manner indicated, and the "cages," which are not expensive, are most valuable in insuring a long supply of fruit in gardens.

Protecting Blossom.—All blossoms are liable to damage by frost; even the latest apple blossom, which does not expand until past the middle of May, is sometimes destroyed. Owing to variation in the date of the blossoms unfolding in different varieties, the opinion has long obtained that the early flowers were, as a rule, destroyed, the late escaping. That is not in close accord with facts. Duchess of Oldenburg and Keswick Codlin apples are amongst the earliest to flower, yet few are more certain in bearing good crops of fruit. Immunity from injury by frost depends largely on constitutional hardiness and, to a material extent, on floral construction. Cup-shaped flowers, especially when the petals overlap, afford better protection to the tender fructifying organs than these can receive when the petals are flat.

Hardy constitution in the trees and perfect floral construction are the most important factors in securing fruit. Blossom suffers most in low damp situations. Trees growing in loose, rich soil have softer flowers than those produced by sturdy examples of the same variety on higher ground, the former failing, the latter enduring and setting good crops of fruit. Selecting hardy varieties, and cultivating them in a way by which they will be least prejudicially affected by climatic influences, is the most certain method, short of protection, to adopt for insuring satisfactory crops of fruit.

Sometimes blossoms are crippled, when not destroyed, by frost, and unable to perform their functions. This is seen in contorted staminate and pistillate organs, resulting in imperfect fertilisation and deformed fruit. Frosts of 6° may damage the blossom when damp, whilst 12° may do no harm when it is dry. It is not wise to entrust trees on walls, or wherever protection can be afforded, to the weather after the blossom buds unfold. A single breadth of tiffany or other light material stretched
over or in front of trees in blossom will prevent the deposition of dew; a shelter of netting, or even the sprays of evergreen, are of greater service against brisk, cutting wind.

Woollen materials, such as worsted netting or frigi domo, are preferable to hempen substances, such as scrim canvas or brown hessian, because the former are much slower cold-conducting mediums; neither is it unimportant at what distance the material is placed from the blossom, it having been found in practice that a shelter is most beneficial when from 3 to 6 inches from the trees than when in immediate contact with their surfaces. Some approved methods of protecting blossom are represented in Fig. 51.

Fig. 51. Protecting Blossom from Frost.

References:—f, protection of wall trees with wood coping, poles and canvas: 1, board, 14 inches wide; 2, iron bracket; 3, pole, 2 inches square. g, glazed projecting coping: 4, projection, 2 1/2 feet; 5, iron bracket; 6, 3/4-inch iron tube. h, pole and canvas shelter. i, hay or straw bands stretched across poles. j, Rivers system of protecting pyramid trees with tiffany wound round stakes, leaving opening at top and bottom for air, as indicated by the arrows. k, protecting with thatched hurdles: 7, stake; 8, 8, hurdles; 9, espalier.

Projecting wall copings and eaves of buildings afford valuable shelter to blossoms. Radiation from wall surfaces is, through their agency, lessened, and the trees are kept drier, which favourably assists resistance to cold; but substances that obstruct light should only be temporarily used as protectors. A 3/4-inch board, 11 inches wide, fixed immediately under the wall coping to iron brackets slightly inclining outwards, answers for a wall of 10 feet or under; one 14 inches wide is excellent for a wall 12 feet or more in height, and, with netting or canvas in front of the trees, kept at
a safe distance by poles, affords the needful shelter. The coping boards and all opaque material should be removed when danger from frost is past.

Glazed projecting copings sloping downwards are highly useful wall fruit tree protectors, particularly in cold districts, not only in saving the blossom but improving the fruit. The earliest, clearest in colour, and altogether best fruits are produced under those copings. A coping projecting 2 feet for a 10-feet wall, and 2 feet 6 inches for a 12-feet wall, is ample. Some copings are "reversible," and can be withdrawn by day, or when rain falls to wash the trees and moisten the border; in others the framework is fixed on stout brackets secured to the wall, and glazed on a system by which the glass is readily removed when required. As a rule it should be removed in autumn and replaced when the blossoms need protection. In addition to the protecting coping, wool netting, canvas, or other covering should be suspended from the front, and so contrived as to be easily raised or lowered according to the weather.

Wall trees may be usefully protected by means of poles and canvas. Place a pole every 6 feet, the top resting under the wall coping, and the bottom let into the ground sufficiently to prevent displacement 18 inches to 2 feet from the wall. At 2 feet from the ground bore a hole with a \( \frac{1}{2} \)-inch auger in each pole, driving in a hard wood peg projecting 9 inches forward. When the canvas is lowered in the day it folds and hangs on the line of pegs. A line of sash-cord is attached to the edge opposite each pole, which has a stout ring fixed with a staple near the top, so as to let the ring hang loose. Through this ring the cord is passed from the under side for pulling up or letting down the canvas. Small pulleys are better than rings, but add to the expense. A binding of small cord at both edges of the canvas adds to its strength and durability.

Roughly-spun hay or soft straw bands stretched tightly across poles fixed as shown in the sectional figure (page 194) often afford sufficient protection to the blossoms of the hardier kinds of fruit trees against walls. The bands should be placed horizontally, 6 inches apart for the first yard down the poles, commencing with an extra stout band at the top, 9 inches for the next yard, and 1 foot between the bands for the remainder to within 2 feet of the ground. Spruce and other evergreen branches stuck in behind the main branches of wall trees, and allowed to hang over the blossoms—not rest on them—afford good protection.

Old repaired fish-netting is extensively used for the purpose in question, but in severe frosts the shelter is not efficient, though the nets are, on the whole, beneficial. A single thickness of pilchard or double thickness of herring nets is necessary. The
netting should be kept from brushing against the blossoms by poles, as above mentioned. Woollen netting with a \( \frac{1}{4} \)-inch mesh is, perhaps, the best textile material for protecting blossom. This, from its openness, does not prevent the air from reaching the trees, but is sufficiently close to prevent the deposition of dew on the flowers, which is very often converted into ice by morning. Canvas or other close material may be best during a night of severe frost, but if continued over the trees throughout the day it does harm in excluding light and air, and as there are times when protection is required as much by day as by night, these canvas coverings are not so good as wool nets. Whatever material is used, it should be made of sufficient width by sewing the necessary breadths together to reach from the top of the wall, immediately under the coping, to within 18 inches or 2 feet from the ground.

The chief essentials in protecting wall trees are dry materials applied before moisture descends, continuing the shelter until the frost has departed. Protection must commence with the appearance of the blossoms. In the bud state, wrapped as they are in their scaly envelopes, the flowers are safe, but when the blossom buds swell, and the petals enclosing the tender fructifying organs appear, these are liable to destruction by frost. The sheltering medium should be retained for use when needed until the season is advanced, the weather genial, and the leafage of the trees abundant, as the tender young fruits are liable to injury, and crops of apricots and peaches have been ruined even after the blossoms have been preserved.

Pyramid and bush trees may be protected by a light awning of tiffany, brown hessian, or scrim canvas, kept clear of the blossoms by stakes at the sides or around the trees with laths across to form a roof. The late Mr. Thos. Rivers advised an opening to be left at the top and bottom for the admission of air. This is imperative, for when trees are enwrapped in close material, moisture is deposited on the organs of fructification and setting prevented. Detached trees are the most economically protected separately. Stout stakes should be driven into the ground around them, about 18 inches apart, clear of the branches, a little taller than the top of the tree, and there made level. A central stake, taller than the rest, is an advantage, as by tacking a piece of waterproof canvas on the top of the stakes, a dew and rain proof roof is formed. Tiffany or other light material should be wound round outside the stakes, commencing about 3 inches lower down than the level of the lowest blossom, bringing it up to within 6 inches of the top, and tacking it securely to the stakes. Air is thus freely admitted by the bottom and top apertures, as shown in the figure (page 194), but during severe...
frost the upper aperture must be closed; therefore, a strip of the protective material of the required width and length should be tacked at one end to a stake ready for winding round to close the aperture when necessary, removing it when frost is gone.

For espaliers there is nothing better than straw mats secured to a light wood frame. They may be fixed with stakes similar to thatched hurdles, which are good for shelter. In constructing the latter, straw, rushes, heather, green broom, or branches of spruce or yew, answer for thatch, provided the work is well done. Pack the material so that air can pass through, and take especial care to fasten it securely by means of runner-bean stakes, or thatching rods, laid upon it and tied to the hurdles. A row of these may be firmly affixed a foot from the north or east side, another row upon them leaning sufficiently forward to project over the trees, fastening them securely with string to each other and to supporting poles. This means of protection may be usefully employed for small pyramids or bushes, and a single row of hurdles driven into the ground aslant and fastened to stakes will suffice for low horizontal cordons.

Gooseberry and currant bushes are effectually protected by a light covering of tiffany, and it is easily kept in position with string secured to pegs driven into the ground. Even a little dry straw spread over the bushes, when severe late frost prevails, will afford the needful shelter and prevent the injurious effects of sudden thawing. Spruce and other evergreen branches placed round and over bush and other dwarf trees shield them from frost, and even bushy, untrimmed pea-sticks placed along both sides of espalier and other forms of trees, and arched over them, have afforded valuable shelter to the blossom.

**THINNING FRUIT.**

Trees frequently produce heavy crops of small, indifferent fruit, or a full crop one year and little or none the next. This is a waste of the soil’s resources, and impairs the energy and value of the trees. It can only be prevented by thinning the fruit where it is set too thickly, in the early stages of its development. Imperfectly-fertilised fruits usually fall prematurely, but there are notable examples to the contrary; peaches and other stone fruits may not show the results of defective fertilisation until considerably advanced in swelling. In a fortnight to three weeks after the flowers are shed the abortive fruits will be cast from the trees, or increase in size slowly. Those that will eventually be the finest take the lead in swelling. These should be reserved, removing any that are small or swell irregularly. As a rule, one or at most two fruits on a spur
suffice for a crop in apples and pears, the spurs being 4 to 6 inches apart. Other kinds of fruit needing thinning will be treated under their special heads. The finer the fruits are wanted, the greater must be the distance between them. The crops must also be apportioned relatively to the vigour of the trees. Weakly trees must have the fruit much thinner than vigorous ones, and weak branches should not be allowed to carry so many fruits as those which are robust. By apportioning the fruit in the manner indicated, weakly trees and parts are invigorated, whilst those trees or parts verging on grossness have their luxuriance subdued and their fruitfulness increased.

Several fruits in a truss of apple, cherry, pear, plum, or strawberry may collectively outweigh one or two; an apricot, nectarine, or peach branch loaded with fruit may bring down the balance on the opposite side of the beam where is placed a properly-thinned branch; and a cluster of wedged grapes may be heavier than a similar-sized bunch with less than half the number of berries, but the latter will be fourfold greater in value. Six Ecklinville apples weighing a pound are not so valuable as two of that weight. Severe thinning, however, except for a special object, is not advised, but a judicious removal of small and ill-shaped productions, in view of securing full-sized, highly-coloured, representative fruits.

Trees that produce a fair burden of fruit do so the most constantly and continuously, but overcropping exhausts the trees, the fruit being indifferent in size, quality and value, whilst blossom buds cannot develop concurrently, and therefore the trees are barren the following season. This is the explanation of many trees bearing only "every other year."

The production of many fruits means a proportional increase of stones and seeds. These exhaust the trees and impoverish the soil much more than an increase of flesh does. The flesh of three fruits embodied in one increases its usefulness and value with benefit to the tree, because there are obviously less seeds in one than in three fruits. A heavily-laden tree, having its fruits thinned to the extent of a third in number, benefits to that extent; reduced half, it doubly profits, and the crops are similarly increased in value.

A bushel of fruit, in five or six dozen select examples, is worth thrice as much as a bushel containing fifteen or eighteen dozen small fruits of the same variety; yet this comparatively worthless trash abstracts the most phosphoric acid, potash, lime, magnesia, and other mineral constituents from the soil, to be wasted on stones, or rind, core, and seeds, at the expense of flesh, and thus the dietetic and hygienic values of the fruit are reduced to a minimum. It thus becomes apparent that it costs less to grow a bushel of
fine fruit than half a bushel of small and inferior, a fair estimate being taken of the

crude material consumed in the manufacture. On these grounds the importance of
thinning the fruit, as soon as it is sufficiently advanced for determining the best to reserve and that to be rejected, cannot be over-estimated, and the subject is strongly commended to the attention of all who desire to turn the resources of the soil to the most profitable account in growing fruit.

The disadvantages of over-crowding, and the benefits resulting from judiciously thinning fruit in its early stages, are well exemplified in the accompanying illustration, Fig. 52, namely:—1, peach tree branch carrying six fruits, the foliage small, and the growth weak: therefore, indifferent provision is made for the succeeding year's crop; 2, inverted ripe fruit, showing the relative proportion of stone to flesh in the unthinned produce; 3, a similar branch bearing two large, handsome fruits, the least promising having been removed at an early stage, the wood being stouter in consequence, and the prospects of a full crop the following year assured; 4, section of ripe fruit, showing the increase of flesh in the thinned fruit over the unthinned, by the dotted outline of the latter inside the former. This is a perfectly fair example of cultural attention on the one hand, and negligence on the other, in thinning overcrowded fruits. The heavy crop of small fruits of trifling worth have exhausted the tree and soil in supporting the stones; the two-thirds less in number of large fruits being fourfold greater in value, and the growth correspondingly satisfactory. The principle sought to be inculcated applies to other kinds of fruits besides those represented, and the importance of the subject is apparent.

Perfecting and Protecting Fruit.

Perfecting Fruit.—High colour and quality are the outcome of highly-elaborated and assimilated matter. Fruit overgrown and shaded during its formation never attains the colour and perfection of that which is subjected to atmospheric influences in all stages of its development. The advantage of exposure and the disadvantage of shade are clearly demonstrated in individual fruits. Fruits are always higher in colour and richer in flavour on the exposed than the shaded side. Whatever interferes with the free access of light and air to the principal foliage in all cases, and to the fruit in most, must be removed or drawn aside. A single leaf overhanging a fruit may so militate against its colouring as to completely spoil it for a special purpose. When the fruit attains its full size it is important that it have light and air, but if up to that stage it has been shaded it is not good policy to remove the obstruction suddenly. It should be removed gradually in order to inure the fruit to the changed
conditions. This will effect some improvement, but when specimens of the first
colour and quality are desired they must be exposed to the sun throughout their
period of growth. Some fruits, however, require a little shade at certain stages, as
will be explained as this work proceeds.

Protecting Fruit.—Birds of varied kinds attack fruits, pecking holes in them,
whereby they are depreciated in value or rendered useless. The birds are partial to the
choicest and most inviting fruit in appearance, and some of them find out the best
flavoured. Even insectivorous birds vary their diet with fruit, and netting must
be employed that will exclude them. It is very important that the netting be
placed over the fruit before the birds commence taking it. Individual fruits of apples
and pears for exhibition and other purposes are often enclosed in large loosely-hanging
gauze bags.

Preventive measures must also be taken to protect fruit from wasps, hornets, ear-
wigs, ants, and slugs. They may not eat much of the fruit, but they spoil its appearance,
and a quantity may be wasted through the wet entering and causing decay. Precau-
tionary and remedial means in respect of these pests will be noted presently.

Protecting fruit from the elements when ripe or ripening is essential to its sound
preservation. In very wet seasons the supply of moisture is so great that the cells of
the fleshy parts of the fruit swell faster than the rind can expand, and it consequently
bursts. This is continually occurring in the case of the cherry and plum, while other
fruits are similarly affected. The more luscious the fruit the greater the danger of vinous
fermentation and decay. Fruit also imbibes water through the pores of the skin, of
which advantage is taken by cultivators in keeping fruit-houses close and moist in
the declining hours of the day to increase the size of the swelling fruit. Growers of
huge gooseberries for prizes keep the calyx end of the berry dipped in a saucer of water,
and in that way seek to enlarge the fruit; but, beneficial as moisture admittedly is,
excess is injurious. The point of least resistance invariably gives way the soonest.
Thus gooseberries split at the nose because in dripping weather water hangs there,
but grapes decay at the shank because that part is most liable to receive the deposited
moisture of a confined atmosphere.

Knowing the conditions most favourable to the preservation of fruit after it is ripe, so
as to keep it sound and usable as long as possible, means must be employed to that end.
The chief essential is dryness. A light waterproof covering spread over gooseberry
bushes may save a crop that would otherwise burst, through rains, in July until Sep-
tember. Currants matted up are safe until rain penetrates and wets the fruit; then it soon decays. Cherries keep sound weeks or months after they are ripe if kept dry; but if soaked with rain they split and decay in as many days, or even hours. Plums do not always reach the ripening stage before cracking through excessive wet. Light waterproof coverings, stretched over a row of bushes laden with ripe fruit, would often save enough from destruction by a deluging rain to pay the first cost of the canvas. It is lamentable to see so much fruit wasted for want of simple inexpensive means of protecting it from disaster. Light frames covered with oiled calico answer well for throwing off rain from wall trees, and glazed wall copings are still better, particularly if some netting be suspended in front and kept at a distance of not less than 12 inches from the trees. Something to throw off the wet, and at the same time admit a circulation of air, is absolutely essential to the preservation of fruit in wet periods in gardens whence a prolonged supply is desired and expected. In extended culture for commercial purposes in fields, artificial shelter is not practicable, but many kinds of fruits can be profitably grown in inexpensive structures, mere glazed sheds, as will be in due course explained.

Gathering Fruit.

Tests for Gathering.—Varieties of the different kinds of fruit are influenced in the period of their gathering by soil, climate, and season. Cultivation, also, has some effect in this respect, as healthy, carefully-cultured trees mature their crops better and earlier than those subsisting in cold, impoverished soil. Light soil also matures fruit sooner than heavy land. The season, therefore, of gathering any particular variety cannot be accurately stated in the case of the common fruits. With some notable exceptions, such as grapes, also red and white currants, fruit falling of its own accord is one of the best tests for gathering, but the distinction must be made between sound and unsound. The latter is cast prematurely, but when sound fruit commences falling, its growth is matured. It is not always prudent, however, to await this intimation, either with fruit that must be made use of as soon as ripe, or that which requires time to ripen after removal from the trees. A practised eye can readily detect the changed appearance apples and pears assume in perfecting. In most varieties the colours become brighter, and the green parts merge into yellow. Close observation of fruit in its last stages is essential to gather it at the proper time. The changing of the pips or seeds from white to brown is not always a safe test, as some varieties have the kernels brown before the fruit is ready for
removal. Easy separation at the natural junction of the footstalk with the spur is the best criterion of the gathering period. If the fruit holds firmly, requiring force to sever its connection, or needs its stalk broken by twisting, it is still deriving support from the tree. Plucking fruit off trees with buds or spurs attached cannot be too strongly censured. The specimens which require much force to detach will not keep sound.

Some varieties are best when left to ripen on the trees. This applies to summer apples, but a few of these, also early pears, become mealy when left too long, while several late varieties are spoiled through being gathered too soon. Frost seldom prevails so early and severely in autumn as to prejudicially affect these, and they should not be gathered for keeping until the kernels are brown and the fruit parts readily from the trees. All fruit for storing should be gathered when dry, preferably in continued dry weather. The gathering baskets should be lined with soft material, and each fruit placed in them without bruising. Care must be taken to prevent such injury. Choice fruit ought to be placed in a single layer in trays or flat baskets, and placed in the fruit room with the greatest care. Plucking fruit off trees in handfuls, throwing it into unlined baskets, and shooting the contents into hampers for conveyance to the store is a certain means of impairing the using, keeping, and selling value of the crops. Apples and pears are more liable to injury by rough handling than eggs are, and need greater care; slight bruises, not apparent at the first, destroy the tissue and cause decay. In gathering fruit, it should be sorted, separating the small and defective from the clean and fine samples. The less fruit is moved about the better; therefore, gather and store with the utmost care, in view of sound keeping and bright specimens.

**Storing Fruit.**

The principal object to aim at in the storing of fruit is the avoidance of decay. This is induced by a combination of moisture, warmth, and the oxygen of the atmosphere; therefore, the more these are excluded the sounder and longer the fruit will retain its characteristic value; but always on condition that its tissues are not injured, either in conveying to, or examining in, the store. Even when the skin is not broken, the cells may be ruptured, which hastens fermentation, to be speedily followed by putrefaction. To insure the sound preservation of fruit, a low temperature, still atmosphere, and darkness are essential. Cold and the exclusion of atmospheric air allows ripening to proceed by very slow degrees, and immobility of the confined air insures the carbonic dioxide, exhaled by ripening fruit, acting as a powerful
preserver. Excluding light contributes greatly to the sound preservation and good appearance of fruit.

Great fluctuations in temperature are highly inimical to stored fruit. Warm air brought into contact with colder fruit causes moisture to be deposited on its surface, which it injuriously affects; and when the atmosphere is colder than the fruit this loses heat and moisture, consequently shrivels. In cold, frosty weather fruit is dry, but on a return of warm weather the skin becomes clogged with moisture. Too moist surroundings impart a musty flavour; too dry conditions extract the juices. Fire-dried air abstracts the virtues from fruit and it becomes wrinkled and dry. Frost ruptures the cells of fruit, and hurries it into incipient decomposition.

_Fruit Rooms._—From the foregoing it may occur to many that they possess a place or room which, by a little alteration or addition, might be converted into an eligible fruit store. Such, indeed, is often the case; yet a well-appointed fruit room is indispensable to a well-equipped establishment, not only to insure the satisfactory keeping of fruit, but to enable the proprietor, with his friends, to enjoy a walk round, and examine the different sorts. Particulars, therefore, for erecting a suitable structure are imperative.

The site should be dry, airy, and slightly elevated; the subsoil dry, or rendered so by efficient drainage. An eastern or northern aspect is most advantageous, inasmuch as the room must be used for retarding the ripening of fruit in summer, equally with preserving it in winter. The site, however, must be open. Tall, deciduous trees thinly disposed on the east, south, and west sides, near enough to shade from hot summer sun, yet not so close as to overhang the room, having their lower branches clear of the ground, practically secures a cool, dry air, for beneath trees so distanced there is always a "draw" of air. Avoid low, sheltered situations, closely hemmed in by trees and dense undergrowth, or a too moist atmosphere will be induced.

To insure a cool temperature, let the floor line be above rather than below the ground level. This is essential to secure a circulation of air below a wood floor through air bricks in the side walls; and a concrete or tile floor must be isolated as much as possible from the damp and heat of the earth. To effect this an air cavity, 4½ inches wide, should be formed outside the walls, from the foundation to the damp-course, taking out the whole of the interior to a depth of 15 inches, laying 3-inch drain tiles, extending through the walls into the air cavity, lengthwise and crosswise of the building, 1½ foot from the outside and 3 feet apart, letting them into the
ground half their diameter, joining them properly at their crossings, filling the space between and over them level with the damp-course with clean rubble, rough at the bottom and fine at the top. By inserting air bricks at each corner, and along the ends and sides, 9 feet apart, in and level with the surface of the air cavity cover—which should be bricks on edge set in cement—a circulation of air will be secured through the drain tiles, and with wood bricks, padded on the under side with hair-felt, to place over the air bricks, the air in the cavity and pipes will be rendered still, whilst removing them will set it in motion. Water is prevented lodging in the area by rubble drains leading to land drains.

Up to the ground level the walls may be solid. There, or a little higher, should be a damp-course (asphalt), continuing it over the whole surface of the rubble. This practically renders the building damp-proof, also invulnerable to rats and mice. Above the damp-course the walls should be hollow, 14 inches thick, with the middle course left out. The 4½-inch walls should be built in cement, a header being placed "here and there" across the 4½-inch cavity. If the headers are placed in one course care must be taken not to close the cavity. A wall built in the way described is quite stable. The roof should be double-ceiled, that is, lathed and plastered beneath the rafters, and the ceiling joists fixed to the under side of the purlins with their ends resting on the inner wall plate. The ceiling joists must not be more than half notched at the purlins, for between the lower ceiling and the purlins a clear space must be left, as between the ceiling joists, to allow a free passage to air. If the ceiling is required boarded, every third joist must be an inch deeper than the others, and the plaster kept above these joists. Care must be taken to fill in the space between the rafters on the outer wall plate, so as to close the air cavity on the outside. The roof should project 12 to 18 inches, and the rafters be covered with ¼-inch close boarding, overlaying this with dry hairfelt. The slating must be well done; tiles, however, are preferable, because less conductive of heat. Fix efficient guttering, with down-spouts properly connected with drains.

Provide ventilation at the upper part of the roof. If a span roof, and hipped, the ventilator should be in the centre of the ridge. An opening, 3 feet long and 12 inches wide in the clear, answers for a large room. Let the casing, 2 inches thick, extend a little above the ridge and below the bottom ceiling, perfectly isolating the ceiling cavities from the room. Two circular holes 3 inches in diameter should be cut on each side the case, also each end directly opposite the roof cavities,
with metal slides affixed for closing or opening. The ventilator should have a wood cover which, by mechanical contrivance, can be raised or lowered from the interior, and the lower part of the casing must have a wood shutter, closed or opened with a line and pulley. With a 2-inch iron pipe inserted at each corner of the building and midway of each side through the outside wall just above the damp-course, opening into the air cavity, each pipe having a screw valve outside, the air cavity can be ventilated by raising the roof ventilator and pushing the slides off the openings in the ventilating case, regulating the current by the valves. To ventilate the room simultaneously by the air cavity, lower the inside shutter, and the air, entering by the 2-inch pipes at the bottom of the cavity, passing up the wall and ceiling space, rushes out by the holes in the sides of the ventilating case, and out by the roof opening, sucking out the vitiated atmosphere of the fruit room without disturbing it perceptibly. When it is desired to keep the air in the air cavity still, the slides are kept over the holes. The ventilator then acts separately, damp being expelled by a circulation of air induced by opening the windows, or a gentle warmth in the heating apparatus.

If the building must be a lean-to against an existing north wall, as commonly occurs, there being a vinery or peach-house on the south side, the existing wall must be isolated from the intended fruit room, for, though 18 inches or more thick, it is in contact with wet soil at its foot, damp striking up a yard or more, and the upper part is warm, if not damp, and therefore prejudicial. A 9-inch wall built in cement, with proper foundation and damp course at the ground level, 4 1/2 inches off the existing wall, fixing ventilating pipes at each end of the cavity near the bottom, with corresponding openings at the top immediately under the wall coping, completely protects the room from damp and heat. The openings in the air cavity should not be closed, but the cavity in the wall at the other side of the room, and at the ends, must be ventilated independently of the back wall area. A 2-inch pipe, with valve, introduced through the outside wall into the air cavity at the upper angle of each end next the back wall, will insure a thorough draught, if corresponding pipes are fixed at the lower part, as already described. To ventilate the fruit room a casing, 18 inches long and 9 inches wide in the clear, fixed in the 9-inch wall at every 9 feet, just below the under ceiling, and closed on the inside by a flap door regulated by a cord and pulley, meets every requirement, but the opening must be continued in the wall, and communicate with the external air above the roof immediately under the
wall coping, taking care to shut out the air cavity from the ventilating openings. Avoid sliding iron gratings; they do not shut off close, and rarely work well long.

Light is essential for storing, examining, and obtaining supplies of fruit. Windows are best on the shaded side, preferably northward. Avoid skylights; they are often leaky, difficult to cover when light is not wanted, and sometimes buried by snow when light is most needed. Two windows are ample for a large room. Each should be 4 feet 6 inches in height, and 3 feet 6 inches in width, including casings, giving about 4 feet by 3 feet of sash, which should be formed into upper and lower lights of equal depth, both hung and moving past each other. These may be glazed with \( \frac{1}{4} \)-inch polished plate-glass, forming two handsome squares in each window, or a sash bar can be fixed up the middle, dividing it into four, for glazing with 21-oz. sheet glass. Provide woollen roller blinds to each window, with folding shutters inside, fitting quite close; also sliding shutters opening at the inner face of the wall inside, thus forming a double air cavity.

The doors should be on the east or north side or end, 3 feet wide, or a little less, in the clear. Let an inner door be fixed, faceable with the inside of the wall, opening inwards, and double-boarded, so as to form a cavity between the boards, having a similar door on the outside opening outwards, the space between the boards stuffed with dry hairfelt. All the hinges, locks, and fasteners for windows and ventilators should be brass or bronze, and the latches for doors should be sunk or not more than flush.

The walls may be plastered or, preferably, cemented inside. Glazed tiles are neat, and encourage neither insects nor fungi. Covering the walls and ceiling with narrow match boarding, tongued and grooved, also well seasoned, stained and varnished, gives the interior an appearance of neatness; but the boarding must be kept clear of the wall by inch strips of wood, and particular care must be taken not to interfere in the slightest with the ceiling or inner wall in fixing the wooden lining, for keeping the air cavity intact is of the greatest consequence. Carefully effected, the lining is advantageous in forming a second air cavity of great value in keeping fruit.

Fire heat cannot be dispensed with, for frost should be excluded, and damp expelled. A stove or fireplace inside is objectionable, on account of fumes, dust, and drying the air. Hot-water pipes are best; they should be placed in a close chamber or flue under the paths, with openings to admit their warmth as required. A flow and a return 4-inch pipe are ample, and there should be a valve on each
outside the building to regulate the heat as desired. Particular care must be taken in making the joints and in fixing the pipes, so as to preclude the necessity for subsequent repairs. The openings inside (12 inches by 4\(\frac{1}{2}\) inches) should have ornamental or brass gratings.

The floor of the room may be of boards, best Baltic, 4\(\frac{1}{2}\) inches by 1\(\frac{1}{2}\) inch, tongued and grooved, properly seasoned and dry, laid on joists on dwarf pigeon-hole walls, but there is always a taint of turpentine arising when this flooring is used. A concrete bottom surfaced with cement is preferable, and not liable, as wood is, to harbour insects or foster fungi: but ornamental (Minton) tiles are the most appropriate; and remember that the floor level must be above the damp-course, or two easy steps above the ground level.

Internally the fruit room should be fitted with shelves all around, leaving the central part clear. Immediately under the window, or windows, fix a wood slab, the breadth of the window and the width of the shelves, with drawers underneath for storing labels and other appurtenances. These tables, in the immediate light of the window, admit of a closer inspection of fruit than by the light generally of the room. The width of the shelves should be 3 feet, just as far as one can reach across comfortably, and the distance between them not less than 18 inches. Uprights should be 3 inches square; bearers, 3 inches by 1\(\frac{1}{2}\) inch, narrow face upwards, and 3 to 4 feet apart, morticed and tenoned into the uprights; the shelves to be formed of laths not less than 2 or more than 3 inches wide, and 1\(\frac{1}{4}\) inch thick, placed so as to leave a space of \(\frac{1}{2}\) to \(\frac{3}{4}\) inch between them; the edges to the shelves being formed of \(\frac{1}{2}\)-inch board, 3 inches deep, let into the uprights flush with their outer face, and the lower edge level with the top of the laths.

The paths should be 3 feet or, better, 4 feet wide. In the centre of the room a table, with a top 4 feet wide, is a great convenience. Immediately under the top provide two tiers of drawers, 4\(\frac{1}{2}\) inches deep each, on both sides, set back 3 or 4 inches from the edge, and beneath these form a closet, with doors, for jars for very late keeping fruit. The whole of the wood, every face, should be dressed, and all the edges rounded. Sycamore is good for shelves, being fine-grained, and remarkably white and clear. Poplar looks well for a time, but soon becomes darkened by fungi. Oak and elm are durable, but fungus soon coats them over, and the tannin of oak is not desirable. Red pine and fir have a bad character for tainting fruit with turpentine or resin, but from white deal we have not found any taint in the fruit during nearly half a century's experience. This we can
Fig. 53. Fruit Room, Ground Plan. (Scale: $\frac{1}{16}$ inch = 1 foot.)
recommend, if well selected and properly seasoned. When painted stone colour, neither fungus or anything else appears to affect the deal, or the deal the fruit, prejudicially. All bare dry wood absorbs moisture, and straw, hay or moss, or old newspapers on the shelves, often impart an unpleasant flavour to the fruit. Fruit lying on a close wood shelf almost invariably has a poor taste on that side; therefore, open shelves are advocated, so that the fruit may have air from beneath, and if anything is placed over the fruit, let it be clean sheets of rather stout white paper.

A ground plan and section answering to the foregoing description of a fruit room will be further elucidatory. Ground plan (Fig. 53) references:—l, area or earth retaining wall (9 inches); m, 4½-inch dry air area; n, ventilating grating or air bricks, let in cover of outside air cavity; o, 4½-inch walls built in cement from damp-course; p, 4½-inch air cavity; q, covered flue for 2-inch flow and return hot-water pipes connecting 4-inch pipes in the fruit room with boiler, pipes wrapped with dry hairfelt; r, 2-inch screw valve on flow pipe; s, 2-inch screw valve on return pipe; t, 2-inch iron pipe with valve for ventilating wall cavity; u, windows; v, folding shutters; w, sliding shutters; x, table with drawers under; y, fruit shelves, showing uprights, bearers, laths, and spaces between them; z, pathway, 4 feet wide; a, gratings to admit heat from hot-water heated flue; b, table, sycamore top, two tiers of drawers under, on each side; c, closets under drawers for earthenware jars; d, inner door; e, outside door; f, porch and steps; g, gravel path all round, inclining from area wall covering. O, P, line of section.

Fig. 54:—Q, part section of lean-to against north wall, showing insulation of fruit room, and top ventilation; h, north wall; i, 4½-inch air cavity; j, 9-inch wall built in cement; k, ventilator—arrow showing direction of air; l, roof, double ceiled, m, air cavity in roof. R, section through ground plan, O to P; n, land drains; o, rubble drains taking water from outside area; p, 9-inch earth retaining wall; q, outside air cavity; r, 14-inch solid wall; s, 3-inch air drains; t, rubble; u, damp-course: v, 2-inch iron pipe with valve; w, hollow wall, showing projecting bricks across cavity—arrows indicate air entering 2-inch pipe, ascent of cavity, and exit by roof ventilator; x, roof, showing projecting eaves, guttering, double ceiling, air cavity; y, cover of ventilator closed—dotted outline raised; z, inside shutter closed—dotted outline shows it open with pulley, line, and weight attached; a, concrete; b, 4-inch hot-water pipe; c, path, ornamental tiles laid in cement; d, heated flue grating; e, closet for jars; f, drawers for choice fruit; g, table top—arrows indicate direction of air when expelling damp; h, fruit shelves; i, gravel path; j, tile or stone edging.
To keep choice fruit in drawers it is wrapped separately in tissue paper, after being gathered and laid on a dry sweet shelf for a few days to sweat and dry. It is then packed in perfectly dry, clean, sweet wheat or oat chaff, peat moss, or cocoanut fibre refuse, placing an inch depth of the substance used at the bottom of the drawer for the fruit to rest on, laying each one separate, and covering them about an inch deep. The advantages are perfect isolation of the fruits from each other, air is excluded from all, a uniform temperature secured, and taint or contamination through decay is practically prevented.

Some persons, in storing fruit in drawers, dispense with packing material, placing half an inch thickness of fire-dried pit sand or powdered charcoal over the bottom of the drawer, forming a soft rest for the fruit; whilst others employ a padding of cotton-wool placing in each case a square of tissue paper for the fruit to lie on. Each fruit being isolated, a decaying one does not injure the others. Yet another substance is available, namely, dry hair-felt. Line the drawer with it, cover with tissue paper,
place the fruits clear of each other, and cover with the paper, over which spread a sheet of the felt. This is, perhaps, the best of all non-conductors, and fruit perfectly dry and sound may be kept by it in good condition over a lengthened period.

Fruits keep well in unglazed earthenware jars, perfectly clean, sweet, and dry. The fruits may be placed in the jars without any packing, the lids being placed on loosely, but the only advantage is ready inspection. Indeed, the fruits keep soundest and longest wrapped separately in tissue paper, and packed so as not to touch each other, in fire-dried pit sand, or, preferably, powdered charcoal, bringing the packing material over the fruit so that the lids of the jars fit close upon it. The fruits keep as well without the paper, but it is generally used on the score of cleanliness. Fruit invariably commences ripening at the eye; hence it is good practice to keep that part downwards.

The temperature of the fruit room should be kept as equable and as near as possible at 40°, for the cooler it is kept, the longer the fruit will last. Use no more fire heat, therefore, than is necessary to exclude frost or prevent the temperature falling below 34°, and never raise it above 40°. Ventilation may be liberally needed in the autumn when fruit is first housed, but after sweating the fruit room should be kept as close as possible. Air, however, cannot be dispensed with, but it should never be admitted unless the air of the fruit room is found to be impure, and then as far as possible when the external and internal temperatures are alike. This is to prevent the deposition of moisture on the fruit when the external air is warm and moist, or save it from unnecessary drying when the external air is cold and sharp. When care is taken to insure a low, sweet atmosphere in the fruit room, and to have the air in the air cavity cool and dry, several days of severe frost may prevail outside before the temperature inside is lowered 1°, and on the other hand a long spell of close, warm weather may prevail outside without raising the inside 2°. A little warmth in the pipes on a dry day, and air admitted by the windows, will soon dry up any damp that may arise from the fruit, but be careful to always keep the windows covered with the roller blinds.

Exhalations from fruit ripening are considered to have a contaminating effect, but unless ripening passes into decomposition they are innocuous. Nevertheless, store and arrange the fruit so that the early, midseason, and late ripening sorts follow in their order. Fruit kept in store until decomposed is highly prejudicial, through the production of fungoid germs in myriads; therefore, fruits showing the least
symptoms of over ripeness, or a speck of decay, must be promptly removed. Avoid continual disturbance of fruits in stores. Handling, however delicately, adds to or takes something from the fruit. Every turn injures it; in fact, the grand secret in keeping choice fruit long, sound and full-flavoured, is to leave it untouched.

Fruit ripening and fruit keeping are totally different things. Many fruit rooms, so-called, are ripening places. Light, warm, airy, they insure the perfect ripening of autumn and mid-season varieties, the late being accelerated; but it not infrequently happens that some sorts never ripen, becoming "sleepy," dry or mealy, while much late fruit is worthless through shrivelling, the result of excessive evaporation. Some varieties of apples, and more of pears, require to be kept close, in a moderate degree of warmth, to mature properly. A ripening room with a temperature from 60° to 70° is considered necessary where large quantities of fruit are required over a long period. Into this room most kinds of the finer winter dessert apples and pears should be brought for a couple of weeks before their usual season of maturity, for the presence of light, warmth, and air is necessary for the elaboration of saccharine matter, but warm, light, dry and airy conditions cause the fruit to shrivel. This must be avoided by excluding air, and wrapping the fruit in sheets of white paper. Old newspapers should never be used, as fruit absorbs the smell given out by the ink used in printing, and is spoiled. In most places a few portable trays, or shallow boxes, in which to remove any slow, or harsh, as well as late, fruits that need hastening in ripening, into a higher temperature than the keeping-room, meet needful requirements, a hot-house, or, preferably, a warm room, answering the purpose in view. When sufficiently ripe, the cooler fruit is kept for use the better, but if warmed for eating its flavour is improved in cold weather.

Notwithstanding that too much care cannot be bestowed on the keeping of fruit it does not follow that expensive structures are essential. Fruit keeps well in any building that is cool and dark, in the spare room of the cottager on a soft bed of clean, sweet straw, which should also form a lining next the wall, and be used for covering alike to exclude frost and prevent shrivelling by exposure to the atmosphere. On the floor of the cottager's pantry, packed as described, russet and other late apples turn out in March, or later, plump, sound, heavy, crisp, juicy, and full-flavoured.

Flour barrels or others that are perfectly clean and sweet, are excellent for storing winter fruit in. If care is taken to have the fruit dry and unblemished, it keeps as well sweet in boxes or barrels placed in a room or outhouse beyond the reach of
frost, or sufficiently covered with straw to exclude it, as in expensive structures; remembering that a damp floor is preferable for keeping late fruit to a dry airy loft, and that cleanliness and sweetness are indispensal everywhere.

Grading Fruit.

The classification of fruit has much to do with its keeping, as well as its selling value. All inferior and injured fruit should be kept by itself, the pecked and bruised can then be used first; but when the inferior fruits are packed away with the best, and the damaged with the sound, trouble arises in sorting, good keeping is prevented, and the value of the crop depreciated. Those persons who dispose of surplus fruit should endeavour to render their wares as even in sample and as attractive as possible. The term grading, as generally used, is applied to size alone, whereas assorting as to colour is almost equally important. A great proportion of the fruit found in our markets and that sent to fruiterers does not bring the price it would were it properly assorted. One or two ill-shapen, unripe, or over-ripe (decaying) fruits will detract from a whole box of the choicest apricots, cherries, nectarines, peaches, or plums, and no matter how fine the others, a considerable reduction is made in the price. One decaying fruit spoils a box intended to keep a few days. Green bunches of currants, or a hard or over-ripe strawberry, when seen by a buyer, leads him to believe that there are others of the same sort, in greater proportion, farther down in the basket. These small matters are apt to be overlooked, but they ought not, for they are really of great importance. If fruit is properly graded there can be no deceit in topping or facing. The prevalence of unfair facing curtails the demand for fruit. There is only one way to pack fruit profitably and creditably, and this, as a Californian fruit grower says, is to "Grade it; grade it carefully for size, colour, and ripeness. Every right-minded grower and packer should insist upon trio grading, and should stamp all fruit packages as uniform, so that the purchaser may be certain of the quality of his purchase. In this way honest growers and packers can, in a measure, protect themselves and the public against those who are unscrupulous and careless in their methods."

Implements.

These are essential for the satisfactory performance of the different operations in preparing the soil, planting, pruning, and the general management of fruit trees. The
description and quality of tools materially affect the amount of work and the manner in which it is done. "Bad workmen complain of their tools" is an axiom; but good and bad workmen alike do more and better work with useful, handy, and good-quality tools than with those which are unsuitable, clumsy, and bad.

Best quality is of primary importance as regards economy, usefulness, and efficiency, inferior articles being the most unprofitable. Bad tools will never make good work. They are always bending, breaking, or getting out of order, which delays operations and wastes money; but many are made bad by rough usage and neglect. They must not be left out in wet weather, taken in dirty, and neglected while stored away, for wet means rust, and dirt greater labour with indifferent workmanship. All tools should be bright, and if put away for a time, greased or oiled; so that with proper usage they may be durable and always ready for their respective purposes. Some of the most frequently used and essential tools employed in preparing the ground, planting the trees, and keeping the ground in order are the subjoined.

**Spade.**—This is the most important of all tools and the most useful. The main points in a spade are strength at the back to lift the soil and at the point in the handle where the first rivet passes through it from the box or hilt end. The rivets must have good and smooth heads, so as not to annoy the user, whilst keeping the blade firm. The spade should consist of a thin layer of steel, hard enough to keep an edge, yet not so short as to break, nor so soft as to bend. The back in good makes is softer than the

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**Fig. 55.—Tools Used in Connection with the Soil.**

References:—1, No. 3 spade; 2, No. 2 spade; 3, lifting spade; 4, diamond-mouthed shovel; 5, square-mouthed shovel; 6, four-pronged digging fork; 7, dung fork; 8, pick-mattock; 9, mattock; 10, drag, or Canterbury hoe; 11, pickfork; 12, iron rake; 13, trowel; 14, draw hoe; 15, swan-neck hoe; 16, Dutch hoe.
face, which insures a sharp edge. Most spades are broken by sudden wrenches and being put to improper uses. We, therefore, give an example of the "lifting spade" (3), which has a strong back, a keen cutting blade, and a handle strapped to within a short distance of the box.

Shovels.—For digging holes in loose soil and shifting hard earth and stones, the diamond-shaped shovel (4), is the best, but for moving or loading soil the square (5) is handiest, the edges being turned up, medium sized, light, and with a good upward bend in the handle.

Forks.—There are several forms of these, some having flat, others square, and others round prongs. They also differ in the number of tines. For general purposes four-pronged are the most useful. The tines should be made of steel, elastic and strong, yet light. Forks are better than spades for stirring the soil. They are useful in digging holes for trees, particularly where the soil is firm and mingled with small stones. In transplanting or lifting trees a fork with thin tines ought always to be used for removing the soil from amongst the roots. For digging square prongs are the best, tapering to a point evenly from the tread. Round or sharply oval four-pronged forks with round tread are the most useful for working amongst manure, leaves, or litter, as they readily enter and are seldom clogged with the materials.

Pickaxe.—Except in excavating, the "common pick" is not much used in gardens and fruit plantations. Both ends are pointed. In the pickaxe one end is pointed, as seen on the right side of 8, but the other end is formed into a wedge, as on the left side of 9, the cutting edge set in the direction of the handle, and it is useful in cutting roots.

Pick-mattock.—This is a useful tool in planting operations. One end is pointed for loosening hard ground and removing stones, and the other end is flattened, 3 or 4 inches broad, with the edge at right angles to the handle. The length of the head may be 2 to 2½ feet, and the handle about 3 feet long.

Mattock.—One end is shaped like a wedge, sharpened for cutting roots, and set in line with the handle, but the other end is flattened and transverse to the direction of the shaft. It is useful for grubbing up trees, the operator uncovering roots with the flat end so as to more expeditiously cut them with the axe-like end. Tools of this description should have ash handles with straight grain, or hickory shafts.

Drag, or Canterbury Hoe.—With the fork end of this implement the ground, rendered hard by rain and baked by sun, may be loosened, and with the mattock-like end trampled soil can be broken up and clods smashed.
Pickfork—One end has tines like a pitchfork, set at right angles with the handle, and is of great utility in unloading manure. The other end may be used with advantage in loosening and breaking lumps of soil, and is serviceable for ground that has become too hard for operating on by an ordinary hoe.

Rakes.—Iron rakes are necessary for levelling ground to sow seeds in and insure their smooth covering, and for clearing up refuse. They should be strong without clumsiness, and have ash handles, especially those required for chopping baked surfaces for the admission of rain or water, and scratching in surface dressings. Rakes with wood heads, into which iron teeth are driven, answer admirably for levelling and smoothing the surface, also for clearing up rubbish. Wooden rakes are the handiest for raking off grass and leaves.

Trowels.—The trowel is a sort of small, round-mouthed spade, useful for transplanting seedling trees, and indispensable for lifting strawberry runners with a ball of earth, and planting them in temporary or permanent quarters.

Hoes.—These are requisite for breaking the surface of the soil and chopping up weeds. They are often made of the softest and worst iron, whereas they should be of good steel, and neither liable to break nor bend. Draw hoes (14) have a short neck and a circular eye for fixing the handle in. They are strong, good for chopping, but get much clogged with soil at the shank and eye. The swan-necked draw hoe (15) prevents the clogging, and in friable soil is a great improvement. The handle is inserted in a socket connected with the blade by a curved solid neck. The neck is generally iron, and the blade steel plate. Large hoes are clumsy, and a man will do more and better work with a 7-inch hoe than with one 9 inches wide. The Dutch hoe is useful in light soils for cutting down weeds, and is of great value in leaving the ground untrodden, as the workmen walk backwards in using this implement.

Edge Tools.

The finest cutting instruments are made of cast steel. In the choicer descriptions the steel possesses hardness and uniformity of texture, great tenacity, and a certain degree of elasticity. The blade must not break or bend. If the instrument snaps the steel is too short and hard, if it bend the metal is too soft. Proper temper is of paramount importance in tools. Their utility depends on the preservation of a keen edge, maintenance of form, and wearing well. Good tools are labour-savers; bad instruments are time and substance wasters.
Cutting instruments of various kinds are required for budding, grafting, pruning, and other essential operations. Knives, scissors, or secateurs are in the most request, of which several forms are represented in the engravings.

_Budding Knives._—The handles of most of these are made of ivory, thinned off to an edge at the end, which is used for raising the bark. Others have horn handles, giving a better grip, and with a piece of thin ivory at the end the bark is lifted with facility. The blades are straight. One has the edge carried to a point, and is the best for cutting; the other has the edge rounded at the point for cutting the bark without entering the underlying wood. The sheath (1) is the strongest and most used where a number of stocks are budded; the clasp (2) is useful for general cutting purposes as well as budding, and the heart-shaped handle end, round-pointed blade knife (4) is the handiest all-round budding instrument.

_Pruning Knives._—The strongest and keenest cutting pruning knife is the sheath (11). The handle is curved, fitting the hand well; the blade is slightly curved, more at the point than heel, and the effect is that the grip of the handle causes the bite of the blade to be keen throughout its length, and it severs branches of considerable thickness in the most perfect manner. It is the best for heading and snagging, also for the heaviest pruning work performed with the knife. The handle should be of stag’s horn, which, from its irregular surface, prevents the hand slipping, and the blade fixed immovably in the handle imparts a steadiness in action not found in clasp knives. A pasteboard sheath is provided to hold the sheath knife when not in use.

Folding or clasp pruning knives are the most favoured. They are portable and handy for general use. The handles should be made of stag’s horn and slightly curved. Straight blades may cut the cleanest, but curved blades cut the deepest. The grafting knife has a straight-edged thinner blade than the ordinary strong straight-bladed pruning knife (10), but in other respects is identical. Peach or general pruning knives have straight or curved handles and blades. The curved (12) are the most useful.

_Scissors or Hand Shears._—These are made in various sizes and are useful for removing soft growths and laterals. The form shown (18) we have found invaluable in trimming the growths of fruit trees and vines under glass. It nips off the points of shoots, and the ends of matting or small twine used in tying, with despatch. The slide pruner (19) is very strong and well adapted for trimming gooseberries. There are other forms of slide pruners, for which it is claimed that, the centres being movable, they make a clean
cut instead of a bruised and torn one, as with the common nippers; but we have not found any scissors or shears make a clean cut like a knife.

Secateurs.—These popular French instruments differ from the ordinary pruning nippers in having a spring for throwing them open after each cut, which makes pruning easy and expeditious. Those with one cutting side (20) answer remarkably well for summer pruning and light work generally. Made in sizes of 6, 7 and 8 inches, with

wood (iron trussed) handles, they are light and easy to the hand. Others similar in shape have iron handles (21), various styles of spring, and, being stronger, are suitable for heavy work. The one-blade forms of secateur do not make a clean cut, the shoot being more or less bruised by the pressure on the non-cutting side of the implement.

The best form of secateur is the improved French (22 and 23), both sides of the
mouth cutting; and the blades being thin, flat, and curved at the edge, they cut clean, little injury being done to the bark. The small sizes are well suited for summer pruning, the larger for operating on one-year-old shoots, or cutting out branches as thick as the little finger. The great defect of all secateurs is their indifferent quality. They ought to have the temper and quality of ladies' scissors, and the edges as keen as a lancet. Then the blades, not parting company their whole length, would make a cut equal to a knife, clean, smooth, and best for healing.

Tree-pruners.—These, in approved makes, combine the clean cut of the knife, expedition of the secateur, with the power of the crab-claw shears or small saw, and enable the pruner to dispense with steps and ladder in pruning tall trees. There are many forms of tree-pruner, but the principle is similar in all; therefore a description of one suffices for the whole. We have selected for exemplification that of which we have had considerable experience and found efficient, namely, the “Standard,” invented by the Standard Manufacturing Company, Derby; but Coppins’ (Croydon) pruners are equally good.

The Standard tree-pruner, though ingenious, is very simple, consisting of a pole in different lengths up to 14 feet, hook, metal rod, lever, and blade. The hook is made double, so that the knife has a support on both sides, which admits of its being made thin, reducing the resistance of the wood, and a smooth cut is consequently made, whilst the branch, encircled by the hook, is altogether under the control of the operator until the portion to be removed is severed. By means of a hook fitted to the pruner instead of the blade, it is converted into a long-handled switch useful in removing dead wood and thinning crowded growths in old trees; or, with a saw affixed, it becomes efficient for cutting larger branches than the hook itself will encircle. In cutting a large branch with the long-handled pruning-saw, it is advisable to use the pruner for lopping off the smaller branches, and still further lighten the branch by cutting off a portion with the saw, and cutting the branch partly through on the under side at the desired point so as to guard against fracturing and tearing the bark off beyond the cut. The curved saw, having the teeth formed to cut in an opposite direction to an ordinary saw, is best for sawing at a distance from the ground.

The aerial hook, with barrel-end chisel, fitted on a straight hardwood pole, is useful for cutting off branches close to the stem by a stroke with a mallet on the opposite end of the pole. Dead wood and small twigs are readily removed with the hook.
Of other tools for cutting and generally useful purposes in gardens, orchards, and their appurtenances, some are represented in the engravings on page 223.

Axe.—One of a handy size, as the Kent, is indispensable for many purposes, such as cutting and sharpening stakes; and for felling and cutting up trees the Scotch is useful. The hatchet with claws is convenient in fencing work. The billhook is used for lopping branches, fagoting, cutting wood of small girth, and sharpening stakes.

Saws.—For cutting large limbs, the American saw is very easy and rapid in its

work, a decided advance on the common hand-saw for green wood. If the latter be used it should be set wide. Pruning saws generally have thick blades with small teeth, preventing their being set wide enough to cut easy. Those with a hook are handy for removing dead wood, thinning spurs and twigs. The key-hole saw is narrow, light, and well-adapted for cutting close to the forks of branches, where a wider blade could not be introduced. It cuts well, is cheap, and an exceedingly useful pruner. The American saw (9), has a spring steel frame, a narrow saw-blade, \( \frac{1}{4} \) to \( \frac{1}{2} \) inch wide, there-
fore not liable to get pinched in the cut, and instead of being stationary, it revolves so that it can be adjusted to cut at any angle. Strength is imparted and the blade tightened by a tension-screw under the handle. The blade is easily detached and can be reversed so as to cut with a push or a pull; and may be carried over the arm whilst the operator is using the knife in trimming the cuts. The American curved blade (10) is 12 to 14 inches long, and the saw cuts with a pull.

Chisels.—These are used for cutting off branches too strong for the knife, and situated where the saw could not work. They are also used for smoothing the cuts made by the saw, and are occasionally employed for pruning, the handles varying in length, the chisels having reflexed ears for pulling downwards any torn strip of wood or bark as shown (M) page 221. These have edges similar to the carpenter's chisel, but the bevel is much longer. The grafting chisel tapers on both sides like a wedge, and is used for splitting the stems of trees in cleft-grafting.

Cutting pliers require to be of a quality equal to the best cutting instrument, and are very convenient for cutting wire, drawing and twisting purposes.

Hammer.—The principal use of a hammer is for nailing wall-trees; but wall-hammers are often used for other purposes, and rendered worse than useless for nailing. One end ought to be rounded, curving inwards, flattened and split in the middle, forming a long triangular cleft for drawing nails; and the driving end hard steel with chequered face. The head should be short, and have long clips properly rivetted to a hardwood handle.

An improvised bag of canvas for holding nails and shreds answers well, but is not so durable as leather. It usually has one or two small pockets for knives or secateurs, and is suspended by shoulder-straips and has a belt for fastening round the waist.

Crowbar.—This is a most useful implement for making holes for stakes. It is made of a round straight bar of iron, thickened towards the lower end, where it is square for about 1 foot, and then tapers to a point. Its service as a lever is considerable.

Mallet.—Different sizes are essential for driving stakes, and for striking chisels used in smoothing the place where branches have been cut off with the saw. Large ones are necessary when branches of trees are cut off with a chisel. Mallet-heads must be of hard, tough wood, and the larger sizes have an iron hoop round each end. The handles should be straight-grained ash or hickory.

Barrow.—This indispensable machine is of different shapes, both with and without
wheels, and often costly without any advantage in utility; therefore we give prominence to the simplest and most useful. The market-garden wheel-barrow (3) has each side and handle formed of one board, 12 to 14 inches deep, and 4 1/2 to 5 feet long, each cut away on the under side to form the handles, and the front upper corner is rounded off. The width at the bottom is 17 inches and at the top 21 inches; the length at the bottom 14 to 15 inches, and at the top 27 inches. The front edge projects forward 11 inches, and the handles bend backward 3 inches, both being 2 inches higher than the sides, into which they are mortised, and the whole is firmly secured by iron bolts and pins. The

wheel is well under the body, lessening the weight on the arms, and admitting the ready tipping of the load and the turning of the barrow in a small space, whilst its narrowness allows it to be used between rows of gooseberries and similar limited areas.

The market-garden fruit-barrow (1) is 7 feet to 7 feet 6 inches long, and about 23 inches wide. It is useful for wheeling fruit in baskets, a dozen half-sieves being easily conveyed. When covered with 3/8-inch board, and 2-inch deep movable sides affixed, as indicated by the dotted lines, it is converted into a handy barrow for wheeling pots and other substances, one man doing as much work as two with a hand-barrow.

Fig. 58. Axes, Billhook, Saws, Hammer.

References:—Axes: 1, Kent; 2, Scotch; 3, hatchet with claws for drawing nails; 4, hammer; 5, billhook; 6 and 7, pruning saws; 8, key-hole saw; and 9 and 10, American pruning saws.
A strong hand-barrow is used for carrying pots and heavy packages of fruit. One may be made as follows:—Sides, 6 feet 6 inches long, 3 inches deep, 2 inches wide, tapered at the ends to form handles, giving the hand 4 inches convenient grip; bars, 2\(\frac{1}{4}\) inches deep, 1\(\frac{1}{2}\) wide, one 20 inches from each end, and a third in the middle, all mortised into the sides and level with the under edge, so as to form a body 2 feet wide including the sides. Boards, \(\frac{3}{4}\) inch, may form the bottom, placing them lengthwise, a little distance apart to allow water to pass through, extending 2 inches over the end bars, thus forming a table 3 feet 6 inches long and 2 feet broad. If an edging be wanted one can be formed of 1-inch board, 2 to 3 inches deep, fixed flush with the sides and ends of the boards, thus forming a box 3 feet 4 inches long and 1 foot 10 inches wide. The legs should be 15 inches long, bolted to the sides by an iron rod passing from side to side, and to keep the legs firm, iron straps, clipping the feet of the legs, may be secured to the under side of the side pieces. The sides must be straight-grained ash, free from knots, also the bars. This applies to other forms of barrow, but the sides of the market-garden wheel-barrow are usually elm, which answers well, and for the sides of wheel-barrows generally sycamore and poplar are not so liable to split as deal.

The fruit hand-barrow (2) has sides 7\(\frac{1}{2}\) feet long, including handles, box 4\(\frac{1}{2}\) feet long and 2 feet inside measure, the sides 4\(\frac{1}{4}\) inches deep, 1\(\frac{1}{2}\) inch wide, ends same dimensions, all fixed narrow side upwards. Two bars, 3 inches by 1 inch, support the bottom, and are dovetailed and secured to the under edge of the sides. The bottom is formed of \(\frac{1}{2}\)-inch boards, which forms a box 3 inches deep. To carry the ends of the boards half-bars should be fixed next the end pieces on the same level as the full bars. The legs, 15 inches long, should be secured by a bolt passing under the bottom, and kept in position by iron straps. This barrow may be entirely formed of deal, free from knots.

Baskets.—Wicker-work baskets vary in shape and size, but a number of baskets in varied proportions are useful and too little regarded in being kept clean and taken care of. Split wood and withes form durable baskets. The Sussex trug baskets, made of willow wood, are light, durable, and generally useful. Market baskets will be subsequently referred to.

Scraper.—Fixed scrapers answer very well if they are placed just at the right spot, which is where the workman would step on a clean gravel path with dirty boots. A portable one (5) is readily made by a blacksmith, as it consists of one side of a \(\frac{5}{6}\)-inch
square iron bar, 1 foot long, welded to, or drawn out and formed into a socket to take a hardwood handle about 3 feet long, the lower end pointed. The other side is 1 foot long, rounded at the top and sharpened at the bottom. Between these a ¼-inch iron plate is fixed, 6 inches long, and 2½ inches wide, hollowed 2/3 inch, with 1-inch ears on each upper side. This, without the socket, driven into hardwood logs, and set at the angles of quarters where the alleys join the gravel or other paths, forms an admirable scraper.

Ladders.—In pruning and gathering fruit various lengths of ladder are required. The chief desiderata in orchard ladders are strength and lightness combined with a good tread. This is important, so as to give a wide reach sideways, for without a good footing the fruit-gatherer is hampered. The minimum breadth of tread should be 9 inches, increasing 3 inches for every 18 feet length downwards. Wide ladders are exceedingly clumsy. The sides should be kept from shifting by an iron rod at every 6 feet, but one round only from the bottom and top, shouldered on the inside and secured on the outside with octagon nuts. Bamboo ladders for low trees are extremely light, strong, and inexpensive.

Step-ladders are used for wall-trees. They should be light, the sides and board steps formed of deal without knots, have a good tread, and fixed at an angle of 85°, calculating from the perpendicular downwards. Two iron spurs should be affixed to
the sides at the top, about 6 inches long, to keep the ladder from injuring the trees. It also ought to have an iron-shouldered rod, as before advised, at the lower end, middle, and top to keep the sides in place.

In the engravings (6 and 7, page 225) a form is represented which may be used as steps or ladder. It consists of two parts, one narrower than the other, and connected at the top round by a slot (a), about 4 inches in length, which serves as a hinge. The ends of the narrow part are cut, as in c, to the depth of $2\frac{1}{2}$ inches, and when the ladder is opened out, the second round of the wide part fits into these notches, as at b, and the ladder is then firm and available for wall trees and other purposes. It is capable of modification, and its length may be increased both as steps and ladders. More steps in the length are shown in 6 than 7. The steps are exceedingly useful in pruning pyramid and other forms of dwarf trees, also in fruit houses. Two pairs of them, with a plank between, form a stage for thinning grapes and many other purposes. They can be made any height, and risk of their slipping at the foot is easily avoided by hooks on the sides with a linked chain to regulate the straddle.

Pincers for drawing nails are often required, and a screw-driver is indispensable in the packing of fruit.

**Diseases.**

Fruit-tree ailments are attributable to—1, excess or deficiency of temperature, moisture, and light; also impure air and defective soil; 2, parasitic animals and vegetables. Excessive heat excites and dilates the tissues inconsistently with healthy growth; extreme cold (relevant to the subject) destroys the connection between the cells, frost-bitten parts having their vesicles partly or completely isolated. Undue moisture prejudicially affects the tender tissues of the roots. Defective light hinders the chemical changes necessary to the complete development of the chlorophyll, a gloomy season being unfavourable to the health and productiveness of trees. A vitiated atmosphere causes trees to sicken, the soot and dust of towns closing their pores, thus obstructing respiration and evaporation, whilst sulphurous fumes are pernicious. Chemical changes effected in soil by manures or cultural operations, when unsuitable, injuriously affect fruit trees. Fertility of the soil depends chemically upon the presence in it of all the ash-elements and nitrates in proper quantity and combination. Soils, however, may be fully supplied with the nutritive elements, yet the trees be barren or unhealthy. Certain physical conditions of soil, rendering it congenial to vegetation, are no less indispensable to health and high productive power than an appropriate amount of
phosphoric acid, sulphuric acid, potash, lime, magnesia, and iron. It is, therefore, desirable to understand and recognise the fact that all fruit trees are dependent upon certain conditions for their health and the development of their valuable products; also it is equally important to have a right comprehension of the fact that diseases are not the result of chance, but really growths that luxuriate under special conditions, and these, as a rule, unfavourable to the trees. Indeed, a very large portion of the diseases of fruit trees spring from direct injuries to the tissues, exhaustion, or deprivation of their juices by fungi and insects.

*Fungi.*—There are very few fruit trees which are not known to support one or more species of vegetable parasites. These, in the case of "blights," "mildews," "rusts," and many affections of the stems, leaves, flowers, or fruit, are invisible, except as a mass, to the unaided eye. Small as these microscopical fungi are, the botanist names and classifies the species, describing their characteristics of form, life, and reproduction in relation to the diseases and injuries of cultivated plants. Thus the cultivator is made aware that "blights" and various diseases are the results of specific organic growths, each producing characteristic effects. Each fungus produces its own seed (spores), and from these alone is reproduction possible. It is of great importance to fully comprehend that fungus spores always germinate outside the plant tissues, and gain entrance by mechanically penetrating the epidermis and by wounds. They cannot be taken up by the roots with water and carried with the latter to any part of the plant. Entrance of the fungus is effected by piercing the surface, the germinal tube accomplishing this by its power of absorbing the substance at the point of contact, or by reaching and passing through the stomata. A thick epidermis is often a safeguard against fungi, this alone being sufficient to account for the immunity of certain varieties from diseases which so nearly exterminate others.

Knowledge on the conditions of germination is essential for comprehending the diseases due to fungi. The spores consist each of a single cell, formed of an enclosed mass of plastic substance (protoplasm), around which are two coats, the inner thin and flexible, the outer usually thicker and much less elastic. In germination the outer is pierced or cracked, and the inner coat protrudes as a long tube containing still the soft internal substance. This tube is that which penetrates the plant, becoming perhaps a hundred times as long as the spore before gaining access to the hypodermal tissues or those beneath the cuticle or bark. Once the living tissues of the host, or tree affected with parasitic fungus, are pierced, the mycelium or delicate transparent filaments (root fibres)
invade the cells, certain destruction in some instances following the penetration; but
the diseases caused by fungi present many peculiarities according to the species of
parasite or of host. Sometimes the tree or plant attacked is simply enfeebled, doubtless
robbed of nourishment. Infested parts, in other cases, take an abnormal shape or size.
These modifications of growth are often as injurious as the abstraction of nutriment.
Stems or branches are swollen and knotted, leaves curled and distorted, fruit made
unsightly or worthless. There is no room for doubt that fungi are the principal agents
in inducing ferment-changes and decay, and that when they occur in great numbers
their effects may prove of serious consequence to the fruit grower and consumer.

Much information of practical value on fighting these invisible foes has been attained
by successful investigators of the maladies. No one method of prevention or cure can
be made general, but something can be offered for special cases. Incorporating material
in the soil, being directly useful to the plant, may prevent or reduce the ravages of
fungi in giving that special condition and quality of growth resistive of the germs. Pow-
dered substances may destroy such fungi as creep over the surface, but are practically
innocuous in the case of those that pursue their destructive work beneath the bark.

Much in the way of prevention is effected by selecting varieties for culture which are not
subject to injury by fungus; indeed, careful discrimination leads to useful results in
the selection of disease-resisting varieties. The least vigorous growths are not always
most liable to disease, the plethoric often suffering most, as in the case of trees grown
on land which is too rich. There are, however, some conditions more favourable than
others for the development of the parasite, and these it is the business of cultivators to
find out by studying the growth, soil, and methods of cultivation. Washing the stems
and larger branches of fruit trees with alkaline solutions makes the bark smooth, more
elastic, less liable to crack or be pierced by insects, and a more certain barrier to fungi.

Knowing how, where, and when to assail fungoid enemies is important. Strike the
fungus spore in spring and summer, when protruding its germinal tube, with a sulphide
or a sulphate, and it is prevented penetrating and burrowing in the tissues of the
intended host. Something, however, can be done in winter. Destruction of dead leaves,
affected fruits, prunings, and all refuse by burning is helpful; and vigilance in
picking off any diseased leaves, twigs, or fruits the following season, and burning them,
does much towards freeing fruit trees from fungus depredations, whilst limiting the
extent of infested areas.

The foregoing remarks on fungi are based on the researches of Professor T. J.
Burrill, Illinois University, U.S.A.; and the following subjects are based upon the recorded investigations of Professor Plowright for canker and Dr. Beijerinck for gum. Various sources have been consulted with regard to apple scab (including Nicholson's "Dictionary of Gardening," L. Upcott Gill, 170, Strand, London), both European and American; and Mr. Worthington G. Smith in respect of mildew; to all of whom we desire to express acknowledgments.

**Canker.**—This malady affects the apple and pear, also ash, beech, elm, oak, and other trees. Its attacks are not confined to any particular period of the tree's age. Young trees and lately-introduced varieties do not escape its ravages. Yet it is most mischievous in aged trees, and varieties which are increased from old specimens are more subject to it than others are. This attests constitutional peculiarity rather than hereditary susceptibility. Sorts resisting cankerous affections do so by the density of their cuticles (their external covering of the bark). Yet there are no varieties of apple and pear that in all conditions of soil and climate are canker-proof. Some conditions, however, favour it more than others, for it luxuriates in trees crowded in neglected gardens and orchards, and is most prevalent in those grown in stubborn clay; in land stagnated with water; in dry, gravelly brash; in a shallow layer of surface mould overlying chalk, and particularly in soils restricted in cultivation to scratching the surface, beneath which, at less than a spade or subsoil-plough depth, is a hard impenetrable pan impregnated excessively with iron oxides and injurious acids. Very rich loose soils assist trees to canker; also the moisture, mist, fog, and hoarfrost incidental to sites near rivers, streams, lakes, and bogs. Exuberant growth, severe and careless pruning, the removal of large branches late in spring, late summer pruning—which induces soft shoots certain to be injured by severe frost—all invite the disease.

The conditions mentioned, being inimical to the health of the trees, must be remedied, as follows: crowded trees in neglected gardens and orchards should be opened out and cleansed; heavy soil lightened, shallow deepened and enriched, wet efficiently drained, dry rendered more retentive, pan be broken up, loose ground firmed, pruning be conducted intelligently, sites chosen insuring disease-resisting vigour, and every cultural essential provided to maintain a normal condition of all the organs, to enable the tree to profit by the influences of external circumstances which are beneficial, whilst its constitution is not materially impaired by temporary unfavouring conditions.

Conduences to canker over which the cultivator has little control are: chills in spring, which injuriously affect the sap-vessels; a late season, inducing excessive growth
Fig. 60. Wounds in Fruit Trees without Canker (S); with Canker (T).

References:—S, part of stem, branches, and shoots, showing wounds healing over without canker;—h, arm fractured by wind; i, bark injured by broken arm; j, shoot killed by frost; k, shoot injured by frost; l, limb sawn off; m, abraded bark wound infested with American blight; n, bruises inflicted by nailed boot; o, arm sawn off close to
at the latter part of summer, a wet season, extreme variations of temperature, and sudden checks occasioned by atmospheric vicissitudes.

Canker is produced more from the action of external than internal causes, hence is much more easy to reach and cure than diseases which originate internally. Indeed, canker is of traumatic (wound) origin. When a tree receives a bruise or injury in a shoot, branch, or stem, sufficient to rupture the bark, that part is destroyed, becomes brown, shrunk, cracked, and exposes the wood. Nature always attempts to cover it with new bark. This is effected by the tree throwing out a ridge of callus around the circumference of the wound, which, growing outwards, ultimately heals over. The time occupied depends on the tree's condition. If healthy and vigorous, its efforts at covering the wood exposed with fresh bark are expeditious; if enfeebled or unhealthy, the wound is healed over slowly, and the wood thus exposed naturally decays, forming a receptacle for water and other accumulations, to the prejudice of the wound ever healing.

The causes that give rise to wounds in trees are—1, natural:—hailstones, breaking of branches and erosion of bark by wind, sun and frost cracks, punctures of insects and burrowing of larvæ, pecking of birds, bites and scratches of animals; 2, cultural:—all manipulations, bruises, and abrasions. A tree, however, may have many (it always has some) wounds, yet those innocent of canker. These, in healing over, are not remarkable for abnormal enlargement. American blight, however, sometimes becomes located in the cavities; then the bark around the wound is considerably distorted, and it has some resemblance to the hypertrophy always associated with canker. Nevertheless, wounds in process of healing over by Nature without, and those with canker, are very different, as will be readily comprehended by an examination of the comparative portrayal of the two forms in the illustration.

When the bark of an apple or pear tree is injured by any of the causes mentioned, the spores of the canker fungus gain admission into the wound, and set up disease of

stem; p, branch split at stem; q, branch with bark off; r, pruning wounds; s, severe bruise in stem; t, wound in small branch; u, crack in stem; v, blow from hailstone. T, wounds in part of stem, branches, and shoots showing cankerous affections:—w, arm broken; x, bark eroded by broken arm; y, shoot killed by frost; z, shoot damaged by frost; a, limb sawn off; b, wound with American blight; c, nailed boot injuries; d, limb cut off close to stem; e, branch split at stem; f, branch shortened in severe frost; g, pruning wounds; h, size of wound occasioned by bruise; i, wood exposed by canker; j, tree's efforts at covering over wood with new bark; k, small branch killed; l, hailstone wound; m, crack in stem being enlarged. U, enlarged shoots, showing extent of a season's growth of canker:—n, discoloured portion of bark; o, point of entrance of canker. V, enlarged shoot, showing canker affection in autumn or early spring:—p, bark raised, fissured, and granulated by canker "fruits" about to shed spores. W, enlarged shoot, showing:—q, bark thrown off cankered portion of previous year; r, dent in wood caused by original blow. X, spur twig of enfeebled and aged tree, showing:—s, ring of bark thrown off the previous season's canker-affected part.
greater or less malignity. The fungus, Nectria ditissima, pushes its mycelial hyphae (spawn threads) through the live portions of the cortex (bark), cambium (formative fluid found between the bark and wood), and alburnous tissues (younger outer layers of wood), causing their destruction. This occasions a considerable swelling of the surrounding tissues, the bark dies sooner or later, becomes fissured and scaly, forming an unsightly excrescence. No exudation occurs. The extension of the mycelium is intermittent, quiet in winter, and active in spring and summer. Then the fungus strives to enlarge the wound. This the tree resists, and a struggle for the mastery ensues. By throwing out an excessive callus around the circumference of the wound the tree endeavours to cover over the wood, and thus expel the fungus and safeguard itself against further inroads. This battle may last many years in the larger branches without causing their death, but in the smaller it is more rapidly fatal, the small twigs and shoots succumbing in the year of attack.

Aiding trees to repel disease forms no insignificant part of intelligent culture, and a knowledge of the enemy to be combated is an immense advantage; therefore the illustration (Fig. 61) will be suggestive.

Steps to combat canker are—1, preventive; 2, remedial. Preventives are those promoting the tree's health, in which all its functions are perfectly performed. A tree growing in too rich soil does not digest and secrete its juices healthily; hence its tissues are large and weak, the wood soft and pithy, and the bark tender, therefore highly susceptible of injury from hailstones, severe frost, bruises, and abrasions in performing cultural operations. This condition, fatal alike to health and fruitfulness, must be prevented by timely lifting and root-pruning, additions of less rich soil or incorporation of counteracting substances, such as old mortar rubbish. This, with the soil firmed, and, perhaps, shallower planting, will induce sturdier and shorter-jointed growth, stouter-textured leaves, assuring solidity to the wood, and a denser, harder (yet elastic) cuticle to the bark.

On the other hand, a tree growing in thin, poor or unsuitable soil, or otherwise enfeebled, must be stimulated, by judicious manurial applications and thinning the branches, to imbibe by its roots and elaborate through its leaves the nourishment essential to its health and vigour. Cleansing the bark enables it to swell. Stunted trees are liable to rend the old bark under a generous regimen. Cleanliness imparts the essential elasticity to the bark, ensuring its enlargement over the new layers of wood without splitting.
The greatest possible preventive of canker is care all round. Wounds must not be inflicted needlessly. Accidents happen, but there is no occasion for subjecting fruit trees to abuse in performing cultural operations, or for breaking branches. Pruning in severe weather, or when there is danger of frost occurring to enlarge the wounds or cause the bark to die back, is to be deprecated. All wounds should be made smooth and protected by a fungus-proof coat. Shellac solution and the cement advised for "inlaid" buds (page 136) answer for the smaller, whilst the larger wounds should be covered with the plastic substance named at page 125 for covering grafts.

Notwithstanding all precautions the Nectria spores gain entrance to apple and pear tree tissues, and in them set up canker. Prompt measures must be instituted to prevent the disease spreading. This is comparatively easy because local. The spawn threads of the fungus pass cell by cell, and obtain nourishment from the protoplasm of the cells of the tree, impairing or destroying its vitality. Certain manurial elements, applied to the soil and entering the affected trees, strengthen their cellulose, whilst acting inimically upon the parasitic growth. Sulphates possess this property. The sulphur is believed to act as food for the protoplasm of vegetable cells, increasing the growth 13.54 per cent. Professor A. Müntz found iron sulphate increased the growth 30.2 per cent., and the chlorophyll 9.6 per cent. "It destroys parasitic fungoid diseases" (Griffiths), and should be applied as a top-dressing early in spring, when the soil is wet, at the rate of a quarter to half an ounce per square yard. To insure its even distribution, mix it thoroughly with ten times its weight of finely-powdered dry clay for light soil, and sand for heavy soil. The rain will wash it in.
Mr. Edmund Tonks, in a paper read at the Apple and Pear Congress of the Royal Horticultural Society, held at Chiswick, in 1888, recommends the following formula for apple trees affected with canker:—"Superphosphate of lime, 12 parts or pounds; nitrate of potash (saltpetre), 10; chloride of sodium (common salt), 4; sulphate of magnesia (Epsom salts), 2; sulphate of iron (green vitriol), 1; and sulphate of lime (gypsum), 8. This may be used at the rate of a $\frac{1}{4}$ pound to the square yard over the whole extent of soil within reach of the roots. It need not be dug in. One effect of the manure may be relied on: if it does not cure canker, it will, at any rate, most certainly benefit the trees."

Trees not too old and canker-eaten are amenable to improvement by re-grafting. A tree that never bears good fruit nor makes little beyond cankered growth may be transformed into a healthy specimen, and bear fine fruit, by putting a new head on old shoulders in the form of a number of grafts of a strong-growing hardy sort, always provided there is nutriment in the soil for the roots to appropriate. Strong-growing apples and other fruit trees established on weakly trees increase their root action, and, finding the requisite support for the growths, new layers of wood form on the old stems, covering over wounds, and a new lease of life is thus given to the trees. Stunted trees necessarily have weak roots, not extending far from the stems; therefore, by establishing a strong-growing variety on a weak one, strength is imparted to the roots, and these push beyond the hitherto small impoverished occupied radius into fresh, practically virgin soil. Strong growing and rooting sorts will live where the weaker fail, but where the food is scant it will sooner be devoured; hence re-grafted trees often grow very well for a few years and then collapse. They succumb because the soil is deprived of its available resources of nutrition, and it is the duty of cultivators to keep it replenished with food that is needed for the health of trees and supporting their crops of fruit.

When Nectria has affected a branch half or more round, cure by any other means than excision or amputation of the affected part is doubtful. With the cankered part cut clean out, the wound heals over if the wood is healthy. Before cutting out the canker, wash it well the day before with a 6 per cent. solution of sulphate of iron or $\frac{1}{4}$ per cent. sulphate of copper (blue vitriol). Pare the wound quite smooth, taking care not to injure the edges of healthy bark. Dress the wound with the alcohol and shellac styptic. Large wounds should be covered with grafting pigment. The operation should be performed in spring or early summer, to allow of the wound healing over as quickly as possible.

_Gum.—_Though similar to canker, gum does not affect apple and pear trees; but
is found in almond, apricot, cherry, nectarine, peach, and plum trees. Gum disease (gummosis, gum-flux) is distinguishable by an exudation of thick gum clinging to the branches of the trees where they have been affected. It is a highly-contagious disease, and can easily be produced by inserting a little of the sticky substance under the bark of the trees named, as found by Dr. Beijerinck, provided it contain spores of a fungus—Coryneum Beijerincki. These spores cannot unaided pierce thick bark, and although they penetrate soft young shoots where there is no apparent wound or abrasion of the external covering of the bark, the spores do not gain access to trees with a dense cuticle without a crack, wound, or abrasion. The first visible sign of attack in a young shoot is the appearance of a red-coloured speck. The bark first dies, then the wood. Sometimes there is no discharge, the shoot simply having the bark discoloured, shrunk, and destroyed. The exudation appears dependent upon the formation of cambium and starch granules, for when the growth becomes somewhat firm, the “tears” of gum are freely exuded. Soft branches (growths of the previous season) infected in winter have the bark completely killed around the buds. In these affections there is seldom any noticeable exudation; but gum fills the wood channels, destroying the branch, or greatly enfeebling the growth above the affected part. Gum also flows from the fruits of trees afflicted with Coryneum. It appears to proceed from the stone, generally at the suture side of the fruit, where it shrinks and gum exudes, and pervades its flesh, rendering it hard and useless. Sometimes the fruit so affected falls prematurely, and is always depreciated in value.

The fungus luxuriates in trees grown under an identity of conditions which induce canker; therefore, what has been advanced under that head, in respect of health-favouring conditions of soil, climate, and cultural management, applies equally to trees afflicted.
with gum. It prevails most in trees that are gross and sappy, but it also assails weakly trees. The predisposing cause of gum appears to be defective food and assimilation, inasmuch as we have seen little of it in really healthy trees. Thus, lifting and root-pruning, with the addition of fresh soil, or an admixture of counteracting substances, with firmer staple and shallower planting, cures the plethoric tree of its tendency to gum; whilst a weakly tree may be strengthened and fortified against attacks by improving the soil, clay marl being good for mixing with porous sandy soil, and then with appropriate food supplies the tree is better able to resist the attacks of the enemy, which is represented in the illustration Fig. 62.

Peaches and nectarines, with other stone fruits grown against walls or under glass, are most liable to receive injuries. These may be slight, yet sufficient to admit Coryneum spores, and everywhere precautions should be redoubled to prevent this contagious disease. In nearly every instance of young trees much cut at the top and but little at the roots, wounds and acute angles are formed by the branches which become seats of acute gum disease. Any young tree showing gum in its stem and angles of the radiating branches should be at once burned. Older trees that do not produce clean healthy wood free from gum after a second or third careful lifting and rectification of soil constituents and staple, should also be burned. But there are conditions of culture essential to stone-fruit trees successfully resisting gum. Thus the apricot and cherry gum in heavy wet soils and in deep alluvial deposits, whilst the plum is nowhere so free from the malady as in calcareous clay. The cherry puts 19·98 per cent. of silica, and 41·95 per cent. of lime in its bark; while the plum strengthens its external covering with a similar percentage of lime, and iron supplants silica to a large extent. The plum also secures 28·06 per cent. of lime and 4·37 per cent. peroxide of iron in the shell of its fruit, safeguarding its skin with 8·25 per cent. of lime and 7·45 per cent. of peroxide of iron, when these essentials are provided. Other stone-fruit trees similarly fortify themselves against their parasitic enemies.

There is little doubt that heavy manuring induces the development of fungoid diseases, and that top dressings of artificials are inimical to them. The exclusive use of stable manure in gardens, under the erroneous impression that it contains everything essential to tree growth and fructification, induces plethoric poverty in trees, rendering them susceptible to gum disease.

A suitable mixture for trees inclined to plethora and gum is:—superphosphate of lime, 5 pounds; muriate of potash, 2 pounds; sulphate of iron, 1 pound; mix, and apply
early in spring at the rate of 2 ounces per square yard, repeating the dressing immediately the fruit is set. If the trees are weakly use the following:—steamed bone-meal, 4 pounds; nitrate of potash, 4 pounds; sulphate of iron, 1 pound; mix, and apply similarly to the preceding mixture. Trees grown under glass should be top-dressed in advance of their growth, following with the second application soon after the setting of the fruit. In either case add sulphate of lime, equal to all the ingredients where there is a deficiency of lime; but a dressing of quicklime should be given in all cases of a deficiency of that substance in the autumn, pointing it in and mixing with the soil as deeply as the roots admit without disturbing them.

When trees under glass are badly affected with gum, they must be carefully lifted, and the roots placed nearer the surface, in fresh soil. The growths must be kept thin, air freely admitted, and the syringe laid aside. If the growth be stunted, or lean and long-jointed, spray with a solution of sulphate of iron, at the rate of a quarter of an ounce to the gallon of water, in the evening when the trees have set their fruit, or when the young shoots are about 2 inches long, repeating at intervals of 15 to 21 days up to the fruit taking its last swelling for ripening. This assists old bark to swell, invigorates the growth, and proportionately increases the size of the fruits. Acting antiseptically, wounds heal over sooner, and Coryneum spores cannot germinate. Trees generally infested with gum disease may be sprayed with carbonate of copper in suspension (see "Apple Scab," page 241). Spraying should commence when the fruit is set, and the young shoots 1 to 2 inches long, repeating two or three times at intervals of 12 to 15 days, or until the young wood becomes rather firm, when it is proof, without damage, against Coryneum spores. Iron and copper solutions must not be used indiscriminately, but be tested on a few growths before applying to the whole of a tree or trees. Trees liable to gum disease may be sprayed while dormant with this solution:—caustic soda 4 ounces; pearlash (carbonate of potash), 4 ounces. Dissolve, and dilute to 6 gallons with hot water. If the trees have been infested with aphides, red spider, thrips, or scale, add soft soap, 1 pound to the solution. Apply hot; 120° is quite hot enough for soft shoots, but ripe wood will bear the solution 20° hotter. The soda and potash wash cleanses the bark and increases its elasticity.

When a tree is badly infested with gum disease every particle of diseased wood must be removed. Shoots should be shortened to sound parts below the infestation, branches be cut back or out to give place to healthy growths, and diseased stems have the Coryneum extracted. Every possible care must also be taken to prevent infestation.
A diseased tree must not be admitted. Wild Cherries, Bullaces, Sloe-bushes, and above all common Laurel, should not have places near stone-fruit trees. Acacias, also, are parents of gum disease, but it does not exist on trees subject to canker, Elms excepted. In the Elm the morbid product is excessive, often saturating the soil a considerable distance from the stem. The deposit shines like varnish, and is a compound of ulmin and carbonate of potash. The white matter around the wound Vauquelin found was composed of—vegetable matter, 60·5; carbonate of potash, 34·2; carbonate of lime, 5·0; carbonate of magnesia, 0·3 = 100·0. The morbid product has a close connection with sugar, and hence the value of gum as a dietary. Cherry is the best of British-grown gums.

Apple Scab.—Apple and pear trees are often afflicted with a disease that causes unsightly blotches on their fruit, and disfigures the leaves and young shoots. The scabs generally appear on the exposed side of the fruit, and this, in consequence, is always less developed than the other. Certain varieties of apples are more subject to scab than others, particularly the thin-skinned and tender-fleshed, such as Hawthornden, Stirling Castle, Yorkshire Beauty, Rymer, and Dumelow’s Seedling. Russets generally escape, but sorts with semi-russety skins sometimes become deformed. Immunity from this disease is most decided in kinds having greasy, elastic coats, such as Lord Grosvenor, Manks Codlin, Ecklinville, Nelson Codlin, Golden Noble, Lane’s Prince Albert, Bramley’s Seedling and others, yet no varieties are in all conditions of soil, climate, and culture scab proof. Season greatly influences the prevalence and development of scab. It flourishes in a wet season, damp localities, and in gardens and orchards lacking health essentials; but it appears also in a dry year. Healthy conditions of cultivation always render an attack less severe and more amenable to the effects of remedial measures.

Scab growths are due to a fungus—Cladosporium dendriticum. On the fruit it gives rise to black patches, which in bad cases run together, covering a large part of the surface, and occasion its cracking by the contraction of the skin and subsequent attempts at swelling. Thus the fruit is greatly disfigured, often to the extent of rendering it worthless, always decreasing its using and marketing value. The general appearance of fruit affected with scab is well shown in the engraving on the next page.

The black small spot soon becomes an irregularly rounded patch, depressed and black in the centre, enclosed by a small white ring, outside which is a black border, indicating the growth of the fungus. The white ring is the edge of the skin of the fruit, and the depressed dark spot is occupied with a mass of minute bodies, which
are the ends of the club-shaped structures bearing brown spores, fixed by the narrow end to short erect stalks; and these are produced on a mass of closely-packed small cells formed by the division of the mycelium by cross walls as represented in Fig. 64.

From the figure it will be seen that the spawn threads (or mycelium) do not penetrate, except a few branch threads, far into the fruit, but remain in the cells of the skin. Thus the fungus devastates the fruit, living on its substance, and continues to grow in the fruit after it is removed from the tree, preventing its keeping and causing its premature decay.

Nor does the fungus confine its mischief to the fruit, but it grows on the leaves and young shoots. These are attacked simultaneously with the fruit, and their substance being abstracted as well as their epidermal (skin) tissues destroyed, the leaves lose their elaborative and assimilative power more or less, according to the severity of the attack, and thus restricted, the vitality of the whole tree is impaired. The young growths, greatly weakened and disordered, cannot form fruit-bearing parts perfectly, or store food essential to floral development. Future crops are more or less imperilled by attacks of the fungus. The spots on the leaves and young shoots are usually from \( \frac{1}{4} \) to \( \frac{1}{2} \) inch across, and branch from the centre tree-like, hence the specific name—dendriticum.

In the leaf of the apple the fungus first appears as a minute black speck. This grows into a patch, and numbers of those prevent its development, causing it to become crimped and malformed, as represented in the example on the following page.

The mycelium in the leaf, as in the fruit, remains almost wholly in the cells of the epidermis, and, spreading, the black spots
often cover a large part of the surface of the leaf. The spawn threads in the leaf are somewhat different in form from those in the fruit, and do not always develop brown spores (conidia), but the short cells of the "clubs" (stroma) may break off and act as spores, and these finding suitable germinating media, as tender shoots, young leaves, and growing fruit, push out spawn threads, and reproduce the scab fungus. This form is well represented in the engraving Fig. 66.

Sometimes the fungus grows on all parts of the flowers. This is usually disastrous, as it often prevents their setting, while the fruits which form cannot swell freely, through the footstalks being affected, and consequently several of them drop. This form of Cladosporium is more, if not entirely, confined to pears (see "Cracking in Pears").

In combating scab (and all diseases) it is necessary that none of the essential conditions to a tree's health be ignored, but whatever is lacking for its restoration to and maintenance in normal health must be afforded. Lifting affected trees, and otherwise attending to the deficiencies or superfluities of soil constituents and general management, as set forth under "Canker," are applicable to trees afflicted by scab.

The seventh annual report of the Agricultural Experiment Station of the University of Wisconsin contains a report by Mr. E. S. Goff, on the "Prevention of Apple Scab." In a somewhat extensive series of experiments it was found that potassium sulphide at the rate of half an ounce to a gallon of water, soda hyposulphite at the rate of 1 pound to 10 gallons of water, sulphur powder, formed by slaking lime to which a certain proportion of sulphur had been
added, 1 pound to 10 gallons of water, and liquid sulphur preparation—the lime and sulphur mixture just noted—diluted with 180 parts of water, were all more or less beneficial, while a solution formed by dissolving 1½ ounce of carbonate of copper in a quart of liquid ammonia, and diluted with 90 quarts of water, was almost a complete remedy for the disease. Spraying the trees commenced on May 18, when the petals had fallen from the flowers but the young fruits were scarcely larger than peas, and repeated on May 30, June 4, June 17, July 1, July 24, and August 10. These sprayings with ammoniacal carbonate of copper solution, so far prevented the growth of Cladosporium as to increase the number of first quality fruits more than 3½ times, and to decrease the number of third quality fruits nearly 14 times. Trees sprayed as above gave the following percentages:—first quality fruits, 75·0; second quality fruits, 23·4; third quality fruits, 1·6. Unsprayed trees:—first quality fruits, 23·3; second quality fruits, 54·0; third quality fruits, 22·7. These figures hardly do full justice to the beneficial effects of the spraying with the ammoniacal carbonate of copper solution, because the fruits from the sprayed trees would necessarily represent a much superior average quality to those of the corresponding grades from the unsprayed trees.

The Wisconsin ammoniacal solution of carbonate of copper found so successful against apple scab, represents a strength of 4 ounce of carbonate of copper and 4 ounces of ammonia to 10 quarts of water = 2½ gallons, or 1 ounce of carbonate of copper and 36 ounces of ammonia to 20 gallons of water. These figures may be useful to amateur growers having few trees, also to those using other formulas in the preparation of ammoniacal carbonate of copper solutions, showing (as they do) the strength at which they must be used in spraying apple trees for the prevention of scab. Although the apple is the commonest of fruit trees, its foliage is more susceptible to injury through the action of fungicides than that of most others; this must be remembered by growers, for when the ammonia is too strong the leaves are injured and the fruit rusted.

During 1891 another series of experiments were conducted by Professor Goff, with precipitated carbonate of copper in suspension, for preventing apple scab. An ounce of carbonate of copper was first well stirred in a small quantity of water, and the mixture thus formed was added to 12½ gallons of water. Four sprayings were given—two before the trees blossomed and two afterwards, and the result was:—first quality fruit, 16·34 per cent.; second quality, 77·43; third quality, 6·23 = 100. Unsprayed—first quality fruits, 0·36 per cent.; second quality, 68·98; third quality, 30·66 = 100.
This is very important, and shows that treatment previous to the opening of the flowers had excellent results. Mr. Hatch, on whose fruit farm the experiments were conducted, states that “there would have been no harm to the foliage if used several times as strong, nor indeed is it likely to prove injurious in any degree.”

Mr. B. T. Galloway, chief of the Division of Vegetable Pathology, United States Department of Agriculture, in a recently-issued bulletin, gives the following formulas for the preparation of fungicides:—“Ammoniacal solution of carbonate of copper (a).—In an ordinary water-pail dissolve 5 ounces of carbonate of copper in 3 pints of aqua ammonia, having a strength of 26°. If 3 pints of ammonia are not sufficient to completely dissolve the copper, add enough to bring about this result. When completely dissolved pour the solution into a barrel and fill the latter with [50 gallons of] water.

“Ammoniacal solution of carbonate of copper (b).—Mix thoroughly 6 ounces of pulverised carbonate of ammonia and 1 ounce of carbonate of copper. Keep in an airtight vessel, and when ready for use dissolve in 10 gallons of water. This preparation is not so expensive as the preceding, and its ease of compounding and portability commend it to amateurs and small growers.”

Mr. Galloway states in “The Canadian Horticulturist,” Vol. XIV., p. 144:—“We first successfully treated this disease three years ago [1887]. Briefly, the treatment we would now recommend is as follows:—When the fruit is about the size of a pea, spray the trees with the solution (a) or (b). A barrel of the solution will cost about thirty-five cents (17½d.), and it will be sufficient to treat fifteen [thirty] large trees once. Make a second spraying 12 or 15 days after the first, and the third two weeks later. If an ordinary season, three sprayings will be sufficient, but if rainy it will be necessary to make one or two more. In applying the solution it is of the highest importance that the leaves and fruit be thoroughly covered, and this is only made possible by using a strong force-pump, provided with a suitable spraying nozzle.

“Eau Celeste, modified formula.—Dissolve 4 pounds of sulphate of copper in 10 to 12 gallons of water. Add three pints of strong ammonia, dilute to 50 gallons, and add 5 pounds of common washing soda.” This solution is for spraying before the leaves appear, though it rarely injures the foliage, and is largely used in northern Ohio as a specific for mildew.

The treatment advised for apple scab may be summarised:—1. In the early spring, before the leaves appear, spray with a simple solution of sulphate of copper, made by
dissolving 1 pound of sulphate of copper in 25 gallons of water, or the "Eau Celeste, modified formula." The object is to destroy any spores that exist on the young shoots and scales of the buds, or lodging in the crevices of the bark. 2. As soon as the petals have fallen, spray with ammoniacal carbonate of copper solution. 3. If the weather should be moist and cool, consequently favourable to the development of the seb fungus, repeat the application of the ammoniacal carbonate of copper solution two or three times during the summer at intervals of a fortnight to three weeks. 4. In the case of trees that in previous years have been infested with seb fungus in their blossoms, spray with Eau Celeste just before the blossoms open, and if the weather be favourable, proceed as in 3; but if the season be cold and wet, spray as soon as the petals have fallen with Eau Celeste, and repeat two or three times at intervals of 12 to 15 days. Ammoniacal carbonate of copper solution is not so beneficial when rains are abundant and frequent during June and July as the Eau Celeste.

In preparing ammoniacal carbonate of copper solutions, Mr. E. S. Goff advises "1 1/2 ounce of precipitated carbonate of copper to 1 quart of ammonia," because, "if more is added it settles to the bottom without dissolving." Professor Saunders, of Ottawa, gives the following recipe for making carbonate of copper:—"Dissolve separately in warm water 1 pound of sulphate of copper and 1 1/2 pound of washing soda; mix the two solutions, when carbonate of copper will be precipitated; then pour off the water."

Mr. Galloway, in Bulletin No. 4, 1891, furnishes the following directions for manufacturing copper carbonate, which may be usefully cited:—"In a tub or barrel dissolve 6 pounds of copper sulphate in hot water. In another suitable vessel dissolve 7 pounds of soda in hot water. When the two solutions are cool, pour the second slowly into the first; then add water until the tub or half-barrel is full. Stir the solution thoroughly and let it stand for 24 hours; then siphon off the clear liquid and add fresh water. Stir again, and again allow the solution to stand 24 hours; siphon off the clear liquid as before; then remove and dry the sediment, which is carbonate of copper. Using the above quantities of copper sulphate and sal soda, there will be formed 3 pounds of copper carbonate."

Bordeaux Mixture:—"Sulphate of copper, 6 pounds; fresh burned or quick lime, 4 pounds; water, 22 gallons. Powdered copper dissolves the most freely. Dissolve the sulphate of copper by placing it in a tub with 3 or 4 gallons of water, stirring this until the water becomes blue. Pour the blue solution into an empty tub; then pour 3 or 4
gallons more of water into the tub containing the sulphate of copper, stirring as before. This process is repeated until all of the sulphate of copper is dissolved, it being found that 8 or 10 gallons of water are necessary for this purpose, providing crystals are used and the water is cold. Powdered sulphate of copper requires much less labour and water to dissolve. Slake the lime in a tub. After slaking, add enough water to make a rather thin whitewash; then pour this slowly into the tub containing the copper solution. Strain the whitewash through a coarse sack, having the latter stretched over the head of the tub. The straining removes all the small pieces of lime, &c., which have a tendency to clog the nozzle. After pouring in all the whitewash, add the remainder of the water, making 22 gallons; then, thoroughly stirred, it is ready for use.

The Bordeaux Mixture represents a $2\frac{3}{4}$ per cent. solution of sulphate of copper, perfectly safe to use as a spray to trees with not unusually hairy leaves and downy tender shoots. Stronger solutions are apt to seriously injure the foliage and disfigure fruit, whilst solutions below 2 per cent. are found of little effect on fungi of the greatest malignity. In all sprayings with sulphate of copper preparations it is safer to commence with a solution a little too weak than too strong, always remembering that fungi are the most easily vanquished when young, and that foliage and fruits are most susceptible to parasitic diseases and to injury by a fungicide or insecticide whilst tender. Doses can be augmented as the growths harden and the fungi are harder to kill, but the essential point is to apply the fungicide at such a strength as destroys the fungus, whatever it may be, without injury to the foliage or fruit. Continental Bordeaux Mixture consists of 6 parts of sulphate of copper, 6 parts of quicklime, and 100 parts of water. That is a 6 per cent. solution of sulphate of copper, and not safe to use, except as a wash, after the fruit is gathered or the foliage mature, for destroying fungoid germs. Solutions, however, may be made of any strength; only observe that the quantity of sulphate of copper used represents the rate per cent. A gallon of water weighs 10 pounds: 10 gallons = 100 pounds; therefore 1 pound of sulphate of copper (with 1 pound of quicklime) dissolved, mixed, and added to 10 gallons of water forms a 1 per cent. solution.

A simple solution of sulphate of copper, 1 pound to 25 gallons of water, is advised only for spraying trees whilst dormant, or in spring before the buds swell, to destroy dormant spores. Ammoniacal carbonate of copper solution is economical, and not likely to injure the foliage. Eau Celeste, modified formula, is best suited to a moist climate and season. Bordeaux Mixture is commended for its never-failing properties of arresting fungoid growths. Treatment with any is advised to commence as soon as the petals
have fallen, or when the leaves are about one-third grown, repeating at intervals of ten or twelve days once or twice, and afterwards at fortnightly or three-weeks intervals until the parasite is subdued. Special attention must be given to early treatment, always bearing in mind that the work is wholly preventive. Waiting until mildew gets hold signifies the spoiling of the crop, success resting with early, earnest workers, and those aiming at keeping the trees in health. Never forget that trees to perfect their current crops must be clean, and that for future ones it is essential that they store up sufficient material to insure vigorous blossom for setting. This is only possible by the presence of healthy foliage.

Mr. Graig, of the Central Experimental Farm Department of Agriculture, Ottawa, Canada, in Bulletin No. 10, under "Treatment of Apple Scab, Grape and Gooseberry Mildew," recommends a trial of the following, as a combined fungicide and insecticide:—"Carbonate of copper, 1 1/2 ounce; ammonia, 1 1/2 pint; Paris green, 1 1/2 ounce; water, 25 gallons."

Mildew.—Trees infested with mildew appear to be thickly dusted over or frosted with a white or greyish-white powder. Every part of the tender growths in bad cases is distorted, curled, swollen, blistered, and sometimes blackened. Flower buds and expanded flowers are often attacked. The latter is so often unnoticed that an illustration will probably lead to close observation of fruit-tree blossoms.

The appearance of an attack of mildew on blossoms and the tenderest terminal leaf shoots is that of a fine white powder, but it is only when the attack is severe that the mischief is noticed by ordinary observers. Yet the fungus grows with virulence upon the stamens and...
styles, preventing the pollen forming in the anthers, and the stigma from attaining such position and formation as to favour pollination. Thus the set of fruit is greatly prejudiced; in fact, the resulting fruit is more or less injured, and in some cases wholly destroyed.

On microscopic examination, fungi of the Oidium species are found to consist of a woven mass of greyish-white mycelia or spawn threads upon one or both surfaces of the petals or leaves, and on shoots, which much resemble a thin stratum of spider’s web, and this spawn is woven over the organs of transpiration (stomata), and the trees are, as it were, suffocated. The mycelium is also furnished with minute suckers which hold on the leaves and other parts, and more or less pierce and injure the cells. This piercing sets up decay. Springing from the spawn threads are numerous necklace-like clubs, and these are much more robust on the softer under surface of the petals, leaves, and tender growths than on the upper surface and harder wood. This club-like growth is the early condition of more highly developed fungi, and distinguished as Oidium, well configured in the illustration.

Each oval body in the figure is a spore, capable, upon germination, of reproducing mildew. The upper spores germinate more quickly than the basal ones. Each bead-like spore is so slightly attached to its neighbour that the least “breath of air” separates them. All are so potent with life that they frequently germinate when standing in club form, others germinate as they float through the air, and the spawn thread may be seen, under a magnifying glass, emerging from the spore ready to invade any fruit tree it may fall upon that affords a suitable nidus.

The various mildews are included under the genus Oidium, but its species are known to be merely a stage of fungi belonging to Erisyphel. Apple Oidium is believed to be an early condition of Erisyphel communis; peach mildew (Oidium leucoconium) of Spherotheca pannosa; whilst vine Oidium (O. Tuckeri) has been traced to Erisyphel communis. Oidium spores, though produced in inconceivable numbers, cannot survive
the winter. How, then, can mildew appear in the following year? Another set of
growths forms on the spawn threads. Each is a slightly flattened sphere, black and
furnished with radiating brown tentacles, with an inconceivably thin outer coat
(wall) formed of cells, surrounding small transparent bladders (asci), each of which
encloses two, four, or eight spores. These are known as "fruits," the outer coat enclosing
them being proof against drought, frost, and water. During winter they remain intact,
but when early summer produces "genial warmth and soft glow of moisture," the outer
coeat of the mildew "fruit" is so acted on that it cracks, and the bladders burst forth, rise
and sail through the air, but soon split open and scatter the spores. These falling on the
blossoms or tender growths of fruit trees, germinate at once, weave a web of mycelium,
and cause the immediate production of mildew, or Oidium in the club form.

With a knowledge of the habits of mildew a clue to possible prevention or cure
becomes tangible, but without such information attempts to ward off the disease are
empirical. Various conditions of tree growth favour fungoid development, and these
are produced by certain climatic and cultural agencies. Rain following a dry period
cleanses mildew-afflicted fruits, leaves, and shoots simply through washing off the spores,
and mildew is rarely seen on well-syringed peach and other fruit trees grown under
glass. Ventilating fruit-houses in spring and early summer by opening only the upper
sashes in spells of cold, dry, "sharp" weather, or admitting air by the front or side
ventilators whilst keeping the top lights closed on account of unfavouring wind direction,
insures immunity from mildew simply because the rush of air is outwards and drives
away its spores. Thus the late Mr. Thos. Rivers, by the fixed roof system of his orchard
houses and practice of ventilating only on the calm side in cold, dry weather, excluded
Oidium. But when the early day ventilation of fruit-houses is neglected in bright, yet
cold weather, and the bottom as well as the top ventilators are thrown open, the external
air rushes in and with it the Oidium germs. Thus chills are said to produce mildew,
but it is always a question of spores.

Cleanliness and careful culture are the antidotes for mildew. Therefore, all fallen
leaves, as well as the prunings, of mildew-infected trees should be collected and burnt,
the trees washed with a fungicide, and the ground about them pointed over. If under
glass, syringe every part of the house and trees with water at 140° to 160°, thoroughly
cleanse the woodwork with soapy water and brush, whitewash the walls, and wash the
trees with a solution of soft soap, 3 or 4 ounces to a gallon of water, using a brush, taking
care not to injure or dislocate the buds. Clear away the surface soil, apply a suitable
top-dressing, and thoroughly cleanse the floor. Sulphur has long been considered a cure for mildew. It arrests Oidium, but does not prevent the production of its "fruits." Dusting tender growths and fruits with sulphur in advance of an attack of mildew hinders the germination of spores producing it, but when the mildew has spread on tender growths and incipient fruits no amount of sulphuring will prevent grapes rusting and cracking, or peaches and other fruits having shrunken patches. Besides, dusting sulphur on fruit or bunches of grapes necessitates washing before such are sent to table or market.

Sulphur as a fungicide is most potent when combined with another element. Thus sulphide of potassium, $\frac{1}{2}$ ounce to a gallon of water, acts as a preventive and cure. Similar remarks apply to bi-sulphide of calcium. Formula:—flowers of sulphur, 1 pound; quicklime, 1 pound. Slake the lime in a pan or copper, add the sulphur, and a gallon of water. Incorporate thoroughly, heat, and boil gently for a quarter of an hour, keeping constantly stirred. Allow it to settle, and when cool pour the supernatant liquid into a stone bottle and keep it well corked. For use, mix a pint with 12 gallons of water, or $\frac{1}{4}$ pint to 3 gallons, spraying the trees liable to mildew before any signs of the disease appear, always before the leaves are 2 inches long, continuing the spraying at fortnightly intervals until the foliage is well developed, when there is little to fear from mildew. Evening is the best time to apply the solution. In cases of attack act promptly with 2 or 3 forcible sprayings on alternate evenings. Sulphide of potassium may be applied similarly. All sulphides discoulour paint, but not permanently.

Trees liable to attacks of mildew should be sprayed with the simple solution of sulphate of copper, 1 pound to 25 gallons of water, when or just before the blossom buds commence swelling, and the ground may be dressed at the same time with sulphate of iron (page 48). A keen (aided) eye must be kept on buds bursting into leaf and blossom, and at the first sign of trouble applications should begin, and be repeated at intervals of 12 or 15 days, always avoiding spraying outdoor trees in blossom with copper preparations on account of the bees. Where the blossoms of apple, cherry, pear, plum, and strawberry are subject to mildew, they may be sprayed with carbonate of copper in suspension, just before the flowers expand; and immediately the fruit is set, spray with the carbonate of copper in suspension mixture (page 241), and repeat as found necessary, but the early treatment only should be practised on the cherry and strawberry. Mildewed blossoms cannot set. Simple, inexpensive means, promptly applied, often insure valuable crops of fruit. A solution of soft
soap, 8 ounces; flowers of sulphur, 4 ounces; and 5 gallons of water, thoroughly dissolved and mixed, syringed over expanding blossoms affected with Oidium, so far arrests its progress as to insure the development of the staminate and pistillate organs and secure the setting of the fruit. Its efficacy, however, depends on the mixture being applied soon enough, and it has the advantage of destroying aphides. Eau Celeste, applied before the buds expand, also destroys aphides, and chermes.

M. de Breuil says, page 27 of his "Culture of Fruit Trees":—"Soften all the green parts on the weak side of a tree with a solution of sulphate of iron. This solution, in a proportion of 24 grains to a pint of water, applied after sunset, is absorbed by the leaves, and powerfully stimulates their action in drawing up sap from the roots." Thus sulphate of iron invigorates enfeebled trees. Again, on page 38 (having regard to the above fact), he says:—"The thought occurred to apply the solution to the fruits, and the effect in increasing the size was extraordinary. Apply it only when the fruit is cool; repeat the operation three times, namely, when the fruits have attained the fourth part of their development, when they are a little larger, and again when they are three-parts grown. The solution excites their powers of absorption, and they draw to themselves a large quantity of sap, which would otherwise flow to the leaves, and they become larger fruit."

This increase in the growth of foliage and fruit, resulting from applications of sulphate of iron, suggests the fungicidal value of this and other sulphates. Elements tending to heal, renew, and increase the growth of impaired tissues render them less vulnerable to fungoid attacks. Such are Bordeaux Mixture, ammoniacal carbonate of copper solution, and sulphate of iron solution. Bordeaux Mixture contains: copper—fungi poison; lime—which preserves injured tissues from putrescence; and sulphur—"food for the protoplasm of vegetable cells" (Griffiths). Sulphate of iron is readily soluble in water. M. Muntz says it "increases the chlorophyll 9.6 per cent." M. de Breuil's solution of sulphate of iron at the rate of 1 pound to 36 gallons of water, is quite safe after the foliage and fruits are a quarter grown, but $\frac{1}{3}$ ounce to a gallon, or 1 pound to 48 gallons of water, is as strong as it is safe to use on smooth, tender foliage, and $\frac{1}{4}$ ounce to a gallon, or 1 pound to 64 gallons of water on hairy or downy soft growths; but cultivators must exercise judgment in applying solutions of the sulphates of copper and iron, taking the condition of the foliage and fruit at the time of application into consideration.

The chief difficulty thus far has been to find a fungicide strong enough to kill mildew.
without also destroying the foliage of trees; but science has revealed the all-important fact that the spores live through the winter on the young shoots and upon the scales of the buds or in the crevices of the bark, and on or within the soil. It therefore rests with the cultivator to prevent the germination of the spores in early spring before the foliage is developed, and when, consequently, strong solutions of copper can be applied to the tree, and iron to the soil. We thus arrive at a practical method of successfully combating fungoid diseases.

*Lichen and Moss.*—Fruit trees and bushes are often crippled and prematurely aged by an overgrowth of these epiphytes. Their growth may be induced and accelerated by 1, wet ground; 2, low situation or damp, stagnant air; 3, a crowded and neglected state of the trees; 4, declining condition of fruit bushes and trees. Prompt steps must be taken to rectify all those evils when they exist. Wet land should be properly drained, low sites abandoned, or damp, stagnant air (caused by a close surrounding of forest trees) dispelled by opening out, crowding remedied by judicious thinning, whilst declining trees should be well nourished, and, if advisable, rejuvenated by re-grafting with freer-growing, more profitable varieties. It is, however, not uncommon to see fruit trees infested with lichen and moss in the driest situations, both as regards soil and atmosphere, also on trees planted in elevated and exposed sites, on young as well as aged trees, and on those that are robust as well as on those stunted and apparently dragging on a wretched existence. Some other cause must therefore exist. It is found in the spores of the lichen or moss.

In lichens each spore case (asci) contains four, eight, twelve, or sixteen spores, which divide into two, but generally remain coherent. Lichens are cellular plants, growing (in this case) on the bark of trees, to which they cling by their lower surface, often with great tenacity, while by the upper they draw their nourishment directly from the air. "Lichens are not parasitic, but where they clothe trees they impede the circulation of air, and hasten decay. They further intercept light when enveloping young shoots, and interfere with the development of cambium and the evolution of the foliage" (Hooker). Mosses are small plants, with very delicate, tufted roots, and a simple or branched stem, leaves small, commonly narrow, and awl-shaped. The capsule (seed vessel) usually opens by a lid, and the powdery particles filling the capsule are spores. Mosses are not parasitic, but are injurious to fruit trees by covering the bark.

Lichens and mosses, separately or combined, harbour insects or their larvae, foster fungi, enfeeble the trees on which they grow, occasion ill-health, unfruitfulness, and
death of the branches. All dead branches and badly infested parts should be removed. Thinning the trees when crowded, and the heads of individual trees so as to admit sun to the soil and light and air to the interior, is a great check to lichen and moss growth. The stems and larger branches should be scraped, using a piece of strong hoop iron, or an implement as shown (Fig. 70); this, with a long handle, is well adapted for cleansing lichen, moss, and rough bark from old trees. Washing trees whilst dormant with a hard scrubbing-brush, dipped in a brine of common salt strong enough to stand an egg on end but not float it, as often as necessary, to insure each portion of the bark being moistened with it, destroys insects, lichen and moss. If the remaining parts of the tree are sprayed with the brine, the effect is beneficial. Or, when the branches are quite wet and there is little or no wind, as during a fog or just afterwards, freshly-slaked lime should be thrown plentifully through the trees, and by means of a ladder it may be scattered over the upper branches, distant parts being coated by attaching a coarse bag to a pole. The lime will adhere firmly, leaving the trees quite white. It cleanses the stems, and the lime that falls to the ground is there beneficial. Trees may also be kept free of lichen and moss, and fungoid germs destroyed, by spraying them whilst dormant with sulphate of copper, 1 pound to 25 gallons of water.

Mr. Leonard Coates, Napa, California, U.S.A., writing in the Journal of Horticulture, Vol. XVIII., Third Series, p. 513, states:—"It is customary to spray our orchards thoroughly in the winter with a strong caustic solution as follows:—½ pound of caustic soda (Greenbank's 98 per cent.), ½ pound of crude commercial potash, 5 gallons of water, to be applied hot (say at 130°), using a force-pump with brass cylinder and a spray nozzle attachment. . . . For peaches and apricots this formula should be altered to read 8 gallons of water. Pears, apples, and plums will stand the full strength. This wash will kill the eggs of almost any insect, and leaves the bark in a smooth healthy condition." This solution has proved very effectual wherever it has been applied.

Mr. S. T. Wright, Glewston Court Gardens, Ross, Herefordshire, states in a letter before us, March 17th, 1891:—"I have done nearly all our trees (all except a few old cider trees) with it, and it makes good work, cleansing the trees, and making the bark look very clean and bright." Under date of May 9th, 1891, the same able
gardener states:—"The caustic soda and potash applied to trees is excellent. All mossy growth falls off, and the trees look as if polished. I sent the recipe to Mr. E. Molyneux, and he is also pleased with the results."

Fig. 71. INFESTED WOOD—LICHEN AND MOSS.  
Fig. 72. CLEAN WOOD.

An infested branch is shown in Fig. 71; a cleansed branch in Fig. 72. A glance suffices for comprehending how impossible it is for the former to bear good fruit, and for showing how full of promise is the latter with its bold, clean buds.

ENEMIES.

Insects.—These possess special interest to fruit growers. The least observant persons are attracted by their many forms, modes of life, and powers of destruction.

Insects injure trees in various ways. Some eat the flowers, others the leaves, shoots, and fruits respectively: others, again, suck out their juices. Larvae, as a rule, are most hurtful, feeding voraciously on the parts they attack. Beetles and weevils do much injury, but the puncturing and sucking tribes are quite as destructive. No attempt will be made to classify these creatures, but details will be given of the species injurious to fruit trees, with special methods of prevention and extirpation. A few of the most generally destructive only will be treated here, particular species infesting the different fruits having attention under their headings.
Essential methods to prevent attacks by insects must depend on their mode of life. No means surpass the destruction of the mature insect before laying its eggs, and no natural agents effect this so satisfactorily as do birds, whilst certain parasitic insects reduce the numbers of the pests. These will be referred to; yet, though useful, the fruit grower must not trust to natural agencies, but take prompt steps to prevent infestation, and destroy parasites inimical to fruit crops. Means to suit special cases may be needed, yet some are applicable for the destruction of several kinds.

*American Blight or Woolly Aphis* (Schizoneura (Eriosoma) lanigera).—The woolly aphis is an almost universal pest of the apple. It first appeared in England in 1787, and on the supposition that it was introduced from America received the opprobrious title—American Blight. Though common in gardens and plentiful in orchards, infections are somewhat local, due to first introductions escaping observation, or repressive steps not being taken until the pest gets thoroughly established and the trees well-nigh ruined.

The aphis (so called) possess six legs, a head with two horns (antennæ), and a sucking tube (rostrum). The males have two pairs of transparent wings, and appear in July and August. The egg-producing female also has wings, and its colour is yellow, tinged with red. In their early condition the aphis are pinkish brown (becoming darker with age) and slightly clothed in down; but when adult the insects exude cottony threads from their pores.

These lice differ from the true aphis in the honey-tubes (cornicles) being absent, therefore not secreting "honeydew," but the wool exuded sufficiently indicates their presence, whilst sheltering the young from rain and cold. In these masses of white woolly matter the wingless larvae pass the winter, no frost appearing to injuriously affect them.

The woolly aphis aptly resorts to places where branches and shoots have been
removed, taking advantage of wounds and abrasions in the bark, there gaining access to
the soft tissues of the trees, and the result of the many punctures is a swollen, distorted
growth of the bark, having a knobbled appearance, similar to, yet easily distinguished
from canker. When no vantage offers, the pest fixes on a tender part, seeming to best
relish trees with downy shoots and fleshy bark, and, by piercing the sap vessels and
sucking the juice, causes wounds, which increase in size with the increase of
insects, until a tree afflicted with American blight presents an unsightly, gnarled,
useless aspect. The aphis attacks the roots as well as the branches, producing
gall-like protuberances on the rootlets, and excrescences of considerable size on
the larger roots. Thus woolly aphis destroys the tissues of the apple and not
unfrequently imperils the lives of the trees. A badly-infested tree is repre-
sented in the engraving, which will enable growers to readily recognise the
pest should it affect their trees in twig, branch, stem, or root.

Prevention is the great point. It
may not be practicable to prevent
American blight entering a garden or
orchard, because a tree in some neglected
spot may be infested, and the long
detached fragments of cottony matter,
hanging by slender threads and laden
with eggs or embryonic insects, may be wafted into the most cleanly and orderly fruit
plantation. Clean trees and careful pruning, the removal of dead boughs, rough bark
and other accumulations, are useful, inasmuch as harbouage favours infection, but the
most important point of all is to keep careful watch for the first sign of white wool,
and then treat with one or other of the following applications.

Petroleum.—A simple, safe, and certain remedy. Procure a half-worn painter's sash
brush, cleanse it of paint, and when dry, dip it in petroleum so as just to moisten the
bristles with the oil. Brush out each infested tuft or patch, taking care that the oil

Fig. 74. Woolly Aphis on Apple Tree.
Showing swellings occasioned on different parts of the branches, stem, and roots; the white cottony matter showing as a film, clearly indicating the crannies haunted.
does not run or touch the leaves and young wood. Pursue this through the season, and the trees will be freed of woolly aphis.

_Spirits of Wine._—Apply with a small soft brush to every speck of American blight, whether on leaf or tender shoot, or wherever situated, and "touch up" other infections as they appear. One season suffices to exterminate the pest, contingent on all the affected parts being dressed with alcohol. Methylated spirit may be used, provided it is free from spirit of tar, which injures the bark and tender growths.

These remedies are of little avail on large orchard trees through difficulty of application. The latter, however, may be reached by a stream of water through the nozzle at the end of a hose pipe when there is sufficient pressure in the main, or a powerful garden engine would deliver a stream of water with sufficient force to drive the woolly aphis from the worst infested places on the branches and stems. This repeated a few times greatly reduces the pests and benefits the trees. To effect a cure, follow, after two or three good washings of clear cold water, with a petroleum emulsion made after this formula:—Dissolve 1 pound of soft soap in 2 gallons of boiling water; remove from the fire, and add ½ gallon of kerosene (petroleum) while hot. Churn the mixture with a force-pump for five minutes, add 80 gallons of water, in which 7 pounds of soft soap have been dissolved by boiling, for use. Spray the foliage and syringe the branches and stems. The mixture must be kept well agitated by one person whilst another applies it with a syringe or engine to the trees. Repeat as necessary, but only upon the reappearance of the enemy. This work is best done in the evening.

Much good may be done by washing the infested trees, directly the leaves have fallen, with a solution of soft soap, 4 ounces to a gallon of water. It should be applied with a brush to all parts of the tree, thoroughly reaching into the places sheltering the insects. Strong soapsuds that contain only the usual hard (soda) soap and a small proportion of washing (refined) soda are as efficacious as a soft (potash) soap solution, and cost nothing. Soapy solutions should be used at a temperature of 90° to 100°.

If the roots are attacked, remove the soil from them and wash the affected parts with the soapy solution. Removing the old soil and supplying fresh is an advantage, but saturating the old soil with ammoniacal liquor from the gas-works, diluted with five times its bulk of water, destroys the pests and enriches the soil. Where "gas water" cannot be had, a thorough soaking with soapsuds as far as the roots extend, and repeated a few times during the winter, has a beneficial effect.

_Ants_ (Formica).—These profit by the sweet limpid fluid ejected by aphides, which is
found on the leaves and other parts of trees infested. They are the most partial to the green aphis, and with a few strokes of their antennæ "tap" the insects, till they yield small clear drops of "honeydew." Ants take care of aphies, fight for their possession, and carry their eggs to their nests for hatching. Truly they are wise in their own interest. They remove aphies from depastured trees to fresh feeding ground, seeking only their own profit. Cultivators may, therefore, banish the idea that ants devour aphies. They are simply scavengers, subsisting on insect secretions. They enjoy sweet fluids. Apples and pears do not escape their attention, whilst they delight in ripe cherries, apricots, nectarines, peaches, and plums. Thus ants are antagonistic to the interests of cultivators. They encourage the fruit grower's enemies, eat or spoil his best fruits, and damage, if not destroy, the prospect of crops by preying on the organs of fructification in blossoms, sometimes denuding peach and other flowers of fruit trees of their stamens, and thus doing irreparable injury.

Black ants are troublesome pests in fruit houses. They get into woodwork and eat it away, and make their abode in any snug place. From the dawn of spring or the commencement of forcing, they swarm upon leaves, shoots, and branches, and carry gum parasites about that may in due course be injurious. The Brown Ant (Formica fusca) infests fruit houses, but keeps away from borders liberally supplied with liquid manure. Brown ants hold the "blacks" as slaves; they cannot live together on equal terms: therefore, structures are seldom infested with both pests; but the brown ants travel long distances to feast on ripe apricots, nectarines, peaches, and plums. The Yellow Ant (Formica flava) infests orchards more than gardens. Partridges delight in the larvae or pupae of ants. Other birds prey on ants, but nothing short of annihilation should content the fruit grower.

Preventives are usually applied too late. A line of coal tar drawn along the base of a wall just below the branches prevents the ascent of ants so long as it remains moist; a mixture of two-thirds resin and one-third sweet oil melted, keeps moist much longer and neither ants nor snails can pass over it. Ants, however, often come from the top of the wall downwards, and therefore the sticky barrier should be placed along the top also. Traps of partially-picked bones laid in the haunts of the ants are quickly covered with them, and can be thrown into boiling water. A sponge partially saturated with treacle has the same effect in attracting them. A garden pot smeared with honey or treacle inside, and inverted over the nest, is soon covered with ants; if held over the steam from boiling water they will soon be rendered harmless. Guano, when fresh, sprinkled on
and around their nests drives ants away. A broad thick chalk line around the stems of trees prevents their passage. Petroleum sprinkled over their nests kills or drives away ants. Ammoniacal liquor diluted with six times its bulk of water is also effectual, as is a decoction of quassia chips, 4 ounces, being boiled a quarter of an hour in a gallon of water, and 4 ounces of soft soap added as the decoction cools. A strong decoction of dwarf elder (Sambucus ebulus) leaves poured on the nest at night destroys it; and a piece of camphor the size of the thumb end to the first joint, dissolved in \( \frac{1}{2} \) gallon of hot water, poured over the nest, or applied to trees in pots infested with ants, is effectual.

In spring, ants are best disposed of by mercurous chloride:—calomel, 1 part; finely-powdered loaf sugar, 11 parts; mix these together, lay them in little heaps in their haunts; the ants eat the compound and perish. This is the least objectionable of drastic measures, but the following must be used with very great care, never entrusting the poison to any but most cautious persons. Arsenic trioxide (common or white arsenic), 1 ounce; boil in an iron pot with a quart of water until reduced to half, then add \( \frac{1}{2} \) pound of brown sugar, stirring well. Drop on pieces of slate, or place in saucers, and set these about the nests, and the sweet-toothed marauders will have their last meal.

**Aphides.**—These insects are noted for their destructive effects upon vegetation. They live on the juices of plants and trees, impair their vitality, and injure, if not spoil, the crops of fruit. The pests cause the leaves to curl, and the tender growths become stunted and distorted. The injury inflicted is, of course, proportionate to their number and the time they are allowed to infest the trees.

Aphides possess short oval bodies, six legs, and a pair of antennæ. When wings are developed, the front pair are membranous throughout their entire extent. The insects have glandular structures which secrete a sweet viscid fluid (see "Ants"). These secretions blacken the bark, close the pores, causing the parts coated to become sickly and exhale a disagreeable smell. The colour of aphides varies with different species. Apple and pear aphides, *Aphis mali* or *pyrimali*, are grass green, but the colour changes with different broods. The first are dark slaty grey, mottled with green; later generations are green, dirty yellow, or rusty, their tints evidently being affected by the juices of the trees upon which they feed. Some species, however, are decided in colour, notably that selected for illustration.

Black Fly (*Aphis cerasi*) is a very dark brown or shining black. It infests the under side of the leaves, points of the shoots, young growths, and trusses of fruit of the cherry, as represented in the engraving on next page.
Brown Fly (Aphis persicæ) is first a pale brown, changing to a deeper and glossier hue, sometimes almost black, and confines its attacks to the peach and nectarine, infesting the leaves, points of the shoots, and young wood. It also attacks the leafless young growths, and the flower-buds and blossoms.

Blue Fly (Aphis pruni) is a light green colour, with a bluish metallic lustre, and surrounds itself with a sort of white meal, which renders its destruction more difficult. Plum, damson, and many other trees and plants are subject to its attacks.

All the aphides survive the winter under favouring climatic conditions, viviparous females existing on the young wood of the trees when grown under glass. Eggs are deposited in the autumn, generally at the base of buds, where they lie throughout the winter. In the following spring all the eggs produce females only, viviparous, this process continuing through several generations. Davau traced the reproduction through eleven, and Kyber over a period of four years. On the approach of autumn, winged males make their appearance, and fertile eggs are produced. These are buried in the crevices of the bark, a spur or the indents about a bud being favourite places. The
hatching appears to be solely influenced by weather after a certain period, and full grown "lice" may often be found infesting the unfolding buds. The fecundity of aphides is very great; their increase is astounding. One aphis, according to Reaumur, may give origin to 5,904,900,000 forms in five generations by the viviparous mode of reproduction, and in a single year twenty generations may possibly be produced.

Salt has long been known as a preserver of eggs whilst destructive of their "basis of life." Spraying trees whilst dormant with a strong brine of common salt, and brushing the stems as advised for lichen and moss (page 251), destroys the vitality of aphis eggs, and has a beneficial effect upon the trees. Salt, however, dries and crystallises, and in a dry winter is not so effectual as the caustic soda and potash solution, named at page 251, for spraying trees to destroy lichen and moss as well as insects or their eggs. This we advise for all fruit trees that have been infested with aphides—namely, spray them in winter before the buds commence swelling, with the caustic soda and potash solution.

Tobacco is one of the oldest and best remedies for aphis. Fumigation with good tobacco paper or rag destroys all aphides infesting fruit trees grown under glass (see "Fumigation"). Tobacco powder causes no smell, and if dusted over aphides effects their destruction. If first attacks are met with a dredging of the powder, large trees may be saved from complete infestation, and small trees, whether under glass or outdoors, can be readily freed of aphides by its early and persistent use. It is best applied in the evening, syringing off the following morning. Tobacco water, made by pouring 3 gallons of boiling water on 1 pound of the strongest tobacco, is, when strained and cool, very effective used as a spray. If for syringing (a wasteful process), dilute to 6 gallons. Apply in either case in the evening and syringe with clear water the following morning. Infested shoots or wood of cherries, and peaches or nectarines, should be dipped in the tobacco water, and whilst immersed be rubbed with the fingers. This unseats the black or brown aphis on the points of the shoots or under side of the leaves, and they are then effectively assailed. A good syringing the following evening with soapsuds thoroughly frees the trees of aphides. The tobacco juice of manufacturers is efficacious and cheaper than tobacco decoction. It may be diluted with six times its bulk of water for spraying purposes, and proportionately more for syringing, but the strength varies considerably, so that no definite proportions can be given. Tobacco water need not, as a rule, be so strong for trees under glass as for those outdoors, because the narcotic vapour rises; hence, spraying extra
strong tobacco juice on surfaces other than the trees is found to prevent aphis attacks. If a solution of soft soap—made by dissolving 2 ounces of the soap in a gallon of boiling water—is added to each gallon of the tobacco water, this destroys black, brown, and blue aphis, by adhering to their bodies, whilst it acts as a preventive of red spider, thrips, and other insects that attack fruit trees, but should not be used on vines.

Quassia chips 1 pound, boiling water 3 gallons, let stand 24 hours, strained, and, sprayed on aphis-infested trees is a preventive and curative. Or the quassia chips, 1 pound, may be boiled a quarter of an hour in 4 gallons of water, straining, and adding, while hot, ½ pound of soft soap, dissolving thoroughly. This should be used at 90° to 100°; it is a safe and good insecticide. For cherry, peach, and plum aphis, increase the soft soap to 4 ounces per gallon, spraying twice or thrice, for the insects are made uncomfortable by the first, reached by the second, and destroyed by the third spraying.

The following day the trees should be syringed with clear water.

Pyrethrum, when fresh, is considered especially valuable if sprinkled on infested leaves, and 1 ounce of the “Buhach” powder, added to 2 gallons of cold water, and sprayed on infested trees, is admitted in America to be the best insecticide, as it involves no danger if eaten. The powdered flowers of the pyrethrum, it is said, “easily subdued flies by closing up the house tightly and slowly burning in it a spoonful of the powder.” Its use in this country has not passed beyond the experimental stage, and the chief difficulty seems to be in procuring the article fresh, otherwise it would be valuable for cleansing trees of insect pests, especially fruit, which must immediately be used as food.

For use as powder the following mixture has shown good results. While slaking 1 peck of fresh lime, add 1 quart of petroleum; sift out lumps. Apply lightly. This would possibly be more efficacious for dusting bush fruit trees than lime alone, which, however, is very useful for gooseberry and currant bushes infested with insects. In fact, these bushes may be kept free from red spider and aphides by forcible syringings with clear lime-water. It may be made by mixing at the rate of 1 pound of quicklime to 3 gallons of water, stirring well together, and letting stand 24 hours; then pour off the water, leaving the sediment.

As a general wash for trees and bushes infested with aphides and all sucking insects, the following, by Mr. Leonard Coates, Napa, California, U.S.A., has proved very efficient. Formula:—“14 pounds of whale oil soap [soft soap], 1 pound of caustic soda, 1½ pound of [flowers of] sulphur, 55 gallons of water. Dissolve the caustic soda.
in 1 gallon of water, in which boil the sulphur until dissolved [15 minutes]. Then dissolve the soft soap in the water intended for the wash, after which pour into this the dissolved soda and sulphur, mixing the two together, and boil for a short time. Use this as a spray with an ordinary spray pump while hot [90° to 100°]. This wash we apply early in the summer, and it acts as a preventive against the perfect insect laying its eggs, or it destroys any that may be hatched out, having escaped the winter spray (page 259), and destroys any fungoid disease. It will not injure the foliage or young fruit."

This is a very valuable combined fungicide and insecticide. In ordinary seasons it is all that is necessary to destroy mildew, apple-seab fungus, aphides, and red spider. The soft soap contained in the wash may prejudicially affect apple foliage, and a 2-ounce solution of soft soap to a gallon of water is sufficiently strong. With 7 pounds of soft soap instead of 14 pounds the wash effectively eradicates aphides and red spider. Growers in America have to contend with many scale insects; besides, the foliage there is harder than in this country.

Resin compounds make speedy work on aphides, and are sure against young scale. Formula:—Caustic soda, $\frac{1}{4}$ pound; resin, 4 pounds. Dissolve the caustic soda in $\frac{1}{2}$ gallon of boiling water, add the resin slowly, and boil until dissolved, stirring rapidly, and then add 2½ gallons of water, mixing well. Strain through a thin cloth, while hot. Use 1 quart of the compound to 3 gallons of water at a temperature of 100°, and spray upwards so as to reach the under side of the leaves. This will destroy the green aphid, but it is sometimes needful to use the wash stronger for black fly; yet it is necessary to ascertain the strength that can be borne by the leafage of the trees before applying the wash wholesale.

Petroleum mixtures are very effective against aphides, but, unless care is exercised in preparation and application, may be injurious to young bark. The following is generally safe: soft soap, 1 pound; petroleum, $\frac{1}{2}$ pint; water, 10 gallons. Dissolve the soft soap in a gallon of boiling water, add the petroleum, and, with a force-pump, drive the liquid back into the vessel holding it for two or three minutes; then add the remainder of the hot water, continuing the pumping as before, whilst it is being added rather slowly. Use as a spray as hot as the hand can be borne in it for ten seconds, and always towards evening. It is the action of hot sun on the wet leaves that causes scorching. Petroleum mixtures are safest applied with a pump having two deliveries, one keeping the liquid agitated whilst spraying is effected by the other.
Much can be effected in clearing aphis off trees or bushes by removing the tops of the infested shoots and burning them, afterwards washing the trees or bushes with soap-suds, which are not mixed with bleaching powder or an excess of soda, washing off the following day with clear water. Dusting infested trees or bushes with soot or dry wood ashes whilst they are wet, and syringing off next day, cleanses them from insects and manures the ground.

*Beetles and Woodlice.*—These are placed together because they hide in much the same places by day and emerge at night to commit their depredations on fruit. Some beetles have a sweet tooth, and woodlice make holes in fruit. Woodlice are common in dark places, as under dead leaves and stones, also in holes in walls and trees. Three species of Oniscidæ, popularly known as woodlice, or slaters, do harm, namely, the Spotted (*Oniscus asellus*), leaden colour, with yellowish spots in two rows near the sides and others dotted on the back; Slater (*Porcellio scaber*), slaty-blue, with spots and tubercles on the back; and Pill Millipede (*Armadillo vulgaris*), lead-coloured and rolling itself up when disturbed.

Preventives are dispensing with rubbish, stopping up holes in walls, keeping the stems of trees clean, and placing sticky bands around stems or drawing a line along the base of walls. Traps may be formed of slates. Place one on the ground, sprinkle a little oatmeal on it and a few leaves; then the other slate with a stone at each corner so as to form a space between the slates of about \( \frac{1}{4} \) inch. Examine early every morning, and turn up the bottom slate for blackbeetles. Two pieces of dry, dirty old boards, placed face to face with a little space between them, are favourite hiding places of woodlice, and thousands have been caught and destroyed by taking up the boards and shaking the contents in a pail of water. Or place pieces of boiled potato in small pots, fill nearly full of moss, but lightly, and place in the forks of the trees, or lay on their sides along the base of walls. Examine every morning, and shake out into hot water. Either of the baits used in time will keep fruit safe. Hollow stems, slices of vegetables or fruit, placed in the haunts of beetles and woodlice, entice numbers, especially if lightly covered with moss, as they abhor daylight. A sprinkling of boiled potato or scalded oatmeal around the walls of melon houses or pits, also pine beds, covered with a little moss, and boiling water poured over it in the morning, soon clear away bad infections.

*Borers.*—A number of grubs—the larvae of moths and some beetles—burrow in the shoots, branches, and stems of fruit trees. Some confine their attacks to the shoots,
causing them to wither. Others bore into young branches, and by their galleries cut off the supplies of sap, whole branches occasionally collapsing when laden with fruit. Not a few infest the stems and limbs, tunnelling those through to the "heart," often hollowing out the centre, or causing it to decay by admitting fungi; but a majority of boring beetles use only the alburnous parts, which, being full of sap, afford the best nourishment for their brood. The channels become coated with a glutinous substance, which forms a nidus for fungus, and food for the boring-beetle grubs. Caterpillars—the larvae of a moth—subsist upon the substance, and their castings are ejected through the

mouth of the burrow. The different borers will be treated under the respective fruits, but an example will be elucidatory of the damage inflicted on fruit trees by borers generally.

The Common Borer (Xyleborus dispar) affects chiefly apples, pears, and plums, but it attacks apricots, cherries, nectarines, and peaches against walls and under glass, also vines and fig-trees. A nearly allied species (Scolytus pruni) occasionally proves hurt-
ful to fruit trees on the Continent; and in America a close resembling species, the Sun-
scald Beetle (Xyleborus xylographus), commits so much havoc that when a tree is
seriously attacked it is best to uproot it. The "Shot-borer" Beetle (Xyleborus pyri), or
pear-blight of the American growers, seems identical with the species first named, if,
indeed, the whole of the species mentioned are not synonymous. The term "shot-borer"
may popularly be applied to all the bark-beetles, but we believe it is chiefly used in
America to distinguish Xyleborus pyri or xylographus (the head resembling a small
shot) from the "flat-headed" apple-borer (Chrysobothris femorata).

The male beetle is \(\frac{3}{4}\)-inch long, and the female \(\frac{1}{2}\)-inch, colour dark brown, nearly black,
head round, not narrow as is general in Scolytidæ, lengthening into a snout-like beak;
body cylindrical, slightly humped, with six legs, each four jointed; the antennæ
are clubbed. The beetles, after pairing, burrow through the bark horizontally to the
pith, or to the opposite side of the stem or branch, and from these the breeding galleries
are taken almost vertically up and down the stem. At the entrance to the tunnels, or
along their sides, the female lays a number of minute oval-shaped white eggs, and the
larvae, on hatching from the eggs in May or June, feed on the substance before alluded
to, and as they grow increase the size of the burrows. When full fed they become
pupeæ, and from these emerge as beetles, the tunnels being crammed with them in the
late summer and autumn.

Fortunately "borers" seldom appear in quite healthy trees, but usually attack those
which are weakened by unfavourable soil, climate, or cultural treatment. Occasionally,
however, they prove injurious to young fruit trees, but the attacks on these may
generally be accounted for through there being no dying or dead wood in contiguous trees
wherein they can increase. All dead parts should be removed from trees preferably in
late summer and autumn, and be at once burned. When young trees are attacked
they should be dug up and burned. If the bark be taken off in June the pests may
be found in the burrows, the larvae thus exposed dying in a short time, or being speedily
taken by birds. Destruction of infested parts is, however, much the best remedy.

As regards prevention, no plan equals the placing of dead trunks or pieces of wood
in new plantations as traps, especially in land cleared of scrub, hedgerows, or where
trees recently existed. The traps may consist of beech or oak, both notorious fungi
breeders, and much relished by Xyleborus. Branches of plum, another remarkable fungi
producer, of about \(\frac{3}{4}\) to 1 inch diameter, may be cut into lengths of 2 feet and stuck in
the ground, but larger pieces need only be laid on the ground. These should be
examined every month through the summer, and when any are perforated, remove the logs and burn them. Old wood of any kind must not be placed in heaps, and remain unexamined in or near gardens and orchards.

For preventing the attacks of borers, nothing surpasses a wash formed of soft soap, 1 pound; flowers of sulphur, 1 pound; snuff, 1 pound; clay, finely pulverised, 1 pound. Dissolve the soap in a gallon of boiling water, add the sulphur, mixing well, then the snuff, and last the clay, using water as necessary to bring the mixture into the consistence of paint. Apply with a brush to the stems not later than May, also to branches liable to attacks, coating the surfaces well and evenly. Another mixture, which we have never known fail, is composed of:—soft soap, 1 pound; flowers of sulphur, 1 pound; quicklime, 1 pound; tobacco juice, 1 gallon. Dissolve the soft soap in a gallon of boiling water, add the sulphur, slake the lime, pour the tobacco juice to the soap and sulphur, work all well together, apply with a brush thoroughly, and the enemy may be vanquished.

Cockroaches and Crickets.—Both devour foliage and eat nectarines, peaches and other fruits. The Cockroach (Blatta orientalis) was originally brought from Asia to Europe. It makes its abode in the cavities near pipes. It is a pest in fruit-houses and fruit-rooms, and the only wholesale remedy is poison. Bait with Indian-corn meal moistened with treacle, then add one-third of red lead to the paste thus formed. Repeat this, and the cockroaches will soon cease coming. The Domestic Cricket (Gryllus (Acheta) domesticus) does little harm to the out-door fruit grower, yet has been known to devour vine-leaves under glass. Phosphor paste spread on slices of bread, or mixed with honey, effects their destruction, also that of cockroaches. The Field Cricket (Gryllus (Acheta) campestris) does little harm in orchards. If a straw is pushed in its hole, it generally seizes and holds it, and may be drawn out; but the Mole Cricket (Gryllotalpa vulgaris) cuts off roots in digging its burrows. It is only found in the south of England. Pieces of raw meat placed near their burrows attract them. They are seldom found in stiff clay soil; as they throw up hillocks like moles, their presence is easily discovered; and the surest method of extirpation is digging out the nest in June or July so as to destroy the eggs.

Codlin Moth (Carpocapsa pomonella).—This is one of the most injurious insects to apples and pears. The grubs (larvae) feed chiefly on the pulpy parts of the apple and pear till nearly full size, then on the pips, and the fruit soon afterwards falls. Quitting the fallen fruit by the hole gnawed by the grub, it wanders about on the ground, till,
finding a tree, it climbs up, shelters in a crack or projecting portion of the bark, spins a cocoon, and after a few weeks becomes a chrysalis. In that state it remains over the winter, and the moth emerges the following season. The moth itself is a beautiful creature, three-quarters of an inch in expanse, forewings ashy brown, with dark streaks uniting into a broadish band towards the base. On the hinder border of the forewings is a large reddish-brown patch, spotted and surrounded with a golden mark. The hind wings are reddish-brown, tinged with yellow. The accompanying engraving represents the moth and its destructive larvae.

Shortly after emerging from the chrysalis the moths pair; the female deposits its eggs in the eyes of the young apples and pears from the end of May to July, one egg in each, and when hatched, the grub gnaws a hole in the crown of the fruit (sometimes on the sides, especially of pears), soon burying itself. The caterpillar is white when hatched, but passes into a dirty or brownish red colour.

Measures for eradicating the codlin moth are rendered somewhat difficult because the enemy cannot be detected within the fruit until the mischief is done, and the moth, from its habit of secreting itself in the crevices of the bark, is not easily caught. Gathering up the worm-eaten apples and pears promptly after falling and opening each before the grub escapes, or giving fallen fruit at once to pigs, greatly reduce the numbers of the enemy. Pigs should be turned into orchards in grass to eat up the fallen fruits where the codlin moth prevails.

The remedies against the moth are banding the trunks of the trees, and spraying the fruit. The bands may be formed of old sacking or hay. Wrap a piece of old sack about 6 inches broad around the tree trunk, fastening it with a piece of twine about the
middle of the band, so that grubs climbing up or down may run under. Remove the
bands regularly once a week, crush all the larvae and replace the bands. Or twist a
rather stout hayband around the stem of each tree about a foot from the ground. In
seeking a suitable place in which to make a cocoon the grubs generally seem to prefer
the sacking. Haybands, when used, must also be examined periodically. Banding
should be done as soon as the worm-eaten fruits begin falling, the bands to remain until
November, then collected and burned. At the same time examine the stems of the trees
and clear them of cocoons; also wash the bark with an alkali solution, forcing it in the
cracks and crevices.

American cultivators regard Paris green as a chief agent in destroying the larvae of
the codlin moth. Mr. Leonard Coates writes from California:—“For the apple worm
or codlin moth, we spray the apple and pear trees, as soon as the fruit has set, with
Paris green (arsenic), 1 pound to 200 gallons of water, the solution to be kept well
stirred while using. The worm as it hatches out will die at once after its first meal at
the poisoned end of the young fruit.”

The spraying must be effected directly the petals have fallen, always before the eye
end of the fruit has turned downwards, for when the stem end of the apple is upwards,
the poison settles in the cavity about the stalk, and has no effect on the grub, which
invariably enters the apple and pear at or near the eye. The Paris green should lodge
in the calyx of the fruit to destroy the grub. One spraying seems to be effective for
early varieties; late apples should be sprayed two or three times, the last time in July.
If the weather be showery, the second spraying may follow in eight or ten days, and
the third at a similar interval, but should the weather prove fine, make the second
spraying twelve to fifteen days after the first, and the third, for late varieties of apples
or pears, about two weeks after the second. For mid-season varieties two sprayings are
usually sufficient, but if wet weather prevail a third may be necessary, so as to keep the
eye end of the fruit coated with the poison. Some pears always hang down, and these
must be sprayed from beneath, though the grub enters some fruits near the stalk. Paris
green must not be employed for apples and pears at greater strength than 1 ounce to
20 gallons of water whilst the foliage is tender.

Earwigs (Forficula auricularia).—Much damage is sustained by fruit growers from
the depredations of earwigs among fruit. They also devour flowers and foliage. Their
attacks are most virulent on ripening apricots, nectarines, and peaches, but they assail
other fruits. The female, after laying her eggs, broods over them, also the young after
hatching. A remarkable fact in relation to the earwig is its great abundance at certain times, and subsequent scarcity. This is accounted for from the circumstance that these insects migrate in considerable flocks, selecting the evening for their excursions. Earwigs prefer dry places to wet, warmth to cold, but they harbour almost anywhere, as beneath bark, stones, cracks in walls, and similar places. Holes should be filled up, the stems of the trees kept smooth and clean, and rubbish removed, so as to destroy eggs and deprive the pests of shelter. There is need for watchfulness, care, and cleanliness in contending with earwigs, especially as they avoid poisoned substances. After their feasts, which are nocturnal, they retire to rest in the morning, comparatively few being seen during the day.

Earwigs are readily trapped, but they must be caught before the fruit is ripe if the choicest specimens are to be saved from destruction. Beanstalks or hollow stems of any kind, cut into lengths of 6 to 8 inches between the joints so as to form a tube, and placed in the forks, or thrust under the branches of the trees so as to make them secure, form excellent traps, and in these the earwigs hide. The traps must be examined every morning, and the earwigs found in them blown out. The operator, having a deep jug half full of hot water, holds one end over the water, applies his mouth to the other, and with a sharp "blow" ejects the pests. They may be enticed with a boiled potato placed in a flower-pot, covered with a little dry moss, and the pots laid on their sides at the foot of the trees on which the fruit is approaching ripeness, also in the forks of the trees. These baits must be examined daily. Shaking the earwigs out into a vessel containing boiling water, or a glazed one narrowing towards the top and partly filled with cold water, secures them.

Millipedes.—These are supposed to feed chiefly on decayed vegetable matter, because found amongst leaves and other refuse; but they prey upon living as well as dead substances, and are positively injurious to roots as well as to strawberry fruit. Their introduction to gardens is generally through the rubbish heap; hence the necessity of strewing such with salt and lime as advised at page 51. The worst pest is the Spotted Millipede (Julus guttatus or pulchellus), which is stated to have one hundred and seventy legs, therefore well capable of migration, and both this and the Earth Millipede (Julus terrestris), with its one hundred and fifty-six legs, easily cross dusty roads. Both species, and others, have a special fondness for beet, and Miss E. A. Ormerod states in her second edition of the "Manual of Injurious Insects and Methods of Prevention," page 150—"Cotton-cake has been found to attract them from the attacked crops, and
the overwhelming fondness of the Pink-spotted Millipede (J. guttatus) for mangolds may be turned to account in attacks on special crops by placing slices of mangolds for traps, which I have seen swarming (when removed) with the millipedes crawling over them in all directions." Baits of beet answer well in strawberry quarters, also pieces of carrot, parsnip, and cut potatoes. Mangolds would, unquestionably, be useful in orchards, with sheep to trample the millipedes to death. Soot at the rate of 40 bushels per acre or 1 peck per rod drives millipedes away, and a mixture of salt and nitrate of soda effects their destruction, applying 3 cwt. of salt and 2 cwt. of nitrate of soda per acre, or 3½ pounds of the mixture per rod in spring. This also acts as a manure to the land.

Red Spider (Tetranychus telarius).—This is a mite, not a spider, and one of the fruit grower's greatest pests. Though so small as to be scarcely visible to the naked eye, it may be found in summer-time, occasionally in myriads, upon the under side of the leaves of fruit trees, and its injurious effects are very great. A severe attack of this minute insect causes the leaves to fall prematurely, prevents the fruit attaining its full size, and the growths and buds formed are so weakened as to imperil the succeeding crop. "Red spider," says Speechly, with truth, "generally reside and breed on the under side of the leaves, and the infested leaves are very distinguishable as soon as they are attacked by them, for the insect wounds the fine capillary vessels with its proboscis, and this causes the upper surface of the leaf to appear full of very small dots or spots of a light colour. When the Acari (mites, or red spiders) are very numerous, they work a fine web over the whole of the under side of the leaf, as also around the edges thereof; and it is curious enough to observe that they commonly carry this web in a straight line from one angle of the leaf to another, on which boundary line, in a warm day, they pass and repass in
very great numbers." Those unacquainted with this pest will be assisted in its detection on infested foliage by the engraving on the preceding page.

The size and colour of the mites differ with age and variety. Outdoor are larger than indoor mites. Of the varieties infesting fruit trees the largest is found on the gooseberry, the smallest on the plum. The colour of the insect is at first very pale, but it soon becomes greyish-green, with brown specks on the sides, rapidly changing to rust-red up to brick-red and vermilion; body oval, without separation of thorax and abdomen, and near the hinder end is a conical wart from which the thread issues for spinning. The larvae (so called) have six legs, adults eight legs, two pairs turned forwards and two pairs backwards. The female lays eggs beneath or attached to the threads of the web by a glutinous secretion, hatching commencing in about eight days. The mites have two minute eyes, and a beak or sucker, by which they bore into and abstract the juices from the leaves, fruit, and shoots. The injury they occasion is often ruinous. Red spiders attack the gooseberry in dry springs as early as April, and continue their depredations throughout the summer on various trees, drought and heat favouring their increase. In autumn the mites seek shelter in the cracks, crevices, and rough portions of the bark of infested trees, also in similar places in stakes, trellises, woodwork, and in the soil beneath clods or stones, where they may be found in ruby-red globules hibernating. Treatment, therefore, is the most effective when applied before hibernation.

Preventives must be such as diminish the risk of attack, and the best possible is cleanly culture. Infested vineries, peacheries, fig and every fruit house should be thoroughly cleansed and the trees washed, as advised for the prevention of mildew, page 247, whilst trees that are infested with red spider must be thoroughly cleansed directly the fruit is gathered. Forcible syringings with water effect their removal, but this is not always desirable, as they find fresh quarters in which to deposit eggs. Destruction is preferable, and the following solution may be used on trees, in or out doors, when the foliage is mature and the fruit gathered.

Soft soap, sulphur, and soda wash:—Soft soap, 15 pounds; dissolve thoroughly by boiling in 30 gallons of water. Caustic soda, 1 1/2 pound; flowers of sulphur, 3 pounds; boil the soda and sulphur in 1 gallon of water until dissolved, keeping stirred, when it is a dark liquid, or sulphide of soda. Mix the soap solution and the sulphide well together, and allow the mixture to boil gently for half an hour. Add 45 gallons of water and the wash is ready for use. Apply warm (90° to 100°) by means of a sprayer, wetting every part of each tree.
The composition must not be used at the strength mentioned on apple foliage early in the season, because stronger solutions of soft soap than 2 ounces to the gallon of water sometimes scorch the tender growths; therefore, dilute to 120 gallons for the apple early in the season, to 100 gallons after the foliage becomes firm, and use at full strength in autumn. Plum and other trees with smooth leaves may be sprayed with it at a strength of 100 gallons whilst tender, and at full strength after the foliage becomes firm.

One of the oldest preventives of red spider and insects generally infesting fruit trees is syringing them well on calm mild evenings with soapsuds strained through a hair-sieve or old sack, taking care not to use the "suds" too strong, making sure that they only contain hard (soda) soap and washing (refined) soda, with the usual water. Trees washed with the soapsuds before the flowers expand, when the fruit is set, and repeated at fortnightly intervals up to the change for ripening, seldom suffer from parasitic infections, and there is no deposit of consequence on the fruits, provided the suds are used warm and the trees are thoroughly washed with clear water. In case of trees in the open washing is not necessary in rainy weather, but trees against walls may need cleansing with water after applying the soapsuds. They have manurial value, while the soda aids the strengthening of the bark.

Water alone is effective against red spider if applied with sufficient force and frequency. Clear rain-water will not leave a deposit, yet this safe and cheap cure must be abandoned immediately the fruit gives indications of ripening, otherwise its beautiful bloom will be lost and cracking may ensue. Red spider attacks are greatly influenced by weather and atmospheric conditions indoors. Drought and heat promote its spread; rains, syringing, and a moist atmosphere having a contrary effect. Deficiency of water and nutriment at the roots invite the attacks of red spider because the leaves are then thin and weak: the stout and strong offer the greatest resistance to this and other enemies. Applications of liquid manure and mulching the surface of the soil are of great service in invigorating growth and preventing much injury by red spider.

Early action in subduing insects is most important. Ruin has often been the result of delay. A keen eye, knowledge, and promptitude are necessary. The first appearance of a brown speck or patch on a vine-leaf should lead to speedy examination, and if red spider be found, wash that speck or patch on the opposite side of the leaf, or where the pests are situated, with a sponge moistened in a solution of soft soap, 2 ounces to the gallon of water, and treat every affected leaf similarly. Five minutes
employed on first infections may save a whole house of black Hamburg grapes from ripening "red." It is the same with fruit trees, namely: promptly exterminate the originators of the mischief, and pursue a course inimical to the insects. If the soil be dry, water and mulch; if the atmosphere be dry, syringe or damp available surfaces, and afford those essentials for promoting growth, such as manurial elements, and ammonia vapour, page 65.

Sulphur used dry on the leaves is no remedy for red spider, but the bisulphide of calcium named at page 248 annihilates the pest. In case of attack whilst grapes and other fruits are ripening, painting the hot-water pipes, heated to 160° or more, with sulphur, is a certain remedy for red spider. Sulphur begins to vaporise at a temperature of 173°, and this vapour is fatal to the insects where the air is thoroughly impregnated with it, but it must be used carefully (see "Mildew on Grapes"). Avoid sprinkling sulphur on hot lime. It gives off sulphurous fumes fatal to vegetable life. If the heat is moderate, the fumes may not injure foliage, but the practice is not safe.

Scale.—Few fruit trees are exempt from the attacks of one or more species of scale insects. Some trees are more patronised than others, which points to the need of growers studying the life history of insects so as to more effectually combat them. Scale insects weaken trees, cause them to become sickly and unfruitful, occasionally killing them. Their secretions render the fruit loathsome, and the sticky matter, besides closing the pores of trees and thus doing injury, becomes the seat of a destructive fungus.

The scales differ greatly in form; the females are larger than the males. All are developed from eggs packed away below the bodies of the females, and protected by the "scale," even after the death of the parent. The larvæ, usually of oval form, have three pairs of minute legs, and are quite active when young. They also possess small antennæ, and a beak with which they bore into leaves, fruits and stems, and suck out their juices. When the larvæ "fix" themselves by pushing in the beak they never leave the location, but undergo alteration in structure. The horns, legs, and rings of the body disappear; thus all power of movement is lost. The insect is protected by a scale-like covering, increasing in size as the larvæ grow, and formed by an excretio from the body. The females only are hurtful; the perfect males resemble small gnats, and are seldom seen. Scales do not increase at anything like the rate of aphides, and rarely produce more than one brood, except indoors, in a season. Their general mode of infestation is represented in the accompanying illustration.
Mussel Scale affects the apple chiefly when grown in warm situations, as inclosed gardens, against walls, and under glass. It is also very common on the pear in similar situations. Indeed, Mussel Scale is widely distributed, prevailing in all countries where apples and pears are grown and the insect has been introduced. It is easily distinguished by its long, narrow form and dark brown colour. The Pear Oyster Scale (Diaspis ostreiformis) is similar, but smaller, and more closely disposed in infestations. One characteristic of scale insects is that the brown are long and the white are round.

White Pear Scale infests pears in warm situations, especially under glass. Size, \( \frac{1}{16} \) inch; form ovoid; colour drab or dirty yellow. It may have been introduced from America. Ordinary infestations of scale on hardy trees yield readily to treatment with the caustic soda and potash solution described at page 251. Trees much infested may be

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**Fig. 80. Mussel Scale (Mytilaspis pumorum) on Apple.**

References:—1, female, enlarged: natural size on right; 2, female, under side, showing eggs, all greatly magnified: natural size on left. 4, apple branch infested with Mussel Scale, natural size; 3, weakened growth and blossomless buds resulting from scale infestation; 4, clean growth with blossom buds; 5, infested apple; 6, clean fruit.

**Fig. 81. White Pear Scale (Aspidiotus rapiæ) on Pear.**

References:—7, female, enlarged, showing form; 8, female, under side, greatly magnified. 9, infested pear branch; 9, 9, spurs enfeebled, wood buds forming instead of blossom buds; 10, 10, clean growths with blossom buds; 11, deformed pear caused by scale; 12, clean pear.
sprayed with a stronger solution, namely:—caustic soda, $\frac{1}{2}$ pound; commercial potash, $\frac{1}{2}$ pound; water, 1 gallon; using this only as a drastic measure in bad cases. In either case follow the winter spraying with the soft soap, caustic soda, and sulphur solution mentioned at page 260, in early summer to destroy young scale insects.

One of the surest means of destroying scale is to brush over infested trees, whilst dormant, with whale (train) oil. This suffocates the insects. Linseed oil answers equally well, but there is danger of closing the pores of the bark. A method of using free oil without prejudice to the bark, yet destroying scale, may be usefully mentioned. Take train (whale) oil, 1 quart; sal soda, 5 pounds; dissolve the soda in 5 gallons of water, and heat it to boiling. When boiling, pour the oil in, and stir briskly a short time. Allow to cool down to $130^\circ$, at which use as a spray on infested trees. Let the dose act on the scale two or three weeks; then spray the trees with the following:—caustic soda, powdered, $\frac{1}{2}$ pound; commercial potash, $\frac{1}{2}$ pound; dissolve in 6 gallons of water. This alkali wash saponifies any oil that, if free, would clog the pores of the bark. Unless the trees are seriously infested—quite encrusted with scale—the soda and potash wash is sufficient; but in bad cases use the whale oil and sal soda wash first, and the other afterwards as advised, remembering that the trees must be perfectly dormant. Scale insects other than those named will be treated under the different fruits; therefore, it must suffice to state here that the resin compound named at page 261 may be used against scale during the growing season.

*Thrips* (Heliothrips haemorrhoidalis) (Thrips Adonidum).—Many species of thrips besides the one named have been described, but are so much alike that it is difficult to distinguish them from each other. The species most familiar to cultivators indoors is that infesting vine-leaves and other fruit trees. There may be some to whom this insect is not known nor understood; therefore the accompanying figures and description will enable anyone to recognise it, if it is infesting their vines or fruit trees. It is highly destructive.

The larvæ and pupæ are yellowish white; larvæ wingless; pupæ have short wing cases. The larvæ are much like the mature insect, only smaller. The perfect insect is about $\frac{1}{4}$ th inch long, but the size varies according to the feeding-ground; bodies black, sometimes of a rusty hue. The wings are long, straight and narrow, four in number, unveined, and fringed with long hairs, dirty white. They have two horns, and three pairs of legs, which end in a bladder, without claws. The mouth has an *apparatus* for piercing and sucking the juices of the infested parts, and at the tip of the tail may
often be seen a globule of blackish fluid, which, being deposited from time to time, stops up the pores of the leaves.

Thrips feed upon leaves and tender shoots, and also attack fruit, causing the parts infested to become paler in colour, and often to wither. Under glass they are most prevalent in summer and autumn; but where plants are grown in fruit houses, and the temperature and atmospheric conditions suitable, they are seldom inactive.

Yellow thrips occasionally make their appearance on vines, and infest the ripe fruit of plums, peaches, and nectarines, rendering those as well as grapes disgusting. *It* (Heliothrips ochraceus) has black eyes and a hairy body. This, happily, is uncommon. Not so, however, is our native very small black or dark coloured thrips (Heliothrips vulgatissima), which as early as April is common in the flowers of fruit trees, crawling about the interior, the corolla, stamens, and all parts receiving attention. This species does not appear to injure the trees, yet impairs the blossoms, which seldom set well. Fortunately thrips are rarely hurtful to fruit trees outdoors, though in a dry season they are sometimes troublesome, yet they yield readily to forcible syringing, and the washes advised for aphides.

Prevention under glass must be directed to cleanliness. Washing the infested vines or trees with soapy water in summer, and cleansing the house, after the infested trees are leafless, must not be neglected. Every care must be taken not to introduce thrip-infested plants into fruit houses, and the trees must be kept healthy by due attention to ventilation, and abundance of moisture both in the air and soil. Forcible syringing with clear water expels thrips, and where this can be practised, and proper culture is provided, they ought not to appear.

Fumigation with tobacco is a good remedy, having the foliage dry, and the smoke
delivered cool. Fumigate on two consecutive evenings, repeat in a week, afterwards fumigate once a fortnight, and the thrips in due course will be eradicated. Syringing the infested trees with the following mixture is effectual:—soft soap, 8 ounces; dissolve in 4 gallons of boiling water; tobacco, 1 pound, place in a vessel, pour in 4 gallons of boiling water, cover over with a sack, strain when cool; mix the soap solution and tobacco decoction together, stir well and apply at a temperature of 90° to 100°. Repeat once a week, cleansing the trees with clear water the day after each application.

Slugs and Snails.—Except in orchards and neglected gardens the Black Slug (Arion ater) is not common, nor the Great Gray Slug (Limax antiquorum or maximus), but the latter is peculiarly fond of ripe fruit, particularly nectarines and peaches, and makes onslaught on grapes, spoiling a bunch in a single night by its slime. These pests travel considerable distances in the night, hiding by day in walls, or wherever they can get out of direct sunlight. They are very fond of melons; hence a ripe fruit cut forms a good bait, and they may be traced by the slime, and, perhaps, taken in their lurking-places. It is an easy matter with the aid of a lantern to find them feeding on the fruit at night, leaving the partially-eaten fruit as baits. This slug takes large pieces out of nectarines whilst they are hard but ripening. It passes over lines of quicklime, and makes nothing of wool wrapped around stems unless the wool is moistened with creosote, and that must be kept off the stem. Specimens stretched out on their night march measure 6 inches in length.

The Garden Slug (Limax hortensis) is common, small, and slender, feeding voraciously on strawberries. Dry soot and quicklime, worked well around and into the crown of the plants before the flowers expand, afford some mitigation of the evil, but nitrate of soda, 1 1/4 to 2 cwt. per acre, or 1 pound to 1 3/4 per rod, kills slugs. Apply before much growth is made, preferably in March or early April. Salt, 4 to 5 cwt. per acre, or 3 pounds per rod, destroys snails, slugs, and noxious insects. Distribute it evenly similar to nitrate of soda. Frequent dusting with quicklime late in the evening or early morning annihilates slugs, as does clear lime water applied through the rose of a water-can. An hour after dark is the best time for these applications. Lime water may be made by pouring 3 gallons of water on 1 pound of freshly-slaked lime, stirring well, letting it stand two or three days, then pouring off the clear water. Ducklings turned into slug-infested plots, early and unfed, soon gobble up the molluses. Ammoniacal liquor from the gas-works, at the rate of 1/2 pint to 1 gallon of water, used similar to lime water, is effectual, and has manurial and insecticidal values, but must be employed carefully,
testing it on small parts before applying generally, as its strength varies; then it can be further diluted if it damage foliage. Fresh brewers' grains placed in small heaps are good traps for slugs, and bran sprinkled with beer placed on a slate with another over it, raised by a stone on one side, thus forming a roof and hiding-place, attracts the pests. Hand-picking has the advantage of certainty, pursuing the practice on moist evenings. Hollowed potatoes, apples, carrots, and other substances laid near fruits are good baits, but to be of service they must be used in advance of the fruits ripening.

Snails possess conspicuous spiral shells, and withdraw into them in cold weather or very dry periods, remaining protected and motionless a long time. They are not nearly so ravenous as slugs. The Common Snail (Helix aspera) is, perhaps, the one most frequent in gardens, the Wood Snail (Helix nemoralis) and Garden Snail (Helix hortensis) being found in hedgerows and tangled vegetation about gardens and orchards. Hand-picking is the best remedy. Glow-worm larvæ feed on them, also many kinds of beetles. The song thrush devours hosts, cracking the shells on stones.

Wireworm (Agriotes (Elater) lineatus).—This beetle, the perfect insect of the larvæ known as wireworm, is popularly called Skipjack, Click Beetle, Snap Beetle, or Spring Beetle. It is of a dull brown colour, with a greyish down over it, head and thorax black. It may be found under moss and elsewhere throughout the year, and its length is about \( \frac{3}{8} \) inch. In the perfect state the insect is harmless, but in the larval condition very destructive. The wireworm is a pale dirty orange or tawny colour, having six short legs. The body is formed of twelve scaly rings besides the head, which is small, flattened, and darker than the body. When the larvæ attain full size they burrow deeply into the soil, each forming an earthen cocoon, in this become pupæ, usually in late summer, and the beetles emerge from the pupæ state in little more than a fortnight, though some may not emerge till spring or summer.

The grubs or wireworms feed on the tender roots and stems of trees, gnawing them just beneath the surface. This occurs with vines or others with fleshy roots. In borders formed of turf wireworms sometimes do considerable mischief. All turf does not contain wireworm, but "where there is any suspicion that wireworm is present, I have found it an advantage to cut the turf and throw it grass side down, and leave it so till it gets a sharp touch of frost; this drives the wireworm to take shelter in the deeper soil, and the frost has a beneficial action on the turf itself" (Mr. W. Thomson, "Journal of Royal Horticultural Society," vol. xiii. page 56). Sward intended for cutting to form fruit borders should have sheep penned on it, feeding them with cake, so that every inch of land may be
trodden and eaten bare. This treads many wireworms to death, and those escaping pass deeper into the soil, often a foot or more in frosty weather, and do not become voracious again before spring, before which time the turf ought to be cut. A dressing of salt, 10 cwt. per acre, applied a few weeks in advance of cutting turf, is excellent for destroying destructive larvae; also a mixture (salt, 3 cwt., and nitrate of soda, 1½ cwt. per acre). These elements act inimically on predatory larvae, and trees grown in the turf are healthier and more fruitful than are those forced into soft growth by the flush of grassy sward. Turf in the latter condition should have one-tenth part of hot lime strewn through it, and a bushel of soot distributed evenly through each cartload. These improve the turf and drive away vermin.

Ground intended for fruit trees or strawberries, in which wireworm is present, should be heavily limed. Lime is an absolute necessity on soils broken up from scrub, or where there have been hedgerows, or the soil is of a vegetable nature. The lime should be fresh from the kiln, placed in small convenient heaps, covered with earth, and left until slaked, spreading whilst hot. This burns off the grass, and destroys eggs from which wireworm would hatch, also slugs and other obnoxious creatures. When the land is foul with wireworm, fresh gas-lime should be applied in autumn, at the rate of 3 to 5 tons per acre, or 42 pounds to 70 pounds per rod, spreading evenly and letting it remain for six weeks; then lightly work it in. Gas-lime destroys all parasitic germs. If the land cannot be treated in the above manner in autumn, and there is known to be wireworm, apply gas-lime in February, at the rate of 1½ to 2 tons per acre, or 20½ to 28 pounds per rod, and let it lie a few days before working in. This causes wireworm to disappear where its numbers are not great, and admits of planting shortly after its application. Paring and burning the rubbish of rough portions of freshly-broken-up land and hedgerows gets rid of many beetles, eggs, and grubs. Turf stacks allowed to become overgrown with grass and weeds retain wireworm indefinitely; in bare soil they cannot live long. To trap and keep wireworms from feeding on vine or other roots, bury pieces of carrots, potatoes, or squares of fresh turf about 2 inches deep in the soil, and if each bait has a stick thrust through it, this serves as a handle by which it may be taken up, and the wireworms which have penetrated it can be destroyed. If these traps are attended to daily, and renewed as required, wireworms may soon be extracted from fruit borders. There is a number of species of Agriotes besides that named, the grubs of which feed on roots and live for several years. The most destructive are *A. obscurus* and *A. sputator*, but all yield to similar preventive and remedial measures.
Wasp.—In the family Vespidae, to which wasps belong, the most formidable representative is the Hornet (Vespa crabro). It is about twice the size of the ordinary wasp, and a very beautiful insect. Hornets are scarce north of the Humber, but have been found at Thirsk. They build in high places, in church steeples, roofs of buildings, on trees, and elsewhere. They feed largely on insects, but devour much fruit, having a particular liking for choice pears, completely eating out the interior, leaving nothing but a hollow rind. Whilst hornets feed wasps stand aside.

The Wood or Bush Wasp (Vespa sylvestris) builds nests under roof-caves, or attached to walls, trees, or bushes, and in some seasons very numerously. These much resemble the Common Wasp (Vespa vulgaris), which forms a nest in the ground. Both species are voracious, feeding on insects till the fruit ripens. Their partiality for ripe apricots and plums is notorious, of gooseberries and grapes they leave nothing but skin, and spoil the finest apples and choicest pears by eating holes into them. In houses wasps are a dangerous nuisance, and in gardens and orchards a devastating plague.

Prevention of the attacks of wasps on fruit is best effected by capturing and destroying the female or "queen" wasp in spring or early summer. This saves much after trouble and loss of fruit. School-children encouraged with a trifle for every "mother" wasp killed in April and May may be of substantial benefit. Some queens will, however, always evade capture. Wasps travel great distances, but may be easily traced, for their flight is, as near as possible, in a straight line from the fruit to the nest; therefore they are easily tracked to earth. Mark the nests by day with a peg split at the top and white paper inserted in the slit, and at night pour from a pint to a quart of coal tar through the spout of an old water-pot into the hole of each nest; there will be a great hubbub for a few seconds, followed by significant silence. Or a soda-water bottle three parts filled with petroleum, the open neck forced tightly in for emptying the contents, will destroy the nest. Spirit of turpentine may be used similarly. A piece of cloth fastened to a stick, soaked in a saturated solution of cyanide of potassium, is immediate death to all wasps within or returning to the nest. It is made thus:—"Four parts of cyanide of potassium are placed in a well-stoppered bottle, and a solution of 9 parts of tartaric acid in 60 parts of water is added. The bottle is shaken several times, and set aside in a cool place for twelve hours, at the expiry of which time the aqueous solution of hydrocyanic acid, containing about 3·5 per cent., may be poured off from the solid tartrate of potassium."—(The Popular Encyclopaedia, vol. xi., page 349.) Dilute aqueous solution of hydrocyanic acid of the pharmacopœia contains about 2 per cent.
of true acid. One drop of the concentrated acid, or the inhalation of the smallest amount of the vapour of the same acid, causes instant death. These data are given because of the extreme danger to life of the aqueous solution for destructive purposes. Only professional men can use it safely. A teaspoonful of powdered cyanide of potassium placed in the entrance to a wasps’ nest in the daytime causes its destruction. It is extremely poisonous.

Some persons prefer digging out wasps’ nests. The grubs are capital bait for fish, and fowls greedily eat them. Squibs are formed of two parts gunpowder and one part sulphur, mixed and damped so as to fuse slowly but surely by combustion. Light the squib, place it well into the wasps’ burrow, covering with a piece of turf 2 or 3 inches thick and about a foot square, pressing it well down to keep in the smoke for a few seconds. When the squib is expended, proceed to dig out the nest, and destroy its occupants before they have time to recover. To catch rovers, insert a clean wine-bottle half filled with water in the place of the nest, so that the top of the neck may be level with the surface of the ground, and as near as possible in the same place as the entrance to the nest was. The bottle must remain three or four days, and will catch every wasp belonging to the nest which may have been away from home at the time the nest was destroyed. The bottle must not be scented, and it may catch 1,700 to 2,000 wasps.

Tree wasp nests, hornets included, are more difficult to take. A sulphur pot or an empty tin (such as a coffee or cocoa canister) mounted on a stick, and charged with stout strips of paper dipped in melted stone brimstone, lighted and applied to the orifice of the nest, and held there closely, stifles all within it. The nest can be safely removed; or a bold person with a cloth will remove the nest and immerse it in a pail of water in a few minutes. Another plan, and very effectual, is to go dressed in bee-manipulating attire with petroleum in a watering-pot, and a syringe. With a light placed so as to show the nest, eject a syringeful of petroleum direct into the nest; there is no further trouble, for it kills eggs, larve, everything.

Traps in the shape of clear glass bottles, with rather wide necks, half filled with a mixture of beer and sugar, are useful, wasps, hornets, bluebottle flies, &c., entering them eagerly and rarely coming out again. They should be emptied every morning, using a colander to drain off the insects, which should be at once deeply buried; they smell offensively. Soda-water bottles are handy for suspending; but all traps should be used in advance of the fruit ripening, for once the insects taste ripe fruit they are so fascinated as to forget anything else. Birds often begin the mischief by pecking the
fruit, wasps following, and swarms of bluebottle flies finish the work. Nets to keep off the birds, and hexagon netting stretched over the openings of houses where fruit is ripening or ripe, are absolute necessities. Traps are then more effective. One of the best is the glass "fly-catcher," baited with sweetened beer; the wasps enter from below, and in striving to get out, fall in the liquid and drown. Another good trap is the old-fashioned hand-light (Fig. 83).

Take two hand-lights, place one on four pieces of wood to raise it about an inch from the ground; break four holes in the top of this hand-light about a quarter down the roof; put a few pieces of ripe fruit on the ground under; place another light of exactly the same size on the top of this, laying moss all round the edge where the two meet. The wasps, attracted by the pieces of fruit, take their fill, fly upwards, pass through the holes into the upper glass, and never "think" of coming through the holes again. A bell-glass trap also answers well. Place a large bell glass with a hole at the top on three pieces of wood an inch thick, over a plate containing a syrup of sugar and beer, or treacle, and above it place another glass closed at the top; this glass, fitting closely on the other and forming the trap, must be a size less. It acts in the same way as the hand-light trap. An improvement on the bell glasses is found in the complete appliance represented in Fig. 84, which first appeared in The Journal of Horticulture. These traps are about 6 inches in diameter, and cost about 4s. 6d. a dozen. They are placed on boards supported on three stakes, forming a tripod, and are easily baited with treacle and water. Many wasps and other insects enter them and few escape, while the traps are readily emptied.
Weevils.—In these the head is prolonged forward into a beak, on which the antennae are placed. The body is generally short, flat or rounded, and very hard. The larvae are usually white legless grubs with hard dark heads and strong jaws. They live on leaves, shoots, and fruits, their habits varying with the species, and the havoc they commit is considerable. The more important species will be treated under the different fruits; therefore an example only is here presented.

Anthonomus pomorum (Fig. 85, 1) is a very small beetle, scarcely one line and a half long, wing-cases dark brown, with whitish-grey stripes; antennae springing from the middle of the beak; all these parts, as well as its eyes and the upper part of the body, black. The female bores a hole in the unexpanded blossom buds, laying one egg in each. In six or seven days small white maggots hatch, which feed upon the fructifying organs, and in a few days turn into brown pupae, from which the weevils emerge. The beetle feeds during the summer on the leaves of the trees, and in autumn hibernates beneath the rough bark on the stems and branches, under stones and dead leaves.

Preventive measures should be directed against the insects hibernating on or near the trees, and laying their eggs. When the leaves are all down, the trees should be
thoroughly cleansed in stem and limb, removing all rough and loose bark, then washing with a salt brine, and spraying all parts with the caustic soda and potash solution named at page 251.

All dead leaves and stones must be cleared from under the trees, and the ground dressed with quicklime, following early in spring with a dressing of superphosphate of lime, 3 cwt.; kainit, 1 cwt.; sulphate of ammonia, \( \frac{1}{2} \) cwt.; sulphate of iron, \( \frac{1}{2} \) cwt.; mixed, per acre, or 4 to 5 pounds per rod from the stems of the trees to the outside spread of the branches. Weevils like nothing better than to be left alone: the disturbance of the soil and application of chemical fertilisers upset them, and are beneficial to the trees. Though furnished with wings, the weevils usually ascend the trees by the stems; the females seldom fly, but the males use their wings freely. Sticky bands placed round the stems early in spring when the buds commence swelling, and keeping the bands smeared until the blossoms expand, capture the invaders. In some instances, however, trees are so rough in stem and branch that the weevils never leave them, and few are then caught on the sticky bands; therefore, when the blossom buds are swelling it is a good plan to spread white sheets under the trees, and shake them sharply; the weevils then fall, and may be collected and thrown into rough trays brushed over inside with gas tar. Evening is the best time to shake the trees, for the weevils fly in the morning, and those which fall are better seen on white sheets than on the dark ground; the shaking must be repeated at short intervals until the flowers expand.

Infested flowers should be removed and burned. Spraying the trees before the buds develop with a petroleum emulsion (page 261) acts as a deterrent to this and other enemies. The greatest injuries from this pest attend negligent culture, and freedom from it is most noticeable in clean trees and well-cultivated ground.

Caterpillars.—The infestation of trees by caterpillars has long been a source of anxiety to the fruit grower. Continental, Canadian and United States horticulturists aver that without means of keeping these in check their occupation would be gone. Except firing a gun to blow a web-net of small ermine caterpillars to atoms, shaking the boughs violently to bring down those feeding on the foliage, hand-picking and other similar measures, nothing has been attempted in this country until recently to prevent or systematically destroy the vast and increasing hordes of caterpillars that devastate fruit trees. A brief description of the most prevalent will first be given, and then means of prevention and destruction, as generally applicable, be pointed out.

*Figure-of-Eight Moth* (Diloba coeruleocophala).—This moth (Fig. 86) appears early
in October. The upper wings are brownish grey, with a yellowish-white spot in their centres, shaped like a double kidney, forming the numeral 8; lower wings, brownish, with darker markings. The eggs are laid singly on the branches and stems of trees, and are green. From each a caterpillar emerges early in summer, green above and paler beneath, yellow striped, with black spots, and bluish head, altogether a handsome, but lazy, creature nearly 2 inches long. When mature, the caterpillars form cocoons, and in these turn to brownish pupae, moths emerging in late summer, some not appearing as perfect insects until spring.

![Figure-of-Eight Moth (Dioboa ceruleogebala) on Apple](image)

References:—1, moth; 2, caterpillar (young); 3, caterpillar, full fed; 4, branch infested with caterpillars; 5, clean branch.

The caterpillars mainly infest the hawthorn, but they are very fond of cherry, apricot, plum, and peach leaves. They have only a slight hold and are easily shaken into cloths held below, or a brisk syringing brings them down, and they can then be destroyed. No moth, perhaps, is more attracted by artificial light than the Figure-of-Eight; therefore, lamps may be turned to account. Cleansing the stems and large branches of rough bark, washing with alkali in winter, and the sprayings in summer for other enemies, equally answer against these caterpillars.
Lackey Moth (*Bombyx* (Clisiocampsia) neustria).—The moths of this species (Fig. 87) are variable in colour, but the forewings are brownish, crossed with darker bands; hinder wings, reddish brown with paler bars. They appear in July to early autumn, flying only at night, remaining concealed during the day under leaves and long herbage. The eggs are deposited in summer and autumn in broad bands, each about $\frac{1}{2}$ inch long, containing 200 to 300, kept together by a tenacious brown gum, which protects them from inclement weather. The larvae emerge in April and May; they are hairy and black. They spin a web, enlarging it as needed, from which the caterpillars go out to feed, returning in the evening and in wet weather. Thus congregating early in the morning or during rain, they form large nests in the forks of the small branches. In these they remain some time, but when nearly full grown they separate and spin cocoons on leaves, in crevices of bark, on walls, under sheds, and in hedges, each cocoon being oblong, yellow, mixed with a whitish or sulphury powder, and from these the moths emerge in due course.

The eggs are easily destroyed by a pruning-knife. The caterpillars should be captured in the webs, taking care to spread cloths on the ground to catch any that let themselves down with a silken thread. This is best effected early in the morning or during rain. A galvanised pail containing some petroleum emulsion or smeared inside with gas tar may be held beneath the nest whilst another person detaches it. When not convenient to cut off the branch, they may be shaken down and crushed under the trees, using cloths where the grass is long, and detaching those hanging by their threads with a pole. Thorough cleanliness in orchards and their precincts hinders infestations of lackey moths, and the caterpillars succumb to spraying the trees with Paris-green.

*Fig. 87. Lackey Moth (*Bombyx neustria*) on Pear.*

References:—Upper figure, moth; left-hand branch, showing bands of eggs; right-hand branch and caterpillar, showing devastation; clean spur-growth below.
Small Ermine Moth (Hyponomeuta padella).—The moths of this species (Fig. 88) appear in June and July, and are white, with black dots on the upper wings; lower wings, lead coloured; expanse of wings, about ¾ inch. The female deposits her eggs in roundish patches on twigs and branches, covering them with gum to protect them. These hatch out minute caterpillars in autumn, yellow with black heads, but they do not leave the gummy substance until spring, when they eat the leaves. After emerging, the caterpillars spin a web around fresh leaves, and, living in large communities, strip hedgerows and trees of verdure. They are smooth, with a black head, and spots on the sides. When full-fed, the caterpillars spin a slender cocoon in the web, turn to pupae, and produce moths about midsummer or later.

As the larvae live in webs, they are easily removed and destroyed. Immense numbers of caterpillars may be taken in a short time, and this should always be as early as possible, never beyond their assuming the chrysalis form. The alkali wash (page 251) causes the small gum-nests on the twigs and branches, and other accumulations, to peel off, leaving the bark clean. Summer sprayings of Paris-green are destructive of small ermine moth caterpillars.

Vapourer Moth (Orgyia antiqua).—This injurious insect (Fig. 89) is widespread, destructive, and common in most parts of the country. The male is dark brown, the wings chestnut, with darker cloudings, and a white spot near the back angle of the fore wings. The female has a clumsy body, grey, and mere scales of wings. The caterpillars are covered with yellowish hairs, body dark with reddish
tubercles, and at the head and tail are tufts of dark clubbed hairs. Good specimens reach 2 inches in length. It is very rapacious, making almost every kind of tree its prey, including fruit trees. When full-fed it forms a cocoon, making use of its hairs, in crevices, among leaves, on trunks of trees, walls, palings, &c., as most convenient, and changes into a dirty yellow hairy pupa. The moths emerge in the autumn, pair at once, and the female lays her eggs on her cocoon or near, where they lie until spring, and hatch out at different times, so that larvae and moths often occur together.

Remedial measures should be directed to the destruction of the larvae by hand-picking, as well as cutting away and burning the webbed-up leaves. Walls and infested trees should be closely scrutinised for cocoons, and in winter be washed with the alkali solution named at page 251.

Fig. 90. MOTTLED UMBER MOTH (HYBERNIA DEFOLIARIA) ON PLUM.

References:—1, moth, male; 2, moth, female; 3, caterpillar; 4, defoliated branch; 5, clean branch.

Mottled Umber Moth (Hybernia defoliaria).—The moths (Fig. 90) emerge between October and March. The male has wings 1 4 to 1 5 inch in spread, brown verging to reddish yellow, with darker bars crossing the front wings and a dark spot between them. The females are almost wingless, brown, with dark spots on the back, and crawl on to the trees, or are carried by the males, to lay their eggs. Their larvae are "loopers," slender, and brown above, greenish yellow below. The caterpillars infest blackthorn, hawthorn, lime, oak, besides fruit trees, and are very destructive. During June or July the larvae become full-fed, let themselves down to the ground by threads, and turn to pupæ on or just within the ground, where they lie near the trees from which they have fallen, and the moths emerge in the autumn, onwards till spring.
Besides the mottled umber moth there are a number of the genus Hybernia, which as caterpillars are frequently destructive to the foliage and fruit of cultivated trees. All the females are wingless, and the larvae "loopers." The pupae are not so deeply embedded in the soil as those of the winter moth, but they are deeper in cultivated ground than in orchards in grass; hence eating this bare in late summer and early autumn by sheep proves destructive of pupae. Dressings of salt, 5 cwt. per acre, watering with ammoniacal gas liquor, diluted with six times the bulk of water; and kainit, 2 cwt. per acre, have all proved useful applications. Gas lime sprinkled over the ground from the stem outwards beyond the spread of the trees has been found beneficial, but great care is required, for the gas lime injures or kills all the roots it comes in contact with. Infestations of mottled umber and other Hybernia species are successfully met by the means detailed under "Winter Moth."

*Pale Brindled Beauty Moth* (Hybernia (Amphidasis, Geometra) polosaria); *March Moth* (Anisopteryx ascularia, Schiff) (Miss A. E. Ormerod).—"Pale Brindled Beauty Moth appears in March; eggs deposited in bands round a twig, as done by the lackey moth. Caterpillars appear with the opening leaves of the elm, lime, lilac, and apple tree. They are, at first, a light green"—(Johnson’s Gardeners’ Dictionary, p. 375.) Male winged, about $1\frac{3}{8}$ inch in expanse, brown with darker bars; female wingless, pale brown, coated with grey silky down. The eggs are placed in parallel lines around, but not always encircling, a shoot of the preceding year, firmly attached to the growth, and embedded in down. Their number varies from a few to many in a band, sometimes reaching over 500. The "loopers" become darker and brighter with age, having a light line along the side, and yellow beneath. They are general feeders, with a partiality for plum trees. Like the rest of the genus Hybernia, the caterpillars leave the trees and turn to pupae on or in the ground, forming a sort of web-like cocoon.

The eggs are easily crushed with a garden knife. In bad infestations the shoots or twigs containing the bands of eggs may be cut off and burnt, examination being made of the trees from the middle of March to the end of April. In other respects the treatment should be the same as for winter moths.

*Winter Moth* (Cheimatobia brumata).—This (Fig. 91) is one of the most destructive insects the fruit grower has to combat, its caterpillar preying on the expanding buds, flowers, and foliage of apple, cherry, pear, plum, and other fruit trees.

The male moth is well provided with wings, measuring about $1\frac{1}{8}$ inch across; but
the female, though not absolutely wingless, possesses mere vestiges of wings, useless for flight. Both are greyish-brown, with darker bands across the wings, and the female is larger in body than the male. The male moths appear a few days in advance of the females, commencing flight early in October, and continue emergence until the end of December or later, some appearing in spring. The female moths crawl up the trees or are carried there by the males, and deposit their eggs on the blossom, i.e., buds, shoots, and other parts of the trees, favourite places of deposition being the ends of pruned branches. Each female may lay from 200 to 300 eggs. The caterpillars and buds come to life together. The caterpillars are bluish green, shining, with a dark stripe down the back, and three white stripes on each side; but in some the ground colour is a dull to a dark brown. The attacks of the caterpillars are shown in Fig. 92, p. 291.

The caterpillars eat into the expanding buds, and as the leaves enlarge they join two or more together, feeding securely. When of full size, they lower themselves to the ground, burrow, and form earthen cocoons. Some become pupae in June, others later, from which moths emerge in due time.

To prevent the ascent of wingless female moths and other crawling insects, placing sticky bands on the stems of trees has been attended with considerable advantage. This may be effected by procuring stout grease-proof paper, and cutting it into strips 9 inches wide. Place the strip of paper round the stem, below the radiating branches, and clear, if possible, of the ground. The strip of paper should be fixed firmly with string passed round the upper and the lower edge. All tree stems, however, are not evenly round but furrowed, and when the material is drawn round them, the hollows are merely converted into channels by which the moths are guided under the greasy bands to the parts of the trees above for depositing their eggs. Stop all such passages with moss, or other material not likely to injure the bark. The bands must be attended to as often as is needed for keeping them sticky. Mr. J. Hiam, Astwood Bank, Redditch, has after

References:—1, male moth; 2, female moth; 3, eggs on buds, small dots; 4, eggs on cut stem; 5, eggs highly magnified.

Fig. 91. Winter Moth and Eggs on Apple Branches.
many experiments found that the paper employed for packing needles is good for banding trees.

Sticky bands to effect the object in view must be applied in good time, and if continued long enough, are efficient. Female winter moths have been noticed ascending trees on the 11th of October, but their appearance is influenced by season and locality. The bands ought to be in position and in working order by the 1st of October, and kept so till spring. This insures the "fixing" of all crawling insects attempting a passage up the trees.

Of the many substances available for smearing, a mixture in about equal proportions of palm oil, soft soap, and tallow is good; as also is a mixture of resin and sweet oil, two-thirds of the former, melted, and one-third of the latter; while Davidson's Composition, Wilson's Sticky Oil and other proprietary preparations are efficient. Oily and tarry substances must be kept from the bark, for these penetrate the tissues and injure, if not destroy, the trees.

The use of lanterns to allure and fix moths on boards or trays smeared with a sticky substance has been recommended. Moths are not attracted any great distance by artificial light; still, no means of destroying the originators of caterpillars ought to be neglected. A handy trap is readily made by setting a post firmly in the ground, sawing its top off level at a height of 3 feet; fixing a tray, 2 feet square, with %1/2-inch edging all round, and a circular block of wood, 2 inches thick, in the centre, wide enough for a hurricane lamp to stand upon. The tray should be smeared inside with sticky stuff, and a lamp lighted and stood on the pedestal at dusk. Moths appear early in the evening, and, allured by the light, are taken in the tray. The great difficulty is wind and rain. A projecting zinc roof, with sides and ends on the principle of venetian shutters, admits of the use of the trap in all weathers. Other means of capturing moths will suggest themselves to ingenious fruit growers.

Forking the ground over lightly and frequently about the trees whilst the insects are in the pupa state assists in thinning their numbers by exposing them to the birds. Even hoeing the ground frequently in the late summer and autumn months contributes to the destruction of the chrysalides.

Ground beneath and near fruit trees allowed to become encumbered with weeds and coarse grasses may be lightly skimmed with a spade or plough from the end of September to mid October in dry weather, and the rubbish should be burned in ridges between the rows of trees. After burning, the ashes should be evenly spread over
the ground. This practice cleanses the ground of weeds, enriches and improves the staple, whilst destroying the chrysalides of the moths.

Despite every precaution some female moths gain access to the trees and deposit their eggs in the ends of pruned shoots; hence it has been found that deferring pruning until February is advantageous where the enemy abounds. So many eggs were discovered between the bark and the wood at the ends of shoots pruned in the autumn in Mr. Lee Campbell's fruit garden, that the infested ends had to be cut farther back in spring, and it was computed by the owner of the trees that in burning these ends six millions were destroyed in one season, or sufficient to prevent a devastating horde of caterpillars.

Caterpillar infestations are largely induced by the neglected condition of garden and orchard hedges. Hedges ought to be kept trimmed, but the cutting should be deferred until early spring, so as to permit insects to deposit their eggs on the twigs, removing them before hatching. Moths, however, travel quickly over the space between hedges, copses, and woods to orchards; therefore, to prevent insect invasion, insectivorous birds should be preserved.
By midwinter the most obnoxious of winter moths have deposited their eggs.
From that time and before the buds commence swelling, spray the trees thoroughly
with the caustic soda and potash solution (page 251) when dry, and with a prospect of
fine weather. This will bring off many of the eggs. Keep the bands smeared and
effective up to the third week in March, when the stems and large branches of old trees
should be washed with this mixture:—soft soap, 2 pounds, dissolve by boiling in 2 gal-
lons of water, remove from the fire and add 1 quart of petroleum while hot. Churn
violently with a spray pump five minutes, and dilute with hot water till 8 gallons of
solution are made. Apply with a brush, reaching well into every crack, crevice, and
angle of the bark, but not allowing the mixture to run down and saturate the soil.
This will destroy all hibernating pests, including red spider, as well as eggs, but it
must be used with caution on young trees. For those we advise a mixture of 1 pound
of freshly-burned lime and 1 pound of flowers of sulphur. Place the lime in a bucket,
sprinkle water over it, then the sulphur, only using water to slake the lime, then add
clay, and form the whole into the consistence of paint, by adding the requisite quantity
of the foregoing soft soap and petroleum solution. Apply with a brush to the stem
and branches, thoroughly coating them. This not only destroys eggs and insects, but
is useful against "borers." The wash has no deleterious effect on the bark, for the acid
reaction of the fats and oils is neutralized by the clay. Thus the bark is not hardened,
as occurs when a strong mixture of soft soap and petroleum is applied to smooth
young stems and branches. As the heat increases, the pigment gradually loses its
tenacity and falls away, leaving the bark more elastic, and the sap flows freely in
enlarged channels. After the stems have been dressed and the débris at the base of the
trees cleared away by scraping off the loose surface, fresh bands may be placed round
the stems to prevent the ascent of caterpillars and weevils.

The eggs of the winter moth do not hatch freely in a lower mean temperature than 45°,
but they incubate quickly in a mean temperature of 50°. Sometimes the caterpillars
appear by the third week in March, and seem to be influenced solely by the weather.
They generally commence hatching out at the same time as their trees cast the scales
of the buds, and become plentiful by the time the leaves unfold and flowers appear.
Caterpillars possess strong preservative instinct, letting themselves down to the ground
by a silken thread when disturbed. This peculiarity has long been taken advantage of to
effect their destruction. By placing sheets under the trees and shaking them sharply,
the caterpillars fall or become suspended, when the threads are readily detached.
Thus a number are captured. They may be destroyed by placing them in a pail partly filled with petroleum and water, or giving them to fowls. The quantity of caterpillars collected varies with the infestations. One man gathered a peck, and two men five bushels of looper, web-nest and other caterpillars in a day. By shaking the trees and detaching the threads, with unfed fowls attending the operator, thousands of caterpillars are picked up, or trampled into the ground, but as some may escape and return to the trees, a hay-band round the stem, and smeared on the outer face with gas tar, will prevent their ascension. Avoid smearing gas tar in a ring on the bark, or on the ground round the butts of the trees, for it sooner or later injures stems and roots, and has sometimes a fatal effect.

For the wholesale destruction of caterpillars, Paris-green and London-purple have been used in America since 1872 with marked success, but, though both substances are manufactured in this country, they were not used by fruit growers at home to any great extent until within the last three or four years. Experiments have been conducted in various parts of the country, notably in the Todddington and Glewston Court Fruit Gardens, with the result that Paris-green paste in the proportion of 1 ounce to 8 or 10 gallons of water for plums, and 1 ounce to 20 gallons of water for apples and pears, destroyed caterpillars without materially injuring the foliage. These proportions must not be exceeded, nor used when the trees are in blossom on account of the bees. Caterpillars, however, devour the blossom; therefore, spraying with Paris-green should be practised in infested orchards when the leaf buds are developing, always before the flowers expand, and not again until they have fallen, and the fruit is forming. Then the spraying may be continued until the trees are free from the voracious pests. On the third or fourth day after spraying, good results are manifested in the death of the caterpillars by eating the poison with the leaves; therefore, that interval should elapse between the sprayings. At Glewston Court, spraying with Paris-green mixture has been practised twice a week for months without any injurious effects on the foliage and fruit.

Emerald or Paris-green is a compound containing:—copper, 32·11 per cent.; arsenic, 28·56; oxygen, 32·48; hydrogen, 0·76; carbon, 6·09 = 100·00. It is a double salt of arsenite and acetate of copper (aceto-arsenite of copper), and a dangerous poison. The paste is less dangerous than the powder. Care must be taken not to breathe in the powder or allow the poison to settle in any sore or crack in the skin, nor should it fall on fruit or vegetables that are soon after used for food, while it is prudent to exclude
cattle and sheep from orchards for some time after spraying. Yet there is no danger in the careful and judicious employment of Paris-green. The evidence of Mr. D. Lee Campbell is conclusive on the point. In the Journal of Horticulture, May 14th, 1891, he states:—"No doubt it is imperative that warning should be given as to the handling of the poison, but that having been done, I am in the position, from my large use of Paris-green in the powder, to affirm that the danger is practically nil. Last year we used many pounds, and not having any proper mechanical sprayer, the distribution was effected by the hand, and although some 10 acres of bush trees were gone over ten times, no one suffered the slightest injury or inconvenience. Now, by means of a Stott's sprayer, wet hands are avoided. Then, as to danger from eating fruit so treated: of course, bush fruit should not be sprayed, but when I tell you that 18 ounces of Paris-green suffice to spray 10 acres of trees, that, of course, the bulk of the spray falls on the leaves and a great part on the ground, and that the fruit is exposed for months to all the washing of rain—it must be admitted that the risk is not worth mentioning."

The liability of Paris-green mixture to be washed off trees by rain has prompted the addition of flour paste to render it more adherent. Professor C. V. Riley, in "Bulletin No. 3" of the United States Entomological Commission, p. 57, states:—"It pays to add 2 or 3 pounds of flour or starch to the mixture, not only from the greater adhesive-ness which they give to the poison (a very desirable object in wet weather), but because by their colour they help to indicate the quantity that has been distributed. In using flour it will be found advisable to mix it first in a bucket of water, and allow it to remain until it sours, the object being to prevent it from forming lumps." The quantity of flour should be double the weight of the Paris-green. The flour aids the suspension of the Paris-green, preventing the particles from settling, and admits of the mixture being distributed by an ordinary syringe or garden engine with a spray nozzle. Without the flour paste it is necessary to keep the mixture well stirred all the time of its application, and to well wash the barrel out after using it half a dozen times. It is important that all vessels used for holding Paris-green mixtures should be well washed out after using.

London-purple has long been used in America for the destruction of caterpillars, and is considered by some growers superior to Paris-green on the score of economy, lightness, greater diffusibility in water, adhesiveness to the foliage, and less poisonous nature. Professor Riley treats of it in the "Proceedings of the United States Department of Agriculture" as follows:—"London-purple, \(\frac{1}{4}\) pound; flour, 3 quarts; water, 40 gallons. The
flour is placed on a funnel with a wire sieve in it, and through the meshes of which the flour is washed by pouring water on to it; the London-purple is then added in the same way. This mixture is then syringed on to the leaves in the form of a fine spray.”

The dose in the foregoing is only usable in America on matured foliage; the quantity of London-purple employed on tender foliage in the United States is 1 pound to 200 gallons of water. It is safer to begin with weaker mixtures in this country, remembering that the effects on foliage are in proportion to its texture, and in our moist climate the foliage is more susceptible to injury than that of trees in the drier atmosphere of the Continent and America. Paris-green has been found more reliable than London-purple for the treatment of orchard moth caterpillars in this country; but London-fluid (a liquid preparation of London-purple) in the proportion of 1 to 20 parts of water effectively disposes of caterpillars, whilst not injuring the foliage. London-purple is an arsenite of lime consisting of the subjoined percentages:—rose aniline, 12·46; arsenic acid, 43·65; lime, 21·82; insoluble residue, 14·57; iron oxide, 1·16; water, 2·27; loss, 4·07 = 100. Its cost is 7d. per pound, that of Paris-green 10d. per pound. These substances, used in the proportions advised, kill caterpillars without injury to the foliage and fruit. Where damage has been inflicted it invariably arose from an overdose.

Though Paris-green and London-purple are specifics for caterpillars and grubs eating the leaves and fruit, their efficacy for the destruction of aphides, chermes, and other insects feeding on the juices of trees by pushing their suckers into the soft tissues, is not so pronounced. This entails spraying with another mixture or solution, doubling the labour. A compound, therefore, that would destroy the whole race of animal and vegetable parasites at the same time would be a boon to growers. It is, however, difficult to compound and combine a fungicide with an insecticide strong enough to destroy fruit-tree pests without injury to foliage and fruit under every condition of growth.

Dr. J. C. Neal, entomologist to the State Agricultural College, Florida, U.S.A., gives, along with other valuable recipes for the destruction of insects, the annexed formula for the preparation of a universal mixture in The Gardeners' Chronicle, vol. ix., third series, p. 269. “Resin compound.—Caustic soda, 1 pound; resin, 8 pounds; to make 32 gallons. Dissolve the soda in 1 gallon of boiling water, take out half; add the resin slowly to the remainder, and boil, stirring rapidly; when dissolved, add slowly the part taken out. Dilute till it will pass readily through a thin cloth, which should be always done. Dilute before using to 32 gallons. This alone is very valuable against most scales (also cherry and plum aphides); but the addition of 2 ounces of London-purple makes assu
rance doubly sure, against even the dreaded Icerya" (and caterpillars). This combined solution of soda and resin with the mixture of London-purple is too powerful to use on tender and hairy foliage; therefore, for safe use on such, dilute the resin compound to 64 gallons, and add 4 ounces of London-purple thereto.

Mr. C. Lee Campbell states:—"I have tested another mixture with excellent results: 10 pounds quassia chips and 7 pounds Calvert's carbolic soap boiled together and mixed with 100 gallons of water, with about 5 ounces of Paris-green. This acts well against the aphid." It may be observed that this preparation is intended for apple trees, but it is available for hardy fruit trees generally, and is destructive of the whole host of orchard pests, applying the mixture as directed for the petroleum emulsion.

All the solutions or mixtures named are for use as a spray, and must not be used in any other manner unless specially advised. Where Paris-green or London-purple is employed for the destruction of orchard moth caterpillars it is not necessary to specially spray the trees for the destruction of codlin moth grubs, if the applications are made directly the fruit is formed and repeated at intervals.

Many injurious insects have their numbers reduced by the parasitic species. Ground beetles guard the roots, and the larvæ of the ladybird beetles and lacewing flies protect the trees from aphides. Ichneumons deposit their eggs upon the bodies of caterpillars so that their grubs may burrow and fatten therein, and house flies prey on aphides directly they emerge from the eggs. Almost every creature is liable to be preyed upon by parasites. It is almost impossible to directly increase those destroying injurious insects, because friends and foes alike perish by the means employed for the destruction of pests inimical to fruit crops. Still it is well to recognise their usefulness, and to have a knowledge of them so as to prevent their needless destruction.

Many birds render important services in the destruction of insects. Birds, in fact, are both injurious and beneficial, and it is suicidal to the interest of the fruit grower to slaughter them indiscriminately.

The hedge-sparrow feeds on insects, worms, and seeds, but never on fruit, leading an entirely useful life, and feeding its young almost entirely on caterpillars. The common wren is ever on the quest for insects. The great titmouse and blue titmouse, though pecking ripening pears, visit expanding apple and pear blossom for aphides and the larvæ of the apple blossom weevil. The chaffinch is useful to the fruit grower, for though it eats seeds its favourite food is insects and their larvæ; two broods of young are reared in a season, and fed chiefly on caterpillars. The redbreast, or robin, likes grapes,
currants, and raspberries, but feeds on ground insects during the greater part of the year. Blackbirds and thrushes for two-thirds of the year or more destroy vast numbers of ground insects.

The starling pursues a most useful life, feeding on worms, grubs of various insects, flies, beetles, slugs, and snails. The common creeper searches tree trunks and branches closely for predatory vermin. The nut-hatch frees trees of boring insects and larvae, adding nuts to its insect food; and woodpeckers continually hop about the trunks and branches of trees and capture insects or their larvae. Swallows, martins, and swifts clear the air of myriads of flies, and the night-jar devours nocturnal beetles and moths. The cuckoo visits gardens and orchards early and late, clearing trees and bushes of caterpillars. The willow-warbler, or yellow wren, is purely insectivorous; it arrives the first and leaves the last, its merry song and useful life never being over-estimated by the fruit grower. The garden warbler feeds chiefly on flies and insects, but takes some fruit; and the black-cap warbler rears its young entirely on caterpillars. The wood-warbler searches for the leaf-rolling caterpillars, and, like the common redstart, pursues insects on the wing. Fly-catchers render essential service in destroying swarms of noxious insects. Larks protect the surface of the soil, assisted by wagtails, the food of which consists mainly of insects. The inestimable good of several birds only requires to be known to the fruit grower to insure their preservation and increase. By sparing such birds, noxious weeds and insects decrease, vegetation flourishes, and much fruit is saved.

Hares and Rabbits.—The hare (Lepus timidus) is a watchful, timid creature, defenceless, yet alert and fleet in escaping from its enemies. Hares are very fond of the bark of young fruit trees, which they sometimes entirely girdle, but more commonly tear off in strips, often from a number of trees in a night, evidently testing them for the most savoury meal. The common rabbit (Lepus cuniculus), with its sharp, chisel-like incisor teeth, does much injury to trees by stripping them of their bark. Wire netting 30 inches high excludes rabbits, when it is let into the ground a few inches to prevent their burrowing under it. In snowy periods the netting assists the snow drifting, and rabbits and hares pass over; then it is no common occurrence to have several fruit trees barked completely round in a single night. This has happened more than once in our experience, and trees were only saved by the expedient of bridging over the gap between the two barks with scions, as represented in Fig. 93, p. 299.

Two or three scions were placed on each tree by whip-grafting. The scions were
taken from the trees. Clean and healthy portions, \( \frac{3}{4} \) to 1 inch or more in diameter, answered much better than young wood of the previous year, the ends being inserted under the bark above and below, as shown in the figure. The whole of the stem from which the bark had been gnawed was covered with grafting clay (page 125), as was the junction of the scions with the stem; soft rope was used for binding, and over this hay-bands, which were kept moist. The scions took in every instance by using clean ripened wood of three years' growth, and the trees bore abundant crops of excellent fruit.

Where attacks are likely to happen, the trees may be protected by running a line of string smeared with gas tar around the plantation or along both sides the rows of young trees, fixing it to small stakes thrust into the ground, about a foot high for hares and 6 inches for rabbits. Whilst the tar is fresh they will not cross it. The trees may also be dressed with "Tree Protective Composition," prepared by Messrs. Dickson, Limited, Chester; this does not injure the bark, but rather encourages its growth. Soot brought to the consistency of cream with skim milk painted on the stems and branches renders them distasteful to hares and rabbits, and Taylor's lime and sulphur mixture (page 191), with the addition of a third part of soot, well mixed, and brushed on the parts within reach of the animals, prevents their barking the trees, and the mixture is inimical to insects.

Mice and Rats.—The domestic mouse (Mus domesticus) needs no description; its characteristics are well known. At times mice destroy young trees and vines by gnawing the bark round the stems just beneath the surface of the ground, and they are fond of ripe fruit, particularly forced strawberries and late grapes. The domestic mouse is easily captured in steel bird-traps baited with a piece of hard cheese secured to the table of the trap, and properly set. This practice, if begun early and persisted in, will effect a clearance.

The short-tailed field mouse or vole (Arvicola arvalis) differs from the house mouse in having a short tail, scarcely one-fourth the length of the body and blunt at the tip, a shorter head, rounder body, shorter legs, and fur of a reddish tinge. These voles are very destructive to young trees in peeling off the bark, nibbling strawberries from the trusses and piling them in heaps, eating only the seeds, before the fruit is ripe. Voles are not easily caught. They, however, cannot resist tasty cheese, but they must be baited in advance of the fruit-forming seeds. Once they acquire the habit of taking cheese, the bird-traps before-named duly set in their haunts.
will do what is needed. **Pit-falls dug in solid ground in places frequented, about 15 inches deep, 4 to 6 inches wide at the mouth, and sloping under the soil to a considerably wider bottom, are very effectual, as the voles fall in and cannot get out.** In loose soil, glazed jars may be sunk to their rims, with water in them, and alluring baits. The long-tailed field mouse (*Mus sylvaticus*) does little harm, but, having no useful properties, should be caught by traps.

Rats are very destructive, carrying fruit from stores, gnawing and spoiling great quantities. The devastation they commit in a house of ripe grapes is appalling. They

![Tree Barked by Rabbits, and Gap Bridged over with Scions](image)

**Fig. 93. Tree Barked by Rabbits, and Gap Bridged over with Scions.**

**References:**—*Y*, apple tree stem torn by hares, and girdled by rabbits; *Z*, stocks and scions prepared for insertion; *A*, scions adjusted to stocks, bridging over gap; *B*, injured part hay-banded.

get into the drains and drainage of borders, make almost perpendicular burrows by the walls, or pillars supporting the hot-water pipes, or gain entrance to fruit houses by the covered channels of the hot-water pipes, in which they hide and are difficult to dislodge. Rats also enter by the front or top ventilators when open, scamper over the vines, eat some grapes, and carry away more to their burrows. The **Norway or brown rat** (*Mus decumanus*), having almost extirpated the **black rat** (*Mus rattus*), is the most rapacious. The brown rat was first noticed in England in 1730, and is much larger than the black rat, supposed to have come into Europe about 1200. Our water rat
(Arvicol.a amphibia) is not injurious to the fruit grower, though near streams it may do harm to the roots of trees.

Rats are prevented climbing vines and fruit trees by tying stout paper around the stem well clear of the ground and branches, securing it near the top with string, and then turning it over so as to form a bell-like projection about 6 inches wide. Bunches of spiny furze have also been found effectual. Box or other traps, carefully set in their runs and covered over with light material, reduce the number, and if one so caught be smeared with gas tar and let loose the whole colony usually migrate.

Mice and rats are easily poisoned. Take 2½ quarts of Scotch oatmeal, scald with boiling water, drain. Form 2 ounces of white sugar into a syrup with water, add ½ ounce powdered strychnine, stir thoroughly until a thin paste is formed. Add this to the damp oatmeal, and stir well for a quarter of an hour, then add half a pint of powdered sugar, and five drops each of oil of rhodium and oil of anise, stirring well. Bait with the preparation, without the strychnine paste, two or three nights, and the rodents having been well satisfied with it, will take the complete preparation. Take care to exclude domestic animals and fowls, also to clear away the remains early the following morning. The preparation must be used with every possible caution. It is a virulent poison.

Mole.—The common mole (Talpa Europœa) is familiar in England and Scotland, but comparatively rare in Ireland. Moles show great ingenuity and skill in the excavation of the upper and lower galleries of their habitations, and in the construction of the series of tunnels leading from the central point to the foraging ground. The food consists of worms, insects, and larvae. They are exceedingly voracious, and though they do good in destroying larval pests, they also do much harm by cutting the roots of plants in cultivated ground, and their earth-heaps interfere with grass-cutting in orchards. It is therefore necessary to extirpate them, but they may be driven from gardens and orchards by placing green leaves or parts of dwarf elder (Sambucus ebulus) in their runs. The smell of common elder is very offensive to the mole, and fresh leaves placed in their main subterranean paths, particularly where they enter the garden or orchard, which is also the best place to set traps, will soon cause them to disappear. Any intelligent labourer will catch them at a bonus of 2d. or 3d. per head.

Squirrels.—The common squirrel (Sciurus Europœus or vulgaris) is exceedingly fond of gage plums and nectarines, not that it dislikes other fruits, but those named are more to its taste and easily carried off. The quantity of plums a nest of these pilferers will
hoard in a snug place is scarcely credible. They once cleared a Coe's Golden Drop plum tree of half a bushel of fruit within two hours, and travelled over a 10-feet wall, hiding the plums in a neighbouring plantation about 50 yards away, not leaving a fruit behind. Every nut grower is made aware of the squirrel's liking for cobs and filberts, which are taken directly the kernels are worth eating.

To prevent squirrels climbing tall standard fruit or nut trees, tying a newspaper around the trunks, letting it extend out 4 to 6 inches at the upper edge, is effective. The rattle of the paper frightens the squirrels attempting to cross it, and if smeared with gas tar, their distaste is complete, but tar must be kept off the stems. A piece of tin or zinc placed round the stems of trees, projecting 6 inches all round, slightly inclining downwards and toothed at the edge, baffles mice, rats, and squirrels; but in many cases there is no remedy but trapping or shooting them.

Remedial Appliances.

With the object of enabling cultivators to apply insecticides and fungicides economically, efficiently, and expeditiously, several useful appliances have been devised. Some are specially adapted for distributing powder, others for producing fumes, such as tobacco smoke, and others again for covering trees and bushes with a dew-like deposit of liquid preparations conveyed in the form of mist-like spray. Dusting, fumigating, and spraying are essential duties of fruit growers, each operation being appropriate under certain specified conditions.

Dusting.—Spreading fungicides and insecticides in powder form by hand can be done on a small scale with a dredger, or tin box, the moveable lid of which is pierced with small holes. A piece of worsted stocking, tied securely at one end so as to form a bag for holding the powder, makes a good duster. All that is necessary is to partly fill with powder, tie or hold it securely by the open end, and shake it briskly so that a fine dust may fall on the parts desired. By mounting the duster on a stick, parts beyond reach of the hand may be dressed. Placing lime or other powder in a coarse bag 'to be held in the hand or attached to a pole, affords a simple method of distribution. These home-made contrivances are within the means of all to provide, while others that will be referred to are specially manufactured and obtainable from nurserymen, seed merchants, and ironmongers.

In all dusting operations care must be taken to have the powder as fine and dry as possible. All lumps must be sifted out. A calm morning after rain or a heavy dew is
generally the best time for dusting, but the evening is also suitable. When the weather is calm and the foliage damp, the powder adheres, and is not wasted by being blown away. Dusting should take place on the first appearance, preferably in anticipation of blight or disease. Be careful to cover the affected parts, or those usually attacked. If the lower side of the leaves be the seat of infestation, expel the powder upwards. A thin coating is all that is required, yet there is need to coat all parts evenly.

The Sulphur Duster (Boîte à Houpe), Fig. 94, is handy for distributing very fine powder. It consists of a tin tube, perforated at one end with rather large holes, through which worsted is threaded, partly closing them, yet allowing sulphur to be evenly distributed. It is filled from the opposite end, closed by a rotary lid. It is cheap, simple, and useful.

The Indiarubber Distributor, Fig. 95, was designed for distributing the powder known as Anti-Blight, as was another invention, the Malbec Bellows, Fig. 96, for use on a larger scale. A straight delivery pipe can be attached, and is preferable for dusting vines and fruit trees overhead. These appliances answer equally well for other light, highly comminuted preparations. The figures have been supplied by the agents, Messrs. Barr & Son, King Street, Covent Garden.

For use on a large scale La Torpille, an adaptation of the Knapsack pump, for distributing sulphur and other powders, has proved highly satisfactory in France. By means of a handle depending in front of the operator from a beam over the shoulder the pump is worked, and the powder in the vessel, which holds 22 pounds of sulphur, is agitated, and delivered through the spout in a "cloud," as shown, Fig. 97.

The hand-power "Strawsonizer," Fig. 98, is an excellent powder distributor, and
useful for the even spreading of fertilisers. It is fitted with an elbow spreader for dressing underneath bushes, and a straight spreader, also lengthening tubes for tall trees. The parts are adjustable, and can be set to distribute in any direction. It will distribute finely ground chemical manures, also lime and soot, evenly, down to a \( \frac{1}{4} \) cwt. per acre. It was invented by an ingenious farmer, Mr. Strawson, and is manufactured by Messrs. R. Hornsby & Sons, Grantham.

Fumigation.—Destroying aphides and thrips by means of tobacco smoke, and various preparations that give out fumes, comprises fumigation. Manufactured tobacco, through its costliness, is little used. The usual fumigating material consists of brown paper or rag steeped in the juice of tobacco obtained in manufacture, dried, and stored in a dry place to prevent mould and loss of narcotic value. Some tobacco papers and rags contain ingredients injurious to vegetation. Those containing sufficient sulphur to destroy mildew and red spider, must be used with great care in fruit houses. One dose of such mixture may cause the loss of a year's crop of fruit, and prejudice the succeeding one by loss of foliage. An overdose of any mixture may have a similar effect. Therefore, the best material only ought to be employed, and this should be used in moderation, more as preventive of attacks by insects than for their destruction.

Dull weather is the best for fumigation, when there is moisture on the glass and in the laps of the panes, to prevent the smoke escaping, while the fumes remain longer about the trees, through the house not being so much opened as in fine weather. The weather must be calm, and every possible means adopted to retain the smoke in the house by stopping up any bad-fitting joints with old newspapers, and covering the glass with blinds or mats. This will save fumigating material, and occasion less need of a dangerous dose. The foliage must be dry. When fumigation is contemplated in the evening, syringing during the day should be dispensed with, otherwise moisture may rest on the foliage and cause its scorching. It is well to avoid closing the house in advance of fumigating. Peach-houses closed early and damped, but the trees not
syringed, may, from the invisible moisture on their surfaces, be so acted upon by the smoke as to have the leaf tissues destroyed, causing the leaves to become skeletonised, and the fruit to fall. Houses that from adverse weather have been kept close for some time must be fumigated very cautiously and moderately, for the foliage is then tender. Care should be taken to have the air dry and to deliver the smoke cool, always filling the house equally from end to end. A fumigator left a considerable time in one place causes the parts above it to receive a scorching dose, and allowing the material to flare not only wastes smoke but burns the air and foliage.

As a rule it is not safe to fumigate whilst plants or trees are in flower. Ordinarily, the fumigation should precede the expansion of the flowers, preferably before they are much advanced in colour, and if care is taken to have the trees perfectly clean before the blossoms unfold, there will be no occasion to fumigate until the petals have fallen. Two moderate fumigations, one in the evening and the other early the following morning, destroy aphides and thrips more effectually and safely than does one strong dose. Indeed, mild smokings on two or three consecutive evenings are the most satisfactory. Fumigation at fortnightly or monthly intervals prevents attacks by aphis and thrips infestations. Remember that all trouble from insects has a small beginning, and that one or two aphides or thrips let alone may be the forerunners of a plague; therefore, destroy the one first seen, and much trouble and loss will be prevented. Cleanse the foliage by syringing with clear water after the destruction of the insects, either in the morning or evening succeeding the fumigations. It is, however, from whatever point of view regarded, cultural or economical, far better to prevent than destroy the insect pests of vines and fruit trees.

There are many forms of fumigators. For use in all of them the tobacco paper or rag must be torn in pieces proportionate in size to the fumigator. Some fumigating materials require no blowing, but tobacco paper, as a rule, requires the use of bellows, and damping to insure smoke without flame. For frames, small houses, and direct application of the smoke to parts infested, Bloxham’s Patent Fumigator, Fig. 99, is handy. It consists of a short barrel for holding the tobacco paper, a diminishing tube for delivering the smoke, and bellows beneath the barrel to insure combustion and force the smoke through the funnel. With a hole bored in the side of a frame or small house to admit the funnel, the operator may fill the structures with smoke from outside.

Fumigators are readily formed of sheet-iron, saucepan-shaped, with a perforated bottom for air, a lid to prevent the material bursting into flame, three short legs to keep the implement off the floor, and a handle for carrying. A typical form is that
known as Appleby's, Fig. 109. These forms are adapted for preparations of tobacco paper, burning without the use of bellows. Hard-burned 8-inch flower-pots may be improvised for fumigating. Stand each pot on a couple of bricks placed about 2 inches apart on the floor, having the pots about 9 feet apart, but half that distance from the ends of the house; and a cloud of smoke may be had that will quickly fill the structure. Be extremely careful that the tobacco does not break into a flame, preventing it by a sprinkling of water very gently applied.

In large establishments an ordinary 4-inch sieve, with a forked stick secured beneath it to form a handle about 3 feet long, serves as an efficient and expeditious fumigator. A few hot cinders are placed in the sieve on which the tobacco paper is spread, and a cloud of smoke arises, speedily filling the house. One person carries the sieve and another attends with damp tobacco paper torn in pieces, and a watering can with a fine rose. It is simply a matter of walking through the houses, shaking the sieve, replenishing it with tobacco paper, damping when necessary to prevent blazing, and exercising judgment as to when to withdraw from the house. There is little danger of scorching by this plan, and it is one of the oldest, simplest, and best modes of fumigation with tobacco paper. Though hot cinders are mentioned in connection with this subject, red-hot charcoal is better, for there are always some sulphurous emanations from cinders. Campbell's "Rolls," McDougall's "Sheets," and Fowler's "Cones," are largely employed in fumigating.

Spraying.—All the solutions and mixtures advised as fungicides or insecticides, unless otherwise directed, are to be distributed in a fine mist or vapour-like spray, or made to ascend and fall, so as to cover the under as well as the upper sides of the leaves, shoots, and fruits with moisture. It is of the utmost importance that every part of the tree be reached. Drenching trees by means of garden engines or syringes that cause more of the solution or mixture to run off than remain on the leafage is wasteful, and more or less injurious. The solution or mixture should never be applied so as to drip from the ends of the leaves or points of the fruits, or the former may die at the tips, and the latter have discoloured patches.
Calm, mild weather should, as far as possible, be chosen for spraying. For leaf-eating caterpillars the work is best done early in the day, so that the leaves become dry before the sun acts powerfully on them, and dull in preference to clear days should be selected. Insects that feed by sucking the juices are best sprayed in the evening, as are trees under glass. The solution or mixture then remains the longest possible time acting on the insects. Early treatment is of paramount importance.

**Sprayers.**—Every owner of a garden, fruit plantation or orchard should possess a spraying machine for the effectual and economical distribution of fungicides and insecticides. There are many forms, most or all being good for their devised purpose, and readily obtainable.

Where only a few trees are grown one of the ordinary brass syringes fitted with a spraying nozzle will answer. Stott’s syringe, shown in the engraving, Fig. 101, is fitted with a chamber marked $A$, which can be disconnected and charged with fungicide or insecticide. The water, in that case, in filling the syringe becomes thoroughly impregnated with the mixture or solution, and the nozzle is made to distribute it in the form of spray.

Snow’s Patent Garden Pump (Fig. 102) has the advantage of simplicity and usefulness. It is adaptable for placing and adjusting in any ordinary pail, and needs no packing. The insecticide is distributed in extremely fine spray, and there is no waste, as the escape all returns to the pail. Appliances of this kind are a necessity in amateurs’ gardens as well as for use under glass. Messrs. Osman & Co., Commercial Street, London, E.C., have obliged with the accompanying illustration.

For gardens and small fruit plantations an engine fitted with a force pump and spray producer, holding from 15 to 30 gallons, is extremely useful, and often indispensable.
The "Stott" Tree and Plant Washer (Fig. 103) combines washing and spraying principles. With the sprayer (Fig. 104), and hose attached, the engine, with improved air vessel, insures a steady continuous stream of spray being distributed to the under sides of leaves as well as to all parts of trees at the will of the operator. The Stott Fertiliser and Insecticide Company, Limited, Barton House, Manchester, have kindly supplied the illustrations of their three specialities.

Where it is not convenient to use a wheeled engine, M. Vermorel's French Knapsack Pump "Eclair" will do the requisite work. This ingenious and useful appliance (for the illustration of which, also the Torpille Duster, we are indebted to Messrs. C. Clark & Co., 20, Great St. Helens, London, E.C.) has proved highly satisfactory on Lord Sudeley's extensive fruit farms at Toddington. There are various modifications of the Knapsack. It contains an air vessel that increases the power of the pump, insuring a stronger spray which is continued for some time without working the handle. The advantages of the Knapsack are that it may be used where the ground is occupied with bush fruit in the spaces between the rows of standard trees, and the movement of the operator keeps the liquid agitated, a very necessary point in spraying with Paris-green. This engine, as will be seen by the illustration (Fig. 103), is carried upon the back, and secured with straps over the shoulders of the operator. It is strongly made of copper, yet is not heavy, and provided with a stout rim at the bottom, so that it may be set on the ground safely for the purpose of filling.

The opening for this purpose, at the top, is furnished with a wire sieve, which prevents material entering that might choke the nozzle. The vessel holds about \(3 \frac{1}{2}\) gallons, and weighs when filled about 40 pounds. The machine is worked by a handle with one hand, and the spray directed where required by the other. It works for two hours.
without re-charging, and is well adapted for bush and young standard trees up to a height of 15 feet. For tall trees the delivery pipe or hose can be lengthened, and the latter with nozzle attached raised by a light cane or stick. This necessitates the help of a boy. Ordinarily, one man can use the machine.

Mr. C. Lee Campbell has found a machine manufactured by Messrs. Boulton & Paul, Norwich, very serviceable in his plantation of about 6,000 trees. The machine is an ordinary water-barrel, holding about 36 gallons, mounted on broad wheels and drawn by hand. A powerful pump fixed at the rear end of the barrel, with two delivery hose-pipes attached, which may be lengthened to any necessary extent, will spray to a height of 30 to 40 feet. "Three men go with the apparatus, two men to spray and one to pump. Should the wind, however, be rough, we cannot always use two sprayers. The two sprayers assist in drawing the barrel. The rapidity of spraying necessarily depends somewhat on the wind, because as the spray is effective at least 50 feet in quiet weather, it follows that in bad weather we are reduced to operate on a small area. I am able to spray 3,000 trees a day under ordinary circumstances. . . . Messrs. Boulton & Paul, at my suggestion, have arranged the pump so that with every movement of the handle the dashers are agitating the liquid. Stott's double sprayer, fixed to the end of the tubes, works admirably, and economises the liquid immensely, besides rendering it less needful for the men's hands to be constantly wet."—(Fourteenth Report of Observations of Injurious Insects, page 101.)

Hemingway's American force-pump is adaptable for fixing on a water barrel or to be fed from a cask or pail. It delivers a dense spray, so that a large tree may be covered in one minute. When furnished with two outlets, one can be turned into the vessel, thus keeping the contents completely mixed. This is a capital spraying machine for large orchards and plantations.
APPLES.

"May the Almighty bless thee with the blessings of Heaven above, and the mountains, and the valleys; with the blessings of the deep below, with the blessings of grapes and apples." Such is said to have been the invocation of the archbishop in the ancient Saxon rite of coronation. Thus early were these valuable fruits appreciated, and if at the present time the votes of growers and consumers of fruit could be taken as indicating their preferences, it is practically certain that the majority of those votes would be cast in favour of the two kinds extolled as "blessings" by our forefathers above a thousand years ago—grapes and apples. While both kinds will have the attention to which they are entitled, the latter claims priority here, for what the wheat is in our grain crops, the potato in our root crops, the cabbage in our green crops, the apple is in our fruit crops—the most serviceable and substantial.

It has been cultivated from the earliest times, and over a wide area of the earth's surface. The apple was grown by the Greeks in the time of Homer, and in their mythology was held sacred to Venus. Epicurus, the "garden philosopher," who died B.C. 270, was not only a cultivator of fruit, including apples, but was acquainted with some of the methods now adopted for facilitating the bearing of the trees, and the so-called "modern" system of root pruning may be fairly regarded as twelve hundred years old. Apples were grown by the Romans, who, according to Pliny, introduced varieties from Armenia, and it has been assumed by some writers that we are indebted to the Romans for the introduction of this fruit into Britain. It may be admitted as probable that some varieties were brought by them, yet it is almost certain that the apple was cultivated by the Britons long anterior to the Roman invasion. This is evident by the etymology of the name Avall or Aball, as it was called in the Welsh and Irish dialects, and, further, the town which occupied the site of Glastonbury, in Somersetshire, was known when the Romans first visited it as Avallonia (apple orchard). This would appear conclusive that the apple is indigenous to this country, and has been grown from time immemorial, for an "apple orchard" certainly implies cultivation. But though the apple, known in its wild state as the crab,
(Pyrus Malus), is indigenous to the British Isles, it is equally so in other temperate regions of the globe.

It does not succeed beyond 60° north latitude, the cultivated varieties requiring to be grown against walls in the Orkney Isles; but although not succeeding in the coldest parts of Europe, it is equally impatient of a high temperature and dry atmosphere: consequently the fruit does not obtain the excellence south of 50° north latitude that it does between 50° and 55°. Increased sun heat without a corresponding amount of moisture may give colour, but it is in this particular case destructive of juice; therefore, we stand unique in our advantages of warmth from the Gulf Stream and of moisture from our insular position, the most wholesome, lasting, and generally useful fruit attaining a combination of qualities in this country not excelled in any part of the world.

The supposition that the progenitors of the existing varieties of apples were introduced from the Continent, and not originated here by cultivation, selection, and cross fertilisation of improvements on the crab is not only unpatriotic but ill founded. Nature gives evolutions slowly, yet surely. In the wild state there are crabs and crab-apples, and our predecessors in cultivation would not be backward in availing themselves of manifest improvements in whatever way they might originate. Dr. Hogg, the greatest living authority on pomology, states in his extremely valuable work, "The Fruit Manual," that the Api or Lady apple was first discovered as a wildling in the forest of Api in Brittany, also that it was alleged to have been brought from Peloponnesus to Rome by Appius Claudius; but it was not known in this country till towards the close of the seventeenth century, when we had such excellent varieties as Golden Reinette, Golden Russet, Juncating, Royal Russet, and Summer Pearmain; and not only those but others distinguished by local names, such as Devonshire Quarrenden, Kentish Pippin, London Pippin, Ribston Pippin in Yorkshire, and Oslin in Scotland. At the same time we had Calville Blanche, a Continental variety; but none showing our particular indebtedness to the continent of Europe. True we had Borsdörffer from Germany in 1785, but the Scotch Hawthornden was known in London about 1790. Gravenstein came from Germany, and English-grown fruits were first exhibited in 1819; Duchess of Oldenburg and Emperor Alexander from Russia, and Red Astrachan from Sweden in 1818. But a shoemaker at Keswick, named Greenup, had in his garden Greenup's Pippin, or Yorkshire Beauty, at the close of the last century, and we had already begun to import trees from our progeny in America, Newtown Pippin being cultivated here in 1768. Our indebtedness to continental Europe for apples as parents of our best varieties is, therefore, over-estimated. We
had the very characteristic old English Pearmain grown in Norfolk so early as 1200, and the Costard is mentioned in the fruiterers' bills of Edward I. in 1292; while of the Golden Pippin, still in cultivation, Switzer wrote in 1724, describing it as "the most antient as well as the most excellent apple that is."

The Sendamore Crab or Red Streak, a Herefordshire apple, and Ashmead's Kernel, a Gloucestershire native, prove conclusively that our present varieties are due to the enterprise of our ancestors. Mr. T. A. Knight was the raiser of many varieties by cross fertilisation, Red Ingestre and Yellow Ingestre both originating from two pips taken from the same cell of the core, the result of crossing Orange Pippin and Golden Pippin; and Wormsley Pippin remains a living monument of an eminent man, though he was wrong in his theory that a variety could not exist more than two hundred years. Apple seedlings are proverbially apt to sport, and cannot be relied upon as coming like the parents. This shows long subjection to natural cross fertilisation effected by insects, particularly bees. It is, however, noteworthy that Waltham Abbey seedling was raised from seed of Golden Noble, which so closely resemble each other as to be scarcely distinguishable; and in Welford Park Nonesuch, we have an assumed crossing of Golden Harvey by Lamb Abbey Pearmain, both small fruits producing a large, with a great loss of quality. Two forces have been at work—nature and cultivation; from the crab nature evolved the crab apple, then man by cultivation and selection produced large apples and not luscious, for the richest in flavour are, as a rule, medium-sized or small.

So great is the hygienic value of apples that there is not a dwelling in the land which can be regarded as satisfactorily furnished with wholesome food without a supply of them during their season of use, and this is nearly all the year round. With well-chosen varieties, and suitable provision for keeping the fruit, home-grown apples may be had every week in the year, but not usefully and profitably in bulk for regular culinary purposes. Nor is an absolutely unbroken supply needed. Two or three practically appleless months give a rest to the palate that might pall under a continual feast of one kind of fruit. It is enough to know that apples can be had every month of the year, if they are wanted, while the season of a full supply is long enough, namely, from the middle of July to the middle of April. There is no other kind of hardy fruit that can be used in a fresh state over such a period, and in so many different ways, and this fact alone gives it pre-eminence. It is a rich man's fruit and a poor man's fruit, and trees should be planted in every garden in which they will thrive. There are varieties of apples and forms of trees adapted for different soils, localities, and positions; and it is
hoped the time is not far distant when, under favourable seasons, our populations will be afforded an adequate supply of apples as the produce of home industry; or, in other words, have a full and satisfactory provision of British fruit grown in British soil.

Relative to the uses of apples, they have been concisely enumerated by Dr. Hogg in his Vegetable Kingdom. He says:—"The apple is the most useful of all British fruits. It is an important article of food in the form of pies and puddings, and in some countries a necessary beverage is made from its juice, and called cider. It also affords several delicacies, as sauces, marmalades, and jellies, and is highly esteemed as a dessert fruit. When baked in ovens and flattened in the form of round cakes, apples are called 'Beefings,' and large quantities are dried in Normandy and America for use during the winter, when they are stewed and used in pies. Roasted apples are remarkably wholesome. They have a laxative effect and strengthen a weak stomach, and they are equally efficacious in putrid and malignant fevers, with the juice of lemons and currants. There is an old English beverage called 'Lamb's Wool,' or more properly, Limasool, composed of ale and the pulp of roasted apples with sugar and spice. It is so called from La maes abhal, which, in ancient British, signifies the day of apple fruit, from being drunk on the apple feast in autumn. In France, a sort of rob, called by the Parisians 'Raisinée,' is made by boiling any given quantity of new wine, skimming it as often as fresh scum rises, and when it is boiled to half its bulk, straining it. To this, apples, pared and cut into quarters, are added. The whole is allowed to simmer gently, stirring it all the time with a wooden spoon, till the apples are thoroughly mixed with the liquor, and the whole forms a species of marmalade which is extremely agreeable to the taste, being sweet, with a slight flavour of acidity, like lemon mixed with honey. In this country, where new wine in sufficient quantity and at a reasonable price, cannot be obtained, cider may be substituted. From the juice of the wild crab, Verjuice is obtained, which is good against strains, spasms, and cramps. 'Pomatum' receives its name from being originally made of the pulp of apples mixed with lard. The wood of the apple tree is very fine-grained, hard, and compact, and when green weighs from 48 lbs. to 56 lbs. per cubic foot; when dried it loses about a tenth. It is used for turning and various purposes where hardness and variegation of colour are objects. The small cherry apple, or scarlet Siberian Crab as it is sometimes called, is Pyrus baccata, a native of Siberia, where it is used for making 'quasar punch.' It is a highly ornamental tree in this country, and its fruit makes an excellent preserve."

The relative proportions of the constituents of apples differ somewhat with the
varieties, also under soil and climatal influences. Perhaps no fairer average analysis can be presented than that of Professor Church in one of the science handbooks of the South Kensington Museum, entitled Food. The chief constituents, omitting a small quantity of essential oil, are represented as follows:—

<table>
<thead>
<tr>
<th></th>
<th>In 100 parts</th>
<th>Oss. Grm.</th>
</tr>
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<tbody>
<tr>
<td>Water</td>
<td>83-0</td>
<td>13</td>
</tr>
<tr>
<td>Albumen</td>
<td>0-4</td>
<td>0-28</td>
</tr>
<tr>
<td>Sugar</td>
<td>6-8</td>
<td>1-36</td>
</tr>
<tr>
<td>Malic acid</td>
<td>1-0</td>
<td>0-70</td>
</tr>
<tr>
<td>Pectose, pectine, and gum</td>
<td>5-2</td>
<td>0-364</td>
</tr>
<tr>
<td>Cellulose</td>
<td>3-2</td>
<td>0-224</td>
</tr>
<tr>
<td>Mineral matter</td>
<td>0-4</td>
<td>0-28</td>
</tr>
</tbody>
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The practical deduction from these figures is this:—For one pound of flesh-formers in apples there are twenty parts of heat-givers reckoned as starch.

It is not uncommon to find the value of apples for consumptive purposes prejudiced because of the quantity of water they contain. No doubt eighty-three pounds in a hundred seems a large proportion, but it is forgotten that lean beef contains seventy-three pounds, and this proportion of water to solid mixed food is not enough for maintaining a man in health, the requisite percentage being 81-5. Yet apart from the question of nutritive properties, Dr. Church says: "Fruits are especially valuable on account of their potash salts, the citrate, malate, and tartrate. When fish or meat which has been preserved with common salt forms the chief article of diet the blood loses much of its potash compounds, and becomes unhealthy unless the loss be made up. Fresh fruits effect this, and they have a nutritive value, if a small one; and besides that their flavour and juiciness may serve to stimulate a weak appetite, to give variety and lightness to our otherwise solid diet, and to contribute in a palatable and refreshing form much of the water required for the daily needs in digestion and assimilation." Thus the water that apples contain is an essential, and ought not to be condemned; moreover it is certain that if the bacon-eating populations of rural villages, and the thousands of townspeople and children whose "animal" food is confined largely to herrings, could obtain a more abundant supply of good fresh fruit, it would be conducive to physical and mental strength and general health improvement.

The best samples of fruit grown in our villages and sold in our markets are too dear, because scarce, for the great mass of consumers to benefit by; and the trash, which so largely abounds, is the reverse of tempting in appearance, and contains too much indigestible tissue to render it acceptable or beneficial. The great aim of cultivators should be
to diminish the supply of inferior and increase that of superior fruit; and when it is stated as a fact, demonstrated by science and proved by experience, that the latter can be produced at less cost than the former, it follows that really good apples, tempting in appearance, fleshy, and juicy, can be grown and sold at prices now paid for third-rate produce without any loss whatever to the cultivator, but, on the contrary, a distinct gain, for the demand would increase enormously and small profits arising from large sales give the best returns to producers of popular commodities. The apple supply will have to be improved and cheapened, and it depends on British cultivators whether this is done by themselves or by others equally skilful and more enterprising in distant lands. We have the best of soil and varieties and the object in view can be accomplished at home, but only in one way, and that is by making the best use of both.

It does not follow that the chief endeavour of all growers of apples in this country will be the making of money by them. The enormously greater number of garden owners must grow the fruit for home use, not for sale. The limited space which they can devote to the culture precludes their competing in markets in the selling of fruit, but too many now have to compete as buyers, who might relieve themselves of the necessity by planting trees adapted for their positions and requirements. These vary considerably. Most persons who have gardens, and cherish them, strive to render them interesting as well as useful. They find charm in variety, and this charm is quite as great in fruits as in flowers. A hundred apple trees grown for the sale of the fruit alone might be profitably limited to a dozen varieties, but if the chief object were a steady and prolonged home supply, and a testing by comparison of approved sorts, not less than ten times the number indicated would probably give satisfaction. Fruit growing is fascinating, and those who engage in it as a pleasurable occupation do not long remain content with a little knowledge on a few varieties, but desire to add new and approved sorts to their collections, also to become practically acquainted with different methods of culture and forms of trees.

The need, therefore, of an early, successional, and late supply of apples, for dessert and culinary purposes, imposes an absolute imperative duty on the cultivator to meet it fully and to the satisfaction of all classes. To effect this the procedure must be in accord with the object. If a supply is required of the choicest varieties in the highest degree of excellence the means employed must be adequate, supplemented by cultural skill. Superior means alone do not suffice, but, other conditions being favourable, it follows that fruit grown on dwarf trees in sheltered situations and fertile soil in gardens
is finer as a whole than that produced by practically unaided trees in orchards. This is demonstrated at the tables of the affluent and at horticultural shows. It may be observed that dwarf apple-trees that do not exceed man's stature are always under the eye, ever interesting and a never-failing source of enjoyment to those who delight in their cultivation.

**Varieties for Cultivation.**

In the following selection of varieties for cultivation, we have striven to limit the small sorts to as few as is consistent with the requirements of the connoisseur, giving most prominence to the medium sized, which combine the greatest amount of quality with usefulness. To large apples we have devoted a legitimate and, in some respects, a generous share of attention. There are too many soft mid-season varieties, too few of the Bramley's Seedling and Lane's Prince Albert type, which are not only large, but possess free cropping, long keeping, and high cooking qualities, and are admissible for dessert. In seeking further improvements we must aim at the three essentials of good appearance, good quality, and long continuance in usefulness. Endeavour has been made to reduce the bewildering number of apples now in cultivation, by describing only 150 well-proved, reliable, or promising varieties, and persons who desire more can choose from the *Fruit Manual* and catalogues of the leading fruit nurserymen.

We have made ample, it may be considered too ample, provision for the majority of planters. We would gladly have still further reduced the number, but there are so many useful purposes to which apples can be put, and so many different tastes to be catered for, that a copious selection was essential for giving general satisfaction, and greatly condensed lists will be found for special purposes and positions. Some local sorts will be referred to, and varieties not named that afford great satisfaction in certain districts are advised to be grown in those districts.

The varieties are arranged in three sections, viz., small, medium, and large fruited for **Dessert**, **Dessert and Culinary**, and **Culinary use**; further dividing each section into early, mid-season, and late under their respective headings, and varieties are enumerated for quality, beauty, and free bearing.

Selections are also made of the varieties most suitable to the climate in the different parts of these islands, also to the varied geological strata or soils that obtain in, perhaps, the most diversified country under the sun. These will assist cultivators in the endeavour
to produce the essentially British apple in a perfection and at a price defying competition, alike to their own advantage and for the good of our common country; and still further selections are made for particular methods of culture.

The time of fitness for use depends upon seasons and localities. To each variety is appended its usual earliest and latest month for that purpose. Some of the soft early varieties may be used when sufficiently large, or the size of walnuts. This applies to all the Codlin race, so well represented in Keswick Codlin, its fruits being available for tarts in July, sometimes in June. This early gathering or thinning is of obvious advantage to the grower, also to the well-doing of the current and future crops, and it is the same with the winter using sorts.

It may be stated that the name "codlin" is derived from coddle, to parboil; and the name "pippin" from the French pepin, the seed of an apple; and was originally applied to trees raised from seed, not from cuttings or by grafting.

The terms used in describing the varieties practically explain themselves—angular meaning angled or ribbed, ovate or oval meaning egg-shaped, and every term if taken in its literal sense will be understood, while the engravings on this page and page 320 will enable the relative sizes and shapes to be appreciated.
We desire to express acknowledgments to Dr. Hogg's *Fruit Manual* for information and descriptive matter, also to the Royal Horticultural Society's *British Apples*, particularly in respect to the newer varieties; the former scientific work gives full descriptions of over 800, and in the latter 1,545 presumably distinct varieties are alluded to.

**DESCRIPTIVE SELECTION OF APPLES.**

(Arranged Alphabetically.)

I. DESSERT VARIETIES—FRUIT SMALL.

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*Early Apples—season, August to October.*

**Beauty of Bath.**—Fruit flat, greenish yellow, flushed and streaked with red; flesh white, tender, juicy, and sweet. A pretty apple. August and September.

**Devonshire Quarrenden.**—Flat, dark red; flesh white, tinged with green, juicy, brisk yet sweet. A great and certain bearer. August and September.

**Duchess's Favourite.**—Fruit round, red; flesh white tinged with red, crisp, juicy, brisk. Great bearer and a very fine apple. September.

**Juneating (or Early Red Margaret).**—Roundish ovate, slightly angular, reddish crimson, striped; flesh greenish white, juicy and vinous. Early August.

**Kerry Pippin.**—Fruit oval or rounded, pale or greenish yellow, russety, tinged and streaked with red or crimson; flesh yellowish white, firm, crisp, juicy, brisk, rich. Good bearer. September and October.

**Lord Lennox.**—Fruit flat or roundish, orange, streaked with crimson; flesh firm, yellowish white, juicy, and brisk. A free bearer and attractive market apple. September and October.

**Mr. Gladstone.**—Fruit conical, angular, reddish crimson, streaked; flesh white, tender, juicy, sweet. Good bearer. End of July or early August.

**Oslin.**—Flat, orange yellow with russety dots; flesh yellowish, firm, juicy, aromatic. Great bearer. End of August and September.

**Summer Throle.**—Flat, greenish yellow, flushed and streaked with red; flesh yellowish white, firm, crisp, very juicy, brisk. Great bearer. August.

**Yellow Ingastrie.**—Fruit conical, even, clear yellow tinged with deeper yellow and faintly spotted with pink; flesh yellow, firm, crisp, brisk, vinous. A great bearer and favourite market apple. September and October.

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*Small Midseason Apples—October to January.*

**Court of Wick.**—Roundish ovate or conical, yellow streaked with orange red, russety; flesh yellow, firm, yet tender, crisp, juicy, rich. October to January. A great bearer.

**Golden Harvey.**—Conical, pale, yellow, russety, flushed and streaked with brownish red; flesh yellow, firm, crisp, juicy, rich, aromatic. Good bearer. December to April.

**Golden Knox.**—Round, grey russet on greenish ground, tinged with orange; flesh firm, greenish yellow, brisk. Great bearer, much grown in Kent. December to March.

**Hubbard's Pearmain.**—Ovate, pale brown russet, darker on sun side, flushed with brownish red; flesh yellow, firm, sweet, aromatic. November to March.

**Lecombe's Pine Apple.**—Fruit conical or ovate, yellow tinged with orange, russety; flesh yellowish white, tender, juicy, rich, aromatic, somewhat resembling a pine apple. October to January.

**Pearson's Plate.**—Conical or oblate, greenish yellow, washed and mottled red, streaked with deeper red, russety; flesh greenish yellow, firm, crisp, juicy, brisk, rich. December to March.

**Pine Golden Pippin.**—Roundish, angular, sometimes even, light russet with grey specks; flesh white, juicy, sprightly, pine apple flavour. October and November.

**Pitmaston Pine Apple.**—Conical, even, pale brown russet, on yellow ground; flesh deep yellow, crisp, tender, juicy, and rich. December to February.

**Scarlet Golden Pippin.**—Conical, golden russeted, streaked with red; flesh yellow, tender, juicy, rich. Attractive. October to January.

**Suke House Russet.**—Roundish oblate or flat, yellowish green, russety, with silvery scales; flesh yellowish,
flesh, crisp, juicy, very rich. A Yorkshire apple. Good bearer. October to February.

**Werder's Golden Reinette.**—Round, even, pale yellow, flushed with red; flesh yellow, crisp, brisk, juicy, sweet. A pretty apple. November to March.

**Small Late Apples—December to May.**

**Ashmead's Kernel.**—Round, flattened, greenish yellow covered with light russet, brown on the sun side; flesh yellowish, firm, crisp, juicy, rich, aromatic. January to May.

**Lamb Abbey Pearmain.**—Conical, greenish yellow, flushed and streaked with red; flesh yellowish white, firm, crisp, juicy, rich. January to April.

**Lord Burghley.**—Roundish, flattened, angular, greenish yellow, bronzed and russeted; flesh yellowish, crisp, brisk, juicy, rich. January to May.

**Nonpareil.**—Roundish, broad at the base and narrowing to the apex; yellowish green and russety; flesh greenish, crisp, juicy and aromatic; one of the best late table apples. January to May.

**Sturmer Pippin.**—Roundish, green, lightly covered with brown russet, and bronzed on the sun side; flesh yellow, firm, crisp, very juicy and rich. February to June.

**Wyken Pippin.**—Oblate, even, greenish yellow, slightly flushed with orange, with russety spots; flesh yellow, tinged with green, tender, juicy, sweet. A pretty apple, and good bearer. December to April.

II. DESSERT VARIETIES—FRUIT MEDIUM-SIZED.

**Early Apples—season, August to October.**

**Benoni.**—Bright yellow, crimson on sun side; flesh tender, sprightly and delicious. Good bearer. August and September. An American apple of great excellence in favourable soils and positions.

**Early Harvest.**—Round, yellowish green, waxen when ripe, with a faint red blush; flesh white, tender, juicy, sub-acid. End of July or early August.

**Irish Peach.**—Roundish, slightly angular, greenish yellow, tinged and streaked with lively red; flesh greenish white, tender, crisp, juicy, rich. A good bearer. August and September.

**Lady Sudeley.**—Fruit conical or oblong, greenish yellow streaked with red; flesh tender, juicy, sweet. Handsome, and a great cropper. August and September.

**Pine Apple Russet.**—Roundish ovate, greenish yellow with light grey russet, flushed red; flesh pale yellow, tender, crisp, juicy, brisk yet sweet, aromatic. September and October.

**Red Astraachan.**—Roundish, greenish yellow, covered with deep crimson, and a grey bloom; flesh white, crisp, juicy, sweet. A very handsome apple, requiring to be eaten off the tree. August and September.

**September Beauty.**—Fruit roundish, slightly angular, orange red, streaked with crimson; flesh tender, juicy and piquant, glossy and beautiful. September and October.

**Worcester Pearmain.**—Conical, brilliant red, with grey bloom; flesh tender, crisp, very juicy, sprightly, sweet. A very handsome apple and a great bearer. September.

**Midseason Apples—October to January.**

**Adam's Pearmain.**—Conical, greenish yellow, tinged with red, slightly russety; flesh yellowish, crisp, juicy, rich, perfumed. December to February.

**American Mother.**—Conical, angular, golden yellow, covered with patches of crimson, streaked with russety dots; flesh yellowish white, tender, crisp, juicy, rich. A handsome apple. October.

**Brownlee's Russet.**—Roundish ovate, green and russety, brownish red on sun side; flesh greenish white, tender, juicy, sweet, briskly flavoured, and aromatic. January to May.

**Claygate Pearmain.**—Conical, greenish yellow, streaked with red, russety; flesh yellowish, crisp, juicy, rich, rivalling Ribston Pippin. Free bearer. November to February.

**Cooble's Pippin.**—Conical or ovate, greenish russet, dotted with grey; flesh yellowish, firm, crisp, rich, aromatic. A Sussex apple of the highest excellence. December to April.

**Cornish Gilliflower.**—Ovate, angular, greenish yellow streaked with brownish red, slightly russeted; flesh yellowish, firm, rich, aromatic. Bears on the extremities of the shoots. December to May.

**Cox's Orange Pippin.**—Roundish ovate, even, greenish yellow, flushed and streaked with red; flesh yellowish, crisp, tender, juicy, rich, perfumed. One of the finest of apples, but does not succeed on cold soil. October to December.

**Frarn's Pippin.**—Roundish or flat, greenish yellow, streaked and flushed with red; flesh yellowish white, firm, crisp, juicy, brisk, sweet. Very hardy and a great bearer. November to February.

**Egremont Russet (Petworth Nonpareil).**—Roundish ovate, greenish yellow when ripe, and russety; flesh greenish, crisp, and juicy. A full bearer, and useful. November to March.
APPLES.

FLESH

SELECTIONS

FREE

MANNINGTON'S GOLDEN MARGIL. ALLEN'S MELON YELLOW SUMMER DEVONSHIRE Bc-auty.

to crimson firm, russet, Round, flushed to white, with quiring with lemon apple crisp, warm November sety, to crimson free bring First of Ingestrie. JULY American Thorle.

RUSSET. EVERLASTING. LATE OF Ski-deen.

to crimson red, Late pale Bath. November situation. Conical, flushed and slightly to crimson red; flesh greenish yellow, firm, rich, with a smack of Ribston flavour. November to April.

BRADDICK'S NONPAREIL. Roundish, flattened, inclined to ovate, brownish red, russety; flesh yellowish, firm, sweet, and aromatic. Great bearer.

COURT PENDÚ PLAT. Flat, yellow, russet, deep red on the sun side; flesh yellow, firm, crisp, juicy, rich. Late flowering. Free bearer. December to May.

DUKE OF DEVONSHIRE. Roundish ovate, lemon, russety, dull red cheek; flesh yellowish, crisp, juicy, rich, perfumed. January to May.

PECK'S PLEASANT. Round, green, olive when mature; flesh greenish white, tender, juicy and pleasantly sub-acid flavour. December to April.

ROSEMARY RUSSET. Ovate, yellow tinged with green, flushed faint red, covered with brown russet round the eye and the stalk; flesh yellowish, crisp, tender, juicy, brisk, rich, and highly aromatic. December to February.

SCARLET NONPAREIL. Round, greenish yellow, flushed with deep scarlet; flesh yellowish white, firm, juicy, brisk, rich. Very beautiful; free bearing, and in every respect excellent. January to March.

I. SELECTIONS OF SMALL DESSERT APPLES.

July to October.
First quality varieties.

Duchess's Favourite.
Kerry Pippin.
Oslin.
Summer Thorle.
Yellow Ingestre.

Free bearers.

Beauty of Bath.
Devonshire Quarrenden.
Lord Lennox.
Mr. Gladstone.

October to January.
First quality varieties.

Court of Wick.
Lucombe's Pine Apple.
Pine Golden Pippin.
Scarlet Golden Pippin.
Syke House Russet.

November to March.

Hubbard's Pearmain.
Pitmaston Pine Apple.
Werder's Golden Reinette.

December to April.

Golden Harvey.
Pearson's Plate.
Wyken Pippin.

January to May

Ashmead's Kernel.
Lamb Abbey Pearmain.
Nonpareil.
Lord Burghley.
Sturmer Pippin.
**THE FRUIT GROWER'S GUIDE.**

**VARIETIES IN ORDER OF SUCCESSION.**

*Twelve for quality.*

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<tr>
<th>Variety</th>
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<td>Juneating.</td>
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<td>Odlin.</td>
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<td>Kerry Pippin.</td>
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<td>Court of Wick.</td>
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<td>Pine Golden Pippin.</td>
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<td>Syke House Russet.</td>
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<tr>
<td>Hubbard's Pearmain.</td>
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<td>Golden Harvey.</td>
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<td>Scarlet Nonpareil.</td>
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<td>Wyken Pippin.</td>
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<td>Ashmead's Kernel.</td>
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<td>Stunner Pippin.</td>
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*Twelve for bearing.*

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<td>Syke House Russet.</td>
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<td>Scarlet Golden Pippin.</td>
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<td>Scarlet Nonpareil.</td>
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<td>Werder's Golden Reinette.</td>
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<td>Wyken Pippin.</td>
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*Six for beauty.*

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<th>Variety</th>
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<td>Mr. Gladstone.</td>
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<td>Summer Thorle.</td>
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<td>Devonshire Quarrenden.</td>
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<td>Lord Lennox.</td>
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<td>Court of Wick.</td>
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<td>Hubbard's Pearmain.</td>
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<td>Wyken Pippin.</td>
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<td>Golden Knob.</td>
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<td>Lord Burghley.</td>
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<td>Stunner Pippin.</td>
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*Six for hearing.*

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*Three for quality.*

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<td>Golden Knob.</td>
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**Fig. 108. SHAPES AND SIZES OF APPLES.**

*References: Shape—Left-hand figures, flat; right-hand, oblong. Size—Centre, core and pips; outlines connected with the eye and stalk represent small, medium-sized, and large fruit respectively.*
## II. SELECTIONS OF MEDIUM-SIZED DESSERT APPLES.

**August to October.**
- Benoni.
- Irish Peach.
- Lady Sudeley.
- Pine Apple Russet.
- September Beauty.
- Worcester Pearmain.

**November to January.**
- Fearn's Pippin.
- Melon Apple.
- Ribston Pippin.

**November to February.**
- Claygate Pearmain.
- Egremont Russet.
- Margil.
- Rosemary Russet.

**December to March.**
- Adam's Pearmain.
- Mannington's Pearmain.

**October to November.**
- American Mother.
- Cox's Orange Pippin.
- King of the Pippins.

**January to April.**
- Baddow Pippin.
- Braddick's Nonpareil.
- Cockle's Pippin.
- Golden Russet.

**February to May.**
- Allen's Everlasting.
- Brownlee's Russet.
- Cornish Gilliflower.
- Court Pendú Plat.
- Duke of Devonshire.
- Scarlet Nonpareil.

### VARIETIES IN ORDER OF SUCCESSION.

**Twelve for quality.**
- Irish Peach.
- Benoni.
- American Mother.
- Cox's Orange Pippin.
- Claygate Pearmain.
- Margil.
- Ribston Pippin.
- Melon Apple.
- Cockle's Pippin.
- Scarlet Nonpareil.
- Brownlee's Russet.
- Allen's Everlasting.

**Twelve for bearing.**
- Cox's Orange Pippin.
- Egremont Russet.
- Court Pendú Plat.
- Baumann's Reinette.
- Scarlet Nonpareil.

**Six for bearing.**
- Worcester Pearmain.
- King of the Pippins.
- Fearn's Pippin.
- Claygate Pearmain.
- Mannington's Pearmain.
- Braddick's Nonpareil.

### III. DESSERT OR CULINARY APPLES.

(Arranged Alphabetically.)

**Early and Midseason Varieties—**

**FRUIT MEDIUM.**

**Season, August to January.**
- Barchaud's Seedling.—Fruit roundish, ovate, lemon yellow suffused with bright crimson; flesh yellowish white, juicy and sweet. A great bearer, and much grown for market. October.
- Beauty of Waltham.—Fruit conical, angular, yellow streaked and flushed with crimson; flesh yellowish, brisk, sweet. Very handsome. October and November.

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**VOL. I.**

---
THE FRUIT GROWER’S GUIDE.

BEAUTY OF HANTS (Syn. : Cobham, and Pope’s Apple).
—Fruit conical, even, pale yellow, flushed with crimson; flesh yellowish, tender, crisp, juicy, rich. Very handsome, an early and good bearer, a rival of Blenheim Orange. October to December.

BOSTON RUSSER.—Fruit conical or ovate, angular, brownish yellow russet, tinged with brownish red; flesh yellowish white, juicy, sweet yet brisk. Good bearer. January to April.

BUCKINGHAM.—Fruit oblong, greenish yellow streaked with crimson; flesh soft, juicy, brisk, sub-acid. Very handsome. November and December.

CARDINAL (or Peter the Great).—Roundish, yellow, flecked with red; flesh tender, transparent, sweet and sprightly. Very handsome and free bearing. August and September.

DUCHESS OF OLDENBURG.—Round, angular, greenish yellow, streaked with bright red; flesh yellowish white, firm, crisp, very juicy, brisk and refreshing. Free bearer. September.

DUTCH MIGNONNE.—Fruit roundish, greenish yellow, streaked red, russety; flesh yellow, firm, crisp, juicy, rich, aromatic. Abundant bearer. December to April.

GASCOCQUE’S SEEDLING.—Fruit oblong, pale yellow, flushed and streaked with red, and covered with grey bloom; flesh yellowish, crisp, juicy, rich. A very attractive apple. November to January.

HORMEAD PEARMAIN.—Fruit conical, even, clear yellow, strewn with brown russet; flesh white, tender, very juicy, and pleasantly sub-acid. Useful, and a good bearer. October to March.

HEREFORDSHIRE PEARMAIN (or Royal Pearmain).—Fruit conical, slightly angular, greenish yellow, brownish red, streaked; flesh yellowish, firm, crisp, juicy, sweet but brisk, perfumed. Free bearer. November to March.

LEMON PIPPIN.—Fruit oval with fleshy knob, yellow, streaked or flecked with russet; flesh firm, crisp, brisk. Good bearer. October to March.

MABBOTT’S PEARMAIN.—Fruit conical, orange yellow, streaked with red, minutely spotted; flesh crisp, juicy, brisk, sweet. A very handsome apple. November to February.

PENNINGTON’S SEEDLING.—Fruit flat, yellowish green, russety, tinged with brown; flesh yellowish, firm, juicy, brisk, aromatic. December to April.

RHODE ISLAND GREENING.—Fruit round, angular, palish green, very slightly tinged; flesh yellowish or pale green, crisp, tender, juicy, rich but brisk, aromatic. A first-rate apple, good bearer. December to April.

STAMFORD PIPPIN.—Fruit roundish or ovate, yellowish green tinged with orange; flesh yellowish, firm, crisp, brisk, with a pleasing aroma. January to April.

WEALTHY.—Fruit round, uniform, red; flesh juicy, with a rich, vinous flavour. An attractive and productive American apple. October and November. Probably more suitable for the south than the northern counties.

MIDSEASON AND LATE VARIETIES—
FRUIT MEDIUM TO LARGE.

October to May.

BAXTER’S PEARMAIN.—Fruit oblong, slightly angular, pale green, flushed and streaked with red, russety; flesh yellowish, firm, brisk, sweet but pleasantly flavoured or sub-acid. A free and certain bearer. November to March.

BLENHEIM PIPPIN (or Blenheim Orange).—Flat or globular, orange, tinged with dull red, and streaked with deeper red, flesh yellow, crisp, juicy, rich, but with a pleasing acidity. A popular apple, but does not bear freely in a young state, and is generally a moderate bearer. November to Christmas.

CALVILLE MALINGRE.—Fruit round, angular, pale yellow, with red flushed, streaked; flesh white, crisp; juicy, and vinous, pleasantly acid flavoured. A very handsome apple, and one of those particularly and peculiarly suited to invalids. A good bearer, but requires a warm soil and situation. January to April.

COX’S POMONA.—Fruit ovate, angular, greenish yellow, flushed and streaked with red; flesh yellowish white, tender but crisp, juicy, sweet, and perfumed. October and November. A beautiful apple.

DOCTOR HARVEY.—Fruit round, pale yellow, slightly russeted; flesh white, crisp, juicy, pleasant acidity, perfumed. One of the oldest English apples; good and a great bearer. October to January.

GRAVENSTEIN.—Fruit round, flattened, pale waxen yellow, streaked and dotted with crimson, and a flush of orange on the sun side; flesh white, crisp, rich, juicy, vinous, aromatic. A first-class German apple. October to December.

KING OF TOMKINS COUNTY.—Fruit large, angular, greenish yellow, streaked with red, and suffused with pink; flesh white or greenish, very tender, juicy, brisk, and pleasantly flavoured. Very handsome and excellent, free bearing, and though an American apple, succeeds admirably in this country in good soil and situations. November to May.
Lady Henniker.—Fruit large, oblong, angular, yellow, flushed and streaked crimson; flesh white, tender, juicy, and perfumed. October to January.

Lewis’s Incomparable.—Fruit conical, yellow, covered with a lively red, streaked crimson, russety dots; flesh yellowish, firm, crisp, juicy, sweet but brisk. A handsome fruit and tree, a good bearer. December to February.

Peasgood’s Nonesuch.—Fruit roundish or conical, even, greenish yellow, covered with reddish purple, and streaked with crimson; flesh yellowish, tender, juicy, pleasing acidity. A Lincolnshire apple and one of the most beautiful in cultivation. October and November.

Reinette de Canada.—Fruit conical or ovate, flattened, greenish yellow, flaked with brown, dotted russet; flesh yellowish white, firm but tender, juicy, brisk, and pleasantly flavoured. A fine apple of the highest excellence, requiring a good soil and situation; free bearer. November to April.

Wadhurst Pippin (or Lincoln Holland Pippin).—Fruit round, greenish yellow, flaked with brownish red, and streaked with crimson; flesh greenish yellow, firm, juicy, sweet, but briskly flavoured. Good cropper, succeeding in cold localities. October to February.

Washington.—Fruit round, greenish streaked with red; flesh white, very tender, juicy; pleasantly flavoured. A very fine apple, requiring a warm soil and situation. October to Christmas.

Wormsley Pippin.—Fruit ovate, angular, clear yellow, tinged with orange, and covered with dark spots; flesh yellow, crisp, tender, sweet but brisk and aromatic. A very fine apple, and free bearer. September and October.

Selections of Medium-Sized Dessert or Culinary Apples.

August to October.

Cardinal.
Duchess of Oldenburg.
Wealthy.

October to January.
Barchard’s Seedling.

Beauty of Hants.
Beauty of Waltham.
Buckingham.
Gascoigne’s Seedling.
Hornead Pearmain.
Lemon Pippin.
Mabbott’s Pearmain.

January to April.

Boston Russet.
Dutch Mignonne.
Herefordshire Pearmain.
Pennington’s Seedling.
Rhode Island Greening.
Stamford Pippin.

Varieties in Order of Succession.

Twelve for quality.
Duchess of Oldenburg.
Wealthy.
Beauty of Hants.
Gascoigne’s Seedling.
Herefordshire Pearmain.
Lemon Pippin.
Boston Russet.
Mabbott’s Pearmain.
Dutch Mignonne.
Pennington’s Seedling.
Rhode Island Greening.
Stamford Pippin.

Six for beauty.

Beauty of Hants.
Herefordshire Pearmain.
Lemon Pippin.
Mabbott’s Pearmain.
Rhode Island Greening.

Six for bearing.
Duchess of Oldenburg.
### SELECTIONS OF MEDIUM TO LARGE DESSERT OR CULINARY APPLES.

**September to December.**

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<tr>
<td>Washington.</td>
<td>Blenheim Orange.</td>
<td>Dr. Harvey.</td>
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<tr>
<td>King of Tomkins County.</td>
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<td>King of Tomkins County.</td>
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**November to April.**

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<td>Blenheim Orange.</td>
<td>Peasgood’s Nonesuch.</td>
<td>Cox’s Pomona.</td>
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<td>Lewis’s Incomparable.</td>
<td>Gravenstein.</td>
<td>Dr. Harvey.</td>
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<tr>
<td>Reinette de Canada.</td>
<td>Lewis’s Incomparable.</td>
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### IV. CULINARY APPLES.

(Arranged Alphabetically.)

#### Early Varieties—Fruit Medium.

**Season, August to October.**

**Early Juyan.**—Fruit small, roundish, flattened, angular, pale yellowish green, with slight orange tinge; flesh yellowish white, crisp, very juicy, with the sprightliness of the Hawthornden. A great bearer. August and September.

**Golden Spire.**—Fruit conical, angular, clear orange yellow; flesh yellowish, soft, brisk, pleasing acidity. A very handsome and productive apple. September and October.

**Keswick Codlin.**—Fruit oblong, angular, pale yellow, occasionally flushed with orange; flesh soft, very juicy, with a pleasing acidity. Perhaps the most popular of early culinary apples, and may be used at the end of June, but is at its best in September and October. It is hardy and a great bearer.

**Mank’s Codlin.**—Fruit roundish or conical, pale yellow occasionally flushed with pink; flesh yellowish, firm, juicy, brisk, great cropper. September to November.

**Old Hawthornden.**—Fruit round, flattened, pale green or greenish yellow, slightly flushed with red; flesh white, crisp, juicy. A favourite apple, but subject to canker. September to November.

#### Midseason and Late Varieties—Fruit Medium.

**October to April.**

**Carlisle Codlin.**—Fruit oblong, angular, greenish or pale yellow, slightly russeted; flesh white, tender, juicy, brisk. Very hardy and free bearing, an excellent apple; may be used for tarts when quite small, but is best from September till Christmas.

**Galloway Pippin.**—Fruit roundish, greenish yellow, suffused with red with russet on sun side; flesh greenish yellow, crisp, tender, brisk, and perfumed. A very handsome apple. December to February.

**Gospatrick.**—Fruit long or conical, angular, greenish yellow; flesh yellowish, tender, juicy. A free bearer. November and December.

**Histon Favourite.**—Fruit conical, even greenish yellow, flushed with red; flesh yellowish, crisp, juicy, brisk, pleasantly acid. A Cambridgeshire apple, remarkable for its free cropping, and early using qualities. From July onwards till November and December.

**Jolly Beggar.**—Roundish, oblate, yellow, tinged with orange; flesh tender and juicy. A dwarf grower and abundant bearer. August to November.
APPLES.

Murfitt's Seedling.—Fruit round, angular, pale-green, greasy; flesh greenish white, firm, juicy, pleasantly acid. A very fine Cambridgeshire apple, in use from November to March.

New Northern Greening.—Fruit roundish ovate, green, flushed with brownish red; flesh greenish white, firm, crisp, juicy, vinous. Hardy and free bearer. November to April.

Queen Caroline.—Fruit oblate, sometimes much flattened, even, greenish yellow, russety, flushed red; flesh yellowish, crisp, juicy, sweet yet sub-acid. Very handsome and a good bearer. October and November.

Schoolmaster.—Fruit oblate, greenish yellow, freckled with russet and flushed with rose; flesh greenish yellow, juicy, crisp, pleasantly acid. Compact grower and good bearer. November to March.

Small's Admirable.—Fruit roundish ovate, angular, pale lemon or greenish yellow; flesh yellowish, crisp, sub-acid, perfumed. An early and great cropper. November and December.

EARLY VARIETIES—FRUIT MEDIUM TO LARGE.

August to October.

Cellini.—Fruit conical, even, greenish yellow, flushed with lively red, and streaked with deeper red; flesh white, tender, juicy, and pleasantly acid. Free bearer, and handsome. Used also for dessert. September to November.

Domino.—Fruit oblong, angular, greenish yellow flushed with red; flesh yellowish, white, tender, juicy, and pleasantly acid. A good Nottinghamshire apple and a very free bearer. September and October.

Frogmore Prolific.—Fruit round, greenish yellow, shaded and faintly streaked with crimson; flesh white, tender, juicy, sweet. Raised in the royal gardens. Great bearer. September to Christmas.

Lord Grosvenor.—Fruit roundish or oblong, angular, pale yellow, tinged orange; flesh white, tender, juicy. A good grower and great bearer of large fruit. August to October.

Lord Suffield.—Fruit conical, angular, greenish yellow occasionally tinged with orange, flesh white, tender, juicy, and brisk. A very popular apple, an early and great bearer, but liable to canker. August and September.

Potts' Seedling.—Fruit roundish, angular, pale greenish yellow, white dotted with russet; flesh white, tender, juicy, and pleasantly flavoured. A valued Lancashire apple; an early and great bearer; good for town gardens. September to November.

MIDSEASON VARIETIES—MEDIUM TO LARGE.

October to January.

Beauty of Kent.—Fruit roundish, ovate, angular, yellow, flushed with red, very deep on the sun side; flesh yellowish, tender, juicy, sub-acid. One of the finest in appearance of all apples. Good bearer. October to December.

Bedfordshire Foundling.—Fruit ovate, or oblong, angular, greenish yellow, tinged with orange, and dotted with russet; flesh yellowish, tender, juicy, sweet, sub-acid. A good apple, and excellent bearer. November to March.

Betty Geeson.—Fruit flat, angular, pale or greenish yellow, flushed with red; flesh white, tender, sweet, brisk, acid. Great bearer, a favourite in the North Riding of Yorkshire. November to April.

Bismarck.—Fruit oblate, angular, yellow, flushed and striped with red; flesh yellowish, rather firm, crisp, tender, juicy, sub-acid. A very free bearer and fine apple. October to December.

Brabant Bellefleur.—Fruit conical, or oblong, angular, lemon, striped and flushed with red; flesh yellowish white, firm, crisp, juicy, sub-acid, aromatic. A very handsome apple. November to April.

Ecklinville.—Fruit flattish, angular, pale straw, dotted with russet, occasionally flushed with crimson; flesh white, tender, juicy, brisk. A very fine Irish apple, one of the most useful in cultivation and a constant bearer. October to December.

Emperor Alexander.—Fruit heart shaped, or conical, greenish yellow, flushed with orange, streaked red, with russet dots; flesh yellowish white, tender, crisp, juicy, sprightly, aromatic. A beautiful apple. October to December.

Golden Noble.—Fruit round, clear bright yellow; flesh yellow, firm, solid, juicy, melting, pleasantly acid. A noble apple, and good cropper. October to Christmas.

Grenadier.—Fruit round, flattened, greenish yellow; flesh greenish white, tender, juicy, pleasantly flavoured. In some soils the fruit becomes oblong and angular. A very good apple, and free bearing. October to December.

Harvey's Wiltshire Defiance.—Fruit roundish, and handsomely shaped; pale yellow, deeper on the sun side; flesh yellowish, juicy, and well flavoured. A valuable free bearing orchard apple. October to January.
HOARY MORNING.—Fruit roundish, flattened, angular, yellowish, striped with bright crimson, and covered with thin bloom; flesh yellowish white, tinged red, pleasantly acid. A beautiful apple, but not of high quality. October to December.

LODDINGTON SEEDLING.—Fruit round, slightly angular, pale green flushed with red; flesh greenish yellow, firm, very juicy, and briskly acid. Much grown in Kent, especially grafted on trees of inferior varieties; a good bearer. November to March.

LORD DERBY.—Fruit angular, greenish yellow; flesh greenish white, tender, juicy, sub-acid. Large, handsome and a good bearer, especially in the south. October to December.

MÈRE DE MÈNAGE.—Fruit ovate, angular, reddish bronze, streaked; flesh greenish yellow, firm, crisp, juicy, brisk, acid. A handsome solid apple of long season, viz., October to March.

NELSON CODLIN.—Fruit conical, angular, greenish yellow, greasy, dark spotted; flesh yellowish white; tender, juicy, sugary. A fine Yorkshire apple, and an abundant bearer. October to January.

NEW HAWTHORNDEAN.—Fruit round or ovate, greenish yellow tinged with red; flesh white, tender, juicy, brisk, sub-acid. An early, great bearer, and valuable apple. November to January.

RUSSIAN TRANSPARENT.—This has been exhibited at the Royal Horticultural Society’s shows under the modern names of Scorpion and Wiltshire Defiance. It was introduced from Moscow by General Boucherett. Those names are incorrect. The fruit is conical or ovate, grass green, dotted with bold pale russet dots; flesh yellowish, firm, juicy, and pleasantly sub-acid. A fine orchard standard apple and productive as a bush when not closely pruned. October to January.

RYMER.—Fruit roundish, flattened, angular, greenish yellow flushed with deep red, faintly streaked and dotted; flesh yellowish white, tender, juicy, brisk, acid. November to January or March.

SANDRINGHAM.—Fruit conical, yellow striped and flushed with crimson; flesh yellowish, crisp, juicy, rich but pleasantly sub-acid. A beautiful fruit, and tree a very free bearer. October to March.

SEATON HOUSE.—Fruit round, flattened, pale green, flushed and streaked with crimson; flesh white, tender, juicy, brisk, sprightly flavoured. A good bearer. November to February or March.

STIRLING CASTLE.—Fruit round, flattened, greenish yellow, flushed with red; flesh white, tender, very juicy, pleasantly sub-acid. A very free cropper, excellent grown as dwarf bushes in small gardens. September to November.

THE QUEEN.—Fruit flat, even, pale or greenish yellow, streaked and slightly flushed with rose; flesh white or greenish white, crisp, tender, very juicy, brisk, vinous, and pleasantly flavoured. A very handsome apple, free bearing. October to December.

TOM PUTT.—Fruit round, angular, dark red, streaked; flesh yellowish, tinged with red, firm, juicy, sweet, sub-acid. An esteemed Somersetshire apple, good bearer. October to January.

TOWER OF GLAMIS.—Fruit conical, angular, pale green, or yellowish flushed with rose and faintly streaked; flesh greenish white, crisp, juicy, sub-acid, perfumed. An excellent Scotch apple and a great cropper. October to January.

TYLER’S KERNEL.—Fruit conical, greenish yellow, flushed with deep red; flesh yellowish, firm, juicy, brisk, sweet, sub-acid. A fine looking and good Devonshire apple. November to February.

WARNER’S KING.—Fruit oval, flattened, pale greenish yellow, russety dotted, and patched with pale brown russet; flesh white, crisp, tender, juicy, briskly sub-acid. One of the finest of apples, and a great bearer. September to December.

YORKSHIRE BEAUTY (or Greenup’s Pippin).—Fruit round, flattened, angular, straw colour, tinged with green, and flushed with bright red; flesh yellowish white, tender, very juicy, sweet but brisk, and vinous. A very beautiful apple, a great and certain bearer, and of better quality in the northern than the southern counties. It is a Cumberland apple, in season from October to December.

YORKSHIRE GREENING.—Fruit oblate, angular, dark green, tinged with dull red, slightly streaked; flesh greenish white, firm, crisp, very juicy, brisk yet pleasing acidity. A Yorkshire apple of excellent quality for sauce. October to April.

LATE VARIETIES—FRUIT LARGE.

January to May.

ALFRISTON.—Fruit roundish, angular, greenish yellow tinged with orange, and veined with russet; flesh yellowish white, firm, crisp, juicy, sweet, briskly flavoured. A very fine apple, but only a moderate bearer. November to April.

ANNIE ELIZABETH.—Fruit ovate or conical, angular, pale green, bronze flushed, streaked with bright crimson; flesh white, firm, tender, solid, brisk, sprightly sub-acid. A good grower and fair cropper. December to March.

BRAMLEY’S SEEDLING.—Fruit flat, angular, green, or greenish yellow, flushed and streaked with red; flesh
yellowish, firm, tender, very solid, juicy, rich but agreeably sub-acid. A fine Nottinghamshire apple, very hardy, and a certain bearer. It is in use from November to May, one of the most useful apples not unsuitable for dessert in spring.

**Chelmsford Wonder.**—Fruit large, symmetrical, roundish, and handsome, yellow, streaked with red on the sun side; flesh fine, and pleasantly sub-acid. An excellent culinary apple, in use from November till March.

**Dredge’s Fame.**—Fruit roundish ovate, angular, greenish yellow, mottled with pale red, russety; flesh yellowish white, firm, crisp, very juicy, rich but brisk, aromatic, December to March and, well kept, to June. It is an early and abundant bearer.

**Dumelow’s Seedling.**—Fruit round, flattened, greenish yellow, with russety dots, tinged and sometimes deeply flushed with red; flesh yellowish white, firm, crisp, very juicy, with a very brisk, sharp acidity. A valuable Leicestershire apple, free bearer, and a favourite for cooking. November to March or April.

(Syn.: Wellington and Normanton Wonder.)

**Gooseberry Apple.**—Fruit oblong, sometimes flattened, angular, green, tinged with brown; flesh greenish white, firm, solid, juicy, brisk, acid, but pleasant. November to June.

**Lane’s Prince Albert.**—Fruit roundish, even, greenish yellow, flushed with bright red, and streaked with darker red; flesh greenish white, firm, crisp, juicy, brisk, sub-acid. A very fine apple, and regular bearer. January to April.

**Nancy Jackson.**—Fruit round, angular, greenish yellow, covered with bright crimson on the sun side; flesh yellowish white, very crisp, juicy, and pleasantly acid. A North Riding of Yorkshire apple of great excellence. November to May.

**Newton Wonder.**—A handsome fruit, resembling Dumelow’s Seedling, but more highly coloured, and sweeter. The fruit is solid and keeps well. Free grower and bearer. November to May.

**Striped Beefing.**—Fruit roundish, flattened, green, patched and streaked with red, russety; flesh yellowish, firm, crisp, juicy, brisk, with a pleasing acidity. A Norfolk apple, very handsome, and a great bearer, with a remarkable season for baking, viz., October to May.

**CRABS OR ORNAMENTAL APPLES—FRUIT SMALL.**

**Cherry Apple.**—Fruit round or oblong, bright shining lemon, blood red on the sun side shading to crimson, very beautiful; flesh yellow, firm, crisp, juicy, with a lively sub-acid flavour. Borne in clusters like a cherry, and known as the Siberian crab, very prolific. October.

**Fairy.**—Fruit round, lemon, covered with lively crimson, and streaked with a deeper hue; flesh deep yellow, firm, crisp, very juicy, brisk, pleasing aroma. Very attractive. December to March.

**Hyslop Crab.**—Fruit ovate, deep crimson on a yellow ground, very beautiful and prolific. October.

**Transcendent Crab.**—Fruit ovate, yellow, flushed with crimson, ornamental, and used for culinary purposes. October.

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**SELECTION OF CULINARY APPLES IN ORDER OF SUCCESSION.**

**August and September.**

Early Julyan.
Keswick Codlin.
Lord Grosvenor.
Domino.
Lord Suffield.
Mank’s Codlin.
Golden Spire.
Potts’ Seedling.
Jolly Beggar.
(All are great bearers.)

**October to December.**

Stirling Castle.
Yorkshire Beauty.
Golda Noble.
Ecklinville.
Warner’s King.
New Hawthornden.
Beauty of Kent.
Bismarck.
Lord Derby.
Small’s Admirable.
Sandringham.
Tower of Glamis.
(All are good bearers.)

**November to March.**

Seaton House.
Bedfordshire Foundling.
Loddington Seedling.
Rymer.
Mère de Ménage.

**December to May.**

Chelmsford Wonder.
Betty Gesso.
Lane’s Prince Albert.
Bramley’s Seedling.
Dumelow’s Seedling.
Striped Beefing.
Gooseberry Apple.
(All free bearers)

Twelve for quality.
Domino.
APPLES FOR SPECIAL DISTRICTS, SOILS, AND FORMS OF TREES.

From torrid to arctic zone plants and trees naturally attain degrees of health and fruitfulness corresponding to their environment, or appropriate requisites of heat, sunlight, air, moisture, and soil, with a growing and a resting season. They are vigorous or unhealthy, fruitful or barren, as those conditions favour or disfavour. Some have a wide range or distribution—the Crab is one, and its character is determined by climate and soil. Heat beyond a certain amount withers its leaves, and dries up the juices of its fruits; cold, oppositely, dwarfs its energies, and impairs its productiveness. Nowhere, perhaps, are the essential conditions better proportioned than on the Kentish rag, the weald of Sussex, on the lava beds of South Devon, in Shropshire, in the Lothians of Scotland, and North of Ireland, in the dales and vales of the Midlands—the washings and deposits of ages from the surrounding hills; nowhere, in fact, is climate more favourable or soil more suitable for the production of apples than on many hill and tree-sheltered slopes of the British Isles.

The surface of the United Kingdom is so diversified that it is scarcely possible to find a county in which suitable situations do not exist for the production of apples of a quality suited to the requirements of every homestead, and the supply in most cases might meet the demands of adjacent towns. The great centres of industry, particularly
South Wales, Lancashire, and Yorkshire, are largely dependent on imported apples. This is a state of things which should not and need not continue. In the Principality there are as fine apple-producing districts as any in the world, which are now browsed by sheep; and in Ireland too, which has given the world such varieties as the Ecklinville—the finest of autumn market apples—the hard-to-be-beaten Mank's Codlin, the delicious Irish Peach, the beautiful Scarlet Crofton, the favourite Kerry Pippin—also Ross Nonpareil, and Irish Russet (Sam Young), apple culture is woefully neglected; the resources of its soil and the latent energies of its occupants only need stirring to afford a plentiful supply of excellent fruit.

The following selections are made, and the varieties grouped in accordance with their adaptability to climatic and geological conditions. These influence apples more or less in the productiveness of the trees and the quality of their fruits. Some are singularly juicy and full-flavoured in the north of England and Scotland, but in the south they prove dry and indifferent. The famous Ribston Pippin nowhere attains such juiciness and high quality as in the best soils and aspects found north of the Humber. In Scotland this variety is particularly rich when grown against a wall with south aspect, but in similar positions in the south of England it is hard and dry. Cockpit is a much esteemed Yorkshire apple, as is the very hardy Large Hunthouse, but neither is of equal quality in Kent. Cambusnethan Pippin, Ravelston Pippin, Beauty of Moray, White Melrose, and other popular Scotch varieties, are not appreciated to the same extent south of the Border Counties, but the Scotch-raised Hawthornden, especially in its newer varieties, Winter Hawthornden, Stirling Castle, and Seaton House, succeed in all parts of the kingdom, and are amongst the most useful and profitable. Downton Pippin, a Herefordshire apple, has given place to other varieties in the south, but it succeeds in elevated situations where the Golden Pippin does not, and Early Julyan, Cellini, and other culinary varieties are valued in the north at dessert.

Other varieties, originated from acclimatised parents, or peculiarity of constitution, have gained local celebrity. Lancashire has its Summer Strawberry, Trumpeter, Scarlet Tiffing, Green Tiffing, Royal Shepherd, and Hutton Square varieties; Cheshire its Minchull Crab and other esteemed sorts, which, through their usefulness, are still prized. Similar observations apply to the Green Costard, Beefing, and Queening of Herefordshire; also to the Hanwell Sourcing of Oxfordshire; Morgan's Sweet and Royal Somerset of the west; Hambledon Deux Ans of Hampshire; Nanny, Forge, Bossom, Duck's Bill, of Sussex; Colonel Vaughan, Goff, and Prince Arthur
of Kent; Huntingdon Codlin; Norfolk Bearer, and others, are all enwrapped in local associations, and possess advantages for special purposes and certain localities that it is not wise to disregard. Some of these varieties are included in the selections, as deserving attention in certain districts until the claims of better varieties can be proven. Trees of local varieties, producing indifferent fruit, may often be rendered doubly profitable in three or four years by grafting them with improved varieties. Those that are healthy make admirable stocks for free-bearing profitable sorts. Some of these do not succeed well on stems of their own, but are productive of fine fruit when grafted on older trees. In no case should persons be deterred from planting trees through lack of knowledge of any locality. The selections are framed with a due regard to requirements of location and soil. All the varieties enumerated are hardy, but should any of them from peculiarity of circumstances not prove satisfactory in growth or fruit, they should be re-grafted with those which are found satisfactory.

**APPLES SUITED TO DIFFERENT PARTS OF GREAT BRITAIN AND IRELAND, NAMED IN ORDER OF RIPENING.**

I. SOUTHERN COUNTIES OF ENGLAND,
Including the Thames and Severn Valleys, South Wales, and the Southern Parts of Ireland (not over 250 feet above sea level).

*All the varieties in the Descriptive List but the following require warm soil and situations.*

| American Mother. | Washington. | King of Tomkin’s County. |

II. EASTERN AND MIDLAND COUNTIES,
Including the Great and Little Ouse, Trent, and Dee Valleys, with the North of Ireland (not over 250 feet above sea level, without shelter).

**Dessert Varieties.**

| Irish Peach. | Lord Lennox. | Wyken Pippin. |
| Duchess’s Favourite. | Margil. | Cockle’s Pippin. |
**APPLES.**

| Court Pendu Plat. | Rhode Island Greening. | Golden Noble. |
| Sturmer Pippin. | | Hoary Morning. |

**DESSERT OR CULINARY.**

| Gravenstein. | King of Tomkin's County. | Murfitt's Seedling. |
| Blenheim Orange. | | Yorkshire Greening. |
| Beauty of Hants. | | Rymer. |
| Lady Henniker. | | Mère de Ménage. |
| Wadhurst Pippin. | | Annie Elizabeth. |
| Gascoigne's Seedling. | | Lodddington Seedling. |
| Dr. Harvey. | | Alfriston. |
| Hormead Pearmain. | | Betty Geeson. |
| Lemon Pippin. | | Schoolmaster. |
| Lewis's Incomparable. | | Lane's Prince Albert. |
| Herefordshire Pearmain. | | New Northern Greening. |
| Mabott's Pearmain. | | Bramley's Seedling. |
| Dutch Mignonette. | | Dumelow's Seedling. |

**III. NORTHERN COUNTIES,**

Including the Ouse, Derwent, Mersey, Ribble, Eden, Tyne, Wear, and Tees Valleys (not over 250 feet above sea level, without shelter).

| Summer Thorle (Lady Derby). | Baumann's Red Winter Reinette. | For warm situations. |
| Yellow Ingestrie. | Sturmer Pippin. | |}

**DESSERT OR CULINARY.**

| Wormsley Pippin. | | Keswick Codlin. |
| Peasgood's Nonesuch. | | Lord Suffield. |
| Cox's Pomona. | | Frogmore Prolific. |
| Gravenstein. | | Lord Grosvenor. |
| Beauty of Hants. | | Stirling Castle. |
| Wadhurst Pippin. | | Cellini. |
| Blenheim Orange. | | Potts' Seedling. |
| Dr. Harvey. | | Histon Favourite. |
| Lewis's Incomparable. | | Warner's King. |
| Baxter's Pearmain. | | Ecklinville. |

**CULINARY.**

| Early Julyan. | | Early Julyan. |
| Keswick Codlin. | | Keswick Codlin. |
| Domino. | | Lord Suffield. |
| Lord Suffield. | | Frogmore Prolific. |
| Lord Grosvenor. | | Lord Grosvenor. |
| Stirling Castle. | | Cellini. |
| Cellini. | | Potts' Seedling. |
| Histon Favourite. | | Histon Favourite. |
| Warner's King. | | Warner's King. |
| Ecklinville. | | Ecklinville. |

**U U 2**
Lord Derby. | Galloway Pippin. | Lane's Prince Albert.  
Bedfordshire Foundling. | Alfriston. | Durnelows's Seedling.  

### IV. EASTERN, MIDLAND, AND SOUTHERN COUNTIES OF SCOTLAND.

(Not more than 250 feet above sea level, without shelter.)

<table>
<thead>
<tr>
<th>DESSERT VARIETIES, IN ORDER OF RIPENING.</th>
<th>DESSERT OR CULINARY.</th>
<th>CULINARY.</th>
</tr>
</thead>
</table>
| Yellow Ingestrie. | Gravenstein. | Winter Hawthornden.  
| King of the Pippins. | Ravelston Pippin. | Grenadier.  
| Court of Wick. | Blenheim Orange. | Tower of Glamis.  
| Cox's Orange Pippin. | Dr. Harvey. | Bedfordshire Foundling.  
| Mannington Pearmain. |  | Yorkshire Greening.  
| Wyken Pippin. |  | Murfitt's Seedling.  
| Adam's Pearmain. |  | Betty Geeson.  
| Braddick's Nonpareil. |  | Mère de Ménage.  
| Golden Harvey. |  | Loddington.  
| Brownlee's Russet. |  | Alfriston.  
| Baddow Pippin. |  | Schoolmaster.  
| Ashmed's Kernel. |  | Annie Elizabeth.  
| Cockle Pippin. |  | Rymer.  
| Golden Russet. |  | New Northern Greening.  
| Court Pendu Plat. |  | Newton Wonder.  
| Rosemary Russet |  | Bramley's Seedling.  
|  |  | Durnelows's Seedling.  

### V. ELEVATED SITUATIONS WITH SHELTER.

(Not over 500 feet above sea level.)

<table>
<thead>
<tr>
<th>DESSERT.</th>
<th>CULINARY.</th>
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</table>
| Summer Thorle. |  | Fearn's Pippin.  
| Devonshire Quarrenden. |  | Ribston Pippin.  
| Worcester Pearmain. |  | Wyken Pippin.  
|  |  | Scarlet Nonpareil.  
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<p>| Cockle's Pippin. |  |  |
| Baumann's Red Winter Reinet. |  |  |
| Court Pendu Plat. |  |  |
| Golden Knob. |  |  |
| Duke of Devonshire. |  |  |</p>
<table>
<thead>
<tr>
<th>Dessert or Culinary.</th>
<th>Dessert Varieties.</th>
<th>Culinary.</th>
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<td>Wadhurst Pippin.</td>
<td>Devonshire Quarrenden.</td>
<td>Mall's Collin.</td>
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<td>Lemon Pippin.</td>
<td>Duchess's Favourite.</td>
<td>Potts' Seedling.</td>
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<td>Lady Sudeley.</td>
<td>Golden Noble.</td>
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<td>Worcester Pearmain.</td>
<td>Queen Caroline.</td>
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<td>King of the Pippins.</td>
<td>Yorkshire Beauty.</td>
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<td>American Mother.</td>
<td>Lord Derby.</td>
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<td>Cox's Orange Pippin.</td>
<td>Lodddington Seedling.</td>
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<td>Court of Wick.</td>
<td>Nelson Collin.</td>
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<td>Fearns's Pippin.</td>
<td>Bedfordshire Foundling.</td>
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<td>Adam's Pearmain.</td>
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<td>Banmann's Winter Reinette.</td>
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<td>Braddock's Nonpareil.</td>
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<td>Mannington Pearmain.</td>
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<td>Ribston Pippin.</td>
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<td>Wyken Pippin.</td>
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<td>Scarlet Nonpareil.</td>
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<td>Golden Russet.</td>
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<td>Court Pendu Plat.</td>
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<td>Sturmer Pippin.</td>
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<td></td>
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<tr>
<td>Ecklinville.</td>
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### DESSERT

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Mr. Gladstone.</td>
<td>Duchess of Oldenburg.</td>
<td></td>
</tr>
<tr>
<td>Irish Peach.</td>
<td>Cox’s Pomona.</td>
<td></td>
</tr>
<tr>
<td>Devonshire Quarrenden.</td>
<td>Peasgood’s Nonesuch.</td>
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<tr>
<td>Lady Sudeley.</td>
<td>Gascoigne’s Seedling.</td>
<td></td>
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<tr>
<td>Worcester Pearmain.</td>
<td>Wadhurst Pippin.</td>
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<tr>
<td>Yellow Ingestrie.</td>
<td>Lemon Pippin.</td>
<td></td>
</tr>
<tr>
<td>Kerry Pippin.</td>
<td>Dutch Mignonne.</td>
<td></td>
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<tr>
<td>King of the Pippins.</td>
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<tr>
<td>Fearn’s Pippin.</td>
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<tr>
<td>Cox’s Orange Pippin.</td>
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<tr>
<td>Claygate Pearmain.</td>
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<tr>
<td>Baumann’s Red Winter Reinette.</td>
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<tr>
<td>Wyken Pippin.</td>
<td>Keswick Codlin.</td>
<td></td>
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<tr>
<td>Brownlees’ Russet.</td>
<td>Cellini.</td>
<td></td>
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<tr>
<td>Scarlet Nonpareil.</td>
<td>Potts’ Seedling.</td>
<td></td>
</tr>
<tr>
<td>Court Pendu Plat.</td>
<td>Mank’s Codlin.</td>
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### III. PEATY SOIL

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Murfitt’s Seedling.</td>
<td>Yorkshire Greening.</td>
</tr>
<tr>
<td>Yorkshire Pippin.</td>
<td>Tyler’s Kernel.</td>
</tr>
<tr>
<td>Annie Elizabeth.</td>
<td>New Northern Greening.</td>
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<tr>
<td>New Northern Greening.</td>
<td></td>
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<tr>
<td>Newton Wonder.</td>
<td></td>
</tr>
<tr>
<td>Bramley’s Seedling.</td>
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</tbody>
</table>

### SELECTION OF APPLES FOR VARIOUS METHODS OF CULTURE.

*(Named in order of succession and planting distances indicated.)*

#### I. PYRAMIDS OR BUSHES

**Dessert Varieties.**

<table>
<thead>
<tr>
<th>Small Trees. 6 feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Gladstone.</td>
</tr>
<tr>
<td>Irish Peach.</td>
</tr>
<tr>
<td>Beauty of Bath.</td>
</tr>
<tr>
<td>Williams Favourite.</td>
</tr>
<tr>
<td>Lady Sudeley.</td>
</tr>
<tr>
<td>Yellow Ingestrie.</td>
</tr>
<tr>
<td>Kerry Pippin.</td>
</tr>
<tr>
<td>Margil.</td>
</tr>
<tr>
<td>Claygate Pearmain.</td>
</tr>
<tr>
<td>Pitmaston Pine Apple.</td>
</tr>
<tr>
<td>Hubbard’s Pearmain.</td>
</tr>
<tr>
<td>Golden Harvey.</td>
</tr>
<tr>
<td>Wyken Pippin.</td>
</tr>
<tr>
<td>Scarlet Nonpareil.</td>
</tr>
<tr>
<td>Cockle Pippin.</td>
</tr>
<tr>
<td>Cornish Gilliflower.</td>
</tr>
<tr>
<td>Baddow Pippin.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium-sized Trees. 9 feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Thorle.</td>
</tr>
<tr>
<td>Devonshire Quarrenden.</td>
</tr>
<tr>
<td>Duchess’s Favourite.</td>
</tr>
<tr>
<td>Oslin.</td>
</tr>
<tr>
<td>American Mother.</td>
</tr>
<tr>
<td>Court of Wick.</td>
</tr>
<tr>
<td>Fearn’s Pippin.</td>
</tr>
<tr>
<td>Cox’s Orange Pippin.</td>
</tr>
<tr>
<td>Melon.</td>
</tr>
<tr>
<td>Pine Golden Pippin.</td>
</tr>
<tr>
<td>Werder’s Golden Reinette.</td>
</tr>
<tr>
<td>Scarlet Golden Pippin.</td>
</tr>
<tr>
<td>Ribston Pippin.</td>
</tr>
<tr>
<td>Adam’s Pearmain.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Large Trees. 12 feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Harvest.</td>
</tr>
<tr>
<td>Red Astrachan.</td>
</tr>
<tr>
<td>September Beauty.</td>
</tr>
<tr>
<td>Worcester Pearmain.</td>
</tr>
<tr>
<td>Pine Apple Russet.</td>
</tr>
<tr>
<td>King of the Pippins.</td>
</tr>
<tr>
<td>Syke House Russet.</td>
</tr>
</tbody>
</table>
## APPLES.

**Northern Spy.**  
**Allen's Everlasting.**  
**Pearson's Plate.**  
**Lord Burghley.**  
**Duke of Devonshire.**

<table>
<thead>
<tr>
<th>Dessert or Culinary.</th>
<th>Culinary.</th>
</tr>
</thead>
</table>
| Small Trees. 6 ft.  | Early Julyan.  
|                    | Carlisle Codlin.  
|                    | Mank's Codlin.  
|                    | Hawthornden.  
|                    | Cellini.  
|                    | Jolly Beggar.  
|                    | Stirling Castle.  
|                    | Frogmore Prolific.  
|                    | Yorkshire Beauty.  
|                    | Lodddington Seedling.  
|                    | New Hawthornden.  
|                    | Seaton House.  
|                    | Schoolmaster.  
|                    | Lane's Prince Albert.  
| Medium-sized Trees. 9 ft. | Domino.  
|                     | Keswick Codlin.  
|                     | Lord Suffield.  
|                     | Histon Favourite.  
|                     | Golden Spire.  
|                     | Queen Caroline.  
|                     | Potts' Seedling.  
|                     | Ecklinville.  

| Large Trees. 12 ft. | Golden Noble.  
|                     | Hoary Morning.  
|                     | Grenadier.  
|                     | Nelson Codlin.  
|                     | The Queen.  
|                     | Bismark.  
|                     | Brabant Bellefleur.  
|                     | Sandringham.  
|                     | Betty Geeson.  
|                     | Small's Admirable.  
|                     | Dunelow's Seedling.  
|                     | New Northern Greening.  
|                     | Nancy Jackson.  
|                     | Gooseberry Apple.  

## LOW STANDARDS FOR GARDENS—GROWTH COMPACT.

(Planting distance 12 ft. apart—Dwarfing Stocks.)

| Dessert Varieties. | Court Pendu Plat.  
|                   | Baddow Pippin.  
|                   | Duke of Devonshire.  
|                    | Lady Sudeley.  
|                    | Yellow Ingestrie.  
|                    | Kerry Pippin.  
|                    | Margil.  
|                    | Claygate Pearmain.  
|                    | Fitmastone Pine Apple.  
|                    | Baumann's Red Winter Reinette.  
|                    | Cockle Pippin.  
|                    | Scarlet Nonpareil.  
|                    | Lord Suffield.  
|                    | Carlisle Codlin.  
|                    | Potts' Seedling.  
|                    | Stirling Castle.  
|                    | Jolly Beggar.  
|                    | Betty Geeson.  
|                    | Lodddington Seedling.  
|                    | Mank's Codlin.  
|                    | New Hawthornden.  
|                    | Seaton House.  
|                    | Schoolmaster.  
|                    | Murfitt's Seedling.  
|                    | Lane's Prince Albert.  
| Desert or Culinary. | Duchess of Oldenburg.  
|                    | Cellini.  
|                    | Lemon Pippin.  
| Culinary. | Early Julyan.  
|           | Domino.  
|           | Hawthornden.  

---

**Notes:**

- Northern Spy is a dessert variety.
- Allen's Everlasting and Pearson's Plate are both dessert varieties.
- Lord Burghley is a dessert variety.
- Duke of Devonshire is a dessert variety.

**Medium-sized Trees:**

- Benoni
- Cardinal
- Beauty of Hants
- Beauty of Waltham
- Herefordshire Pearmain
- Mabbott's Pearmain
- Cox's Pomona
- Dutch Mignonne
- Reinette de Canada
- King of Tomkin's County

**Large Trees:**

- Wormsley Pippin
- Lewis's Incomparable
- Gravenstein
- Gascoigne's Seedling
- Lady Henniker
- Blenheim Orange

---

**Dessert or Culinary:**

- Small Trees. 6 ft.
- Early Julyan
- Carlisle Codlin
- Mank's Codlin
- Hawthornden
- Cellini
- Jolly Beggar
- Stirling Castle
- Frogmore Prolific
- Yorkshire Beauty
- Lodddington Seedling
- New Hawthornden
- Seaton House
- Schoolmaster
- Lane's Prince Albert

- Medium-sized Trees. 9 ft.
- Domino
- Keswick Codlin
- Lord Suffield
- Histon Favourite
- Golden Spire
- Queen Caroline
- Potts' Seedling
- Ecklinville

- Large Trees. 12 ft.
- Lord Grosevenor
- Tom Putt
- Warmer's King
- Beauty of Kent
- Lord Derby
- Russian Transparent
- Gospatrick
- Tower of Glamis
- Tyler's Kernel
- Yorkshire Greening
- Annie Elizabeth
- Mère de Ménage
- Alfriston
- Bramley's Seedling
- Rymer
- Dredge's Fame
- Striped Beefing
### APPLES SUITABLE FOR TALL STANDARDS.

#### Dessert Varieties.

*Small growers for planting 18 feet apart.*

- Early Red J uneating
- Irish Peach
- Beauty of Bath
- Lady Saducey
- Yellow Ingestria
- Kerry Pippin
- Margil
- Claygate Pearmain
- Pitmaiston Pine Apple
- Baumann's Red Winter Reinette
- Cockle Pippin
- Braddock's Nonpareil
- Baddow Pippin
- Scarlet Nonpareil

*Medium growers for planting 24 feet apart.*

- Devonshire Quarrenden
- Duchess's Favourite
- Oslin
- Court of Wick
- Fearn's Pippin
- Pine Golden Pippin
- Syke House Russet
- Cox's Orange Pippin
- Werder's Golden Reinette
- Scarlet Golden Pippin
- Brownlee's Russet
- Ashmead's Kernel
- Lamb Abbey Pearmain
- Rosemary Russet
- Pearson's Plate
- Lord Burghley
- Duke of Devonshire
- Sturmer Pippin

*Large growers for planting 30 feet apart.*

- Early Harvest
- King of the Pippins
- Golden Russet
- Golden Knob
- Allen's Everlasting

#### Dessert or Culinary.

*Small growers for planting 18 feet apart.*

- Duchess of Oldenburg
- Cellini
- Lemon Pippin

*Medium growers for planting 24 feet apart.*

- Benonii
- Cardinal
- Beauty of Hants
- Cox's Pomona
- Dutch Mignonne
- Reinette de Canada
- Pennington Seedling
- Stamford Pippin

*Large growers for planting 30 feet apart.*

- Wormsley Pippin
- Lewis's Incomparable
- Gravenstein
- Gascoigne's Seedling
- Lady Henniker
- Blenheim Orange
- Horneal Pearmain
- Dr. Harvey
- Baxter's Pearmain
- New Bess Pool
- Wadhurst Pippin
- Rhode Island Greening

#### Culinary.

*Small growers for planting 18 feet apart.*

- Early Julyan
- Domino
- Hawthornden
- Lord Suffield
- Carlisle Codlin
- Cellini
- Potts' Seedling

*Large growers for planting 30 feet apart.*

- Stirling Castle
- Mank's Codlin
- Yorkshire Beauty
- Winter Hawthornden
- Seaton House
- Schoolmaster
- Betty Geeson
- Lane's Prince Albert

- Keswick Codlin
- Histon Favourite
- Golden Spire
- Ecklinville
- Golden Noble
- Grenadier
- The Queen
- Small's Admirable
- Sandringham
- Alfriston
- New Northern Greening
- Dunelow's Seedling
- Gooseberry Apple

*Large growers for planting 30 feet apart.*

- Lord Grosvenor
- Tom Putt
- Warner's King
- Beauty of Kent
- Tower of Glamis
- Hoary Morning
- Lord Derby
- Bntant Bellefleur
- Bedfordshire Foundling
- Galloway Pippin
- Tyler's Kernel
- Russian Transparent
- Yorkshire Greening
- Annie Elizabeth
- Mère de Ménage
- Rymer
- Bramley's Seedling
- Dredge's Fame
- Striped Beefing
APPLES SUITABLE FOR BORDERS.

DESSERT VARIETIES.
(For low trellises and horizontal cordons.)
Mr. Gladstone.
Beauty of Bath.
Yellow Ingestrie.
Margil.
Claygate Pearmain.
Pitmaston Pine Apple.
Hubbard's Pearmain.
Wyken Pippin.
Scarlet Nonpareil.
Baddow Pippin.
Starmer Pippin.

(For tall trellises.)
Summer Thorle.
September Beauty.
Lady Sudeley.
Worcester Pearmain.
Pine Apple Russet.
American Mother.
King of the Pippins.
Cox's Orange Pippin.
Ribston Pippin.
Adam's Pearmain.
Scarlet Golden Pippin.
Lord Burghley.
Duke of Devonshire.

DESSERT OR CULINARY VARIETIES.
(For tall trellises.)
Cardinal.
Gravenstein.
Beauty of Waltham.
Gascoigne's Seedling.
Mabbott's Pearmain.
Hormead Pearmain.
Baxter's Pearmain.
Reinette de Canada.
King of Tomkin's County.
Calville Malingre.

CULINARY.
(For low trellises.)
Domino.
Carlisle Codlin.
Potts' Seedling.

APPLES SUITABLE FOR ESPALIERS.

DESSERT VARIETIES.
Early Harvest.
September Beauty.
Worcester Pearmain.
King of the Pippins.
Cox's Orange Pippin.
Fearn's Pippin.
Scarlet Golden Pippin.
Adam's Pearmain.
Brownlee's Russet.
Ashmead's Kernel.
Allen's Everlasting.
Duke of Devonshire.

DESSERT OR CULINARY.
Beauty of Hants.
Beauty of Waltham.

CULINARY.
Lord Grosvenor.
Ecklinville Seedling.
Golden Noble.
The Queen.

Warner's King.
Beauty of Kent.
Grenadier.
Bismarck.
Grenadier.
Brabant Bellefleur.
Lord Derby.
Sandringham.
Bramley's Seedling.

The preceding are eligible for large trellises or high espaliers. Those named for low cordon trellises are suitable for low espaliers.
APPLES FOR WALLS.

All the varieties named for cordons are suitable for growing in that method against walls and wood fences. In the North of England, Scotland, and all elevated or cold situations, apples attain larger size, higher colour, and better quality than grown in the open. The varieties named for espaliers are eligible for walls on the horizontal, fan, and upright systems of training. For growing choice fruit, walls with east or west aspects answer in the South, but in the North of England and in Scotland south aspects are not too hot.

The following varieties are deserving of a wall in the most favoured localities. In cold and exposed situations that aid is absolutely essential to have fine examples.

<table>
<thead>
<tr>
<th>American Mother</th>
<th>Melon Apple</th>
<th>Peck's Pleasant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington</td>
<td>Northern Spy</td>
<td>King of Tomkin's County</td>
</tr>
<tr>
<td>Wealthy</td>
<td>Reinette de Canada</td>
<td>Calville Malingre</td>
</tr>
</tbody>
</table>

Propagation.

The apple may be perpetuated and increased on its own roots by seeds, cuttings, layering, and suckers; also by budding, grafting, and inarching on stocks of certain species of Pyrus and varieties of apple.

Seeds.—Pips taken from the cores of high-class dessert or esteemed culinary fruit, as well as seeds resulting from crossing the flowers, are often sown with a view of continuing the variety, or raising new sorts, and has been fully treated at page 96. Seeds of crab and cider apples produce strong plants, and are employed as stocks, for raising which instructions are given on page 114.

Cuttings.—All the varieties may be increased by this mode, but it is an uncertain and undesirable process. Some varieties, such as the Burr-knot, Codlin, Juneating, and Jenning’s Seedling, are more readily rooted than others. Cuttings should be taken of last year’s wood not less than 8 inches in length, with an inch or two of two-year-old wood attached. Pare smoothly the ends, removing all the buds except the three uppermost, and insert firmly up to the lowest bud in sandy loam, in mild weather, as soon after the fall of the leaf as possible. They will root more securely if covered with a hand-glass, kept rather close, and shaded from bright sun until they push growth freely; then gradually inure them to sun and air, until they endure full exposure. Transplant in November, 3 feet apart. Trees so raised are said not to be so liable to canker as their parents, but it does not accord with our experience, and, except for growing under glass, and as a novelty, we do not advise the plan. For preparation of cuttings see page 101, Fig. 16, g.

Layering.—This is a less uncertain, but an undesirable means of increase for general purposes, yet useful for raising small trees to be grown in pots. It should be
done in autumn or winter, the branch being tongued or notched at a joint about half way through, and that part buried and secured 4 inches beneath the surface, with a stout peg. The autumn following, the layer may be detached and transplanted. Layering is shown on page 105, Fig. 18, D.

**Suckers.**—Occasionally, these spring from the roots of a seedling tree, and are taken advantage of as a means of obtaining young trees. These suffer more or less in removal, but with care may be moved safely. Like the parent, they are subject to throw up suckers; therefore, all buds on the underground stem should be cut clean out. The practice of relying on suckers for stocks is not a commendable one, as they are always liable to push growth from the roots.

**Budding.**—This mode has, to a great extent, superseded grafting. It is characterised by finer growths, and the operation is more expeditiously and conveniently performed. July and August are the usual months of budding apples, in performing which particulars are given at page 115.

**Grafting.**—As this has been fully treated on page 120, it is only necessary to remark that tongue or whip grafting (page 123, Fig. 20) is the most eligible for young stocks, and rind or crown grafting (page 133, Fig. 22, G) for large stocks and old trees. Information as regards time of operating and heading stocks will be found on pages 120 and 121, and treatment of scions on page 121.

**Inarching.**—Very seldom is this method practised. It may be useful in transferring a weakly tree or branch to a stronger stock, with a view to more vigour and finer fruit.

**Stocks.**

Crab stocks are employed for standard, half-standard, and every description of trained tree; also for dwarfs not to be subjected to the restrictive, close pruning, lifting system. The chief merit of the Crab stock consists in its hardiness, and its principal adaptability is to elevated, exposed, cold situations, also negligent culture. Many so called Crab stocks are raised from the pips of cider apples, and vary somewhat in hardiness and character. They are known as Free stocks, and express their own fitness, namely, for apple trees or standards and half-standards in good natural or properly-prepared soil, in suitable natural or artificially sheltered situations. They are also suitable for pyramids, bushes, and all trained trees subject to the conditions indicated.

**Paradise stocks** are the best possible kinds for trees grown on the dwarfing plan. If
not so hardy as the Crab they are hardier than Free stocks. Producing fibrous roots in abundance near the surface, they have the best soil. Trees on these stocks may be had thriving in damp soils where trees on the Crab canker, and those on the Free stocks produce little beyond useless wood; and they thrive on shallow soils where the other kinds fail. If trees on Paradise stocks grow too freely, they submit to lifting without fear of receiving a greater check than is necessary for insuring a crop of fruit in place of a superabundance of barren shoots, but the Crab and Free stocks would by such a radical process have their lives imperilled, and not recover in double the time taken by the Paradise. Reciprocal in root and branch, trees on the Paradise stocks make the most of their opportunities, benefiting by good fare and judicious management, and return for all timely attention the most profitable, because the most certain crops of fruit. The small French stocks are less useful than the stronger English, including the Nonesuch and Broad-leaved Paradise.

Situation and Shelter.—After what has been advanced on these subjects, relative to gardens, on pages 65 to 70, and on pages 82 to 90, as regards orchards, further remarks are unnecessary, inasmuch as those referred to are applicable to apples.

Soil.

The soils of the British Isles are extremely variable, and are made up of inorganic and organic ingredients. The inorganic are derived from rocks by weathering; organic trace their origin to plants or animals. Organic matter in a soil is the standard of its fertility. The organic residues (humus) vary considerably in different soils, ranging from 2 to 9 per cent. Sandy soils need its fertilising properties and moisture-holding capacities; water-holding clays benefit by its physical properties of loosening, opening, and aerating the soil. A soil, however, may be overladen with humus. Excessive application of stable or farmyard manure, and undue accumulation of crop residues within the soil may render its cultivation disadvantageous. This condition occurs when the soil is soured by injudicious manuring, and may often be seen in gardens as well as naturally in peaty soils or moorlands. To increase in some cases, and in others to regulate, the quantity of organic matter contained in the soil is one of the most important objects of cultivation. Condition or fertility is the result of humus assuming the form of nitric acid, which, combining with lime and other alkaline substances, form soluble compounds in water, and these either pass off by the drainage, or the crop appropriates them, for nitrates enter into no combination with the soil, and cannot
accumulate. Fresh nitrates are formed each year from the decomposition of humus by the oxidation effected through the agency of minute organisms, one kind converting matter into nitrites, and the other transforming these into nitrates; therefore, the fertility of soil depends upon its yielding nitric acid and mineral substances in due proportion, and in available form, as needed for food by trees. A soil is fertile in proportion to the varied character of its ingredients. Sand, clay, or limestone separately do not form good soil, but an admixture of sand, clay, pulverised limestone, and humus judiciously blended constitutes a fertile soil. When the soil consists of sand, siliceous and calcareous, from 50 to 70 per cent.; clay 20 to 30 per cent.; lime 6 to 10 per cent.; and humus 5 to 10 per cent.—it is made warm and permeable by air and rain by the sand, clay renders it moist and retentive of manures, lime decomposes organic matter, and humus supplies material for the manufacture of food. Such is a good apple soil when properly tilled. Brick-earth and alluvial soils answer to this description, and are generally good apple producers. They consist of matter worn from hillsides and washed on to slopes and plains by the rain.

A study of the soils of these islands leads to the conclusion that they are richer in their variety than perhaps any other area of equal size on the face of the earth. It has to be remembered, however, that not only the mineral composition of the soil, but its altitude, aspect, and slope are important factors in determining its availability for fruit production. Two soils of identical components may differ greatly in their value for apples, as one may be on a gentle slope merely raised above the line of fog, with a south aspect, while the other may be highly elevated, slope sharply, and have a north exposure. The former will derive the most benefit from rain, receive the most sun, and be less liable to have its ameliorated surface washed away. The underlying stratum is also important, for it may be clay, and therefore resisting the downward passage of water; or the surface accumulations may rest on sand, gravel, or chalk, and hence permeable to rain and air. These are important considerations in connection with water supply and drainage, and must not be overlooked in selecting sites. A garden without water is practically useless; a water-logged soil is worse than useless; and a thin shallow soil over sand, gravel, or chalk is a gourmandiser of manures. A stubborn soil, however, well repays judicious outlay in draining, working, and even burning. The drainage and amelioration of soils, also their moisture and temperature as affected by cultural conditions, have already received a large share of attention; therefore, we now pass to suitable soils for apple production.
1. **Old Red Sandstone.**—Constituents: sandstone, impure limestone (corn stone) and marl. Soil: reddish loam. Occurrence: counties Hereford, Shropshire (also in Cumberland, Vale of Eden), Monmouth, Brecknock, Glamorgan, Carmarthen, and Pembroke. Numerous tracts also occur in the Scotch Lowlands, at the southern feet of the Grampians, along the coastlands of Moray Firth, and in the Orkney Isles; also in the south-west of Ireland, and in its central plain. Soils of the Old Red Sandstone formation produce grand apples.

2. **New Red Sandstone.**—Constituents: sandstone, limestone (occasionally), and marl. Soil: red loam, sometimes a rich brown loam (a result of tillage—humus), and greyish loam when limestone admixes. Occurrence: counties Devon, Somerset, Gloucester, Worcester, Warwick, Stafford, Chester, Lancaster, Nottingham, Lincoln, and York. Soils of this nature are noted for apple production.

3. **Lias.**—Constituents: marlstone—clay and sand, with limestone. Soil: rich brown loam, red (new red marl), and dark (alluvium). Occurrence: counties Dorset, Somerset, Gloucester, Worcester, Warwick, Northampton, Leicester, Nottingham, Lincoln, and York. Good apple soils are formed on Lias of the nature indicated.

4. **Oolite.**—Constituents, best forms: calcareous matter, sand, and clay. Soil: brown, yellow, or grey loams, as humus, sand, and limestone, respectively enter into their composition. Occurrence: counties Dorset, Somerset, Wilts, Berks, Gloucester, Oxford, Bucks, Beds, Hunts, Rutland, and Lincoln. Where lias and oolite ramify the produce is a fertile soil, as in Northampton, around Rockingham and Kettering.


6. **Alluvium and Drift.**—These are admixtures, and as variable as the formations from which they have been worn. Alluvial soils occur in the great vale of York and
Lincoln, including the Trent valley (Nottingham), and watered by rivers having their confluence in the Humber; the extensive valley of the Thames, the Severn valley, and that of the Mersey and other rivers. In these, alluvial soils have overlaid the original rocks, and, where situated above the line of fog, are suitable for apple production, but always contingent on a sufficient depth of loamy soil and efficient natural or artificial drainage.

Brick-earth affords a good example of loamy soil in which apple trees thrive. It obtains in the south, where there has been no drift in its original state as worn from hillsides. Fertile accumulations of brick-earth occur in the lower Thames and Medway valleys. Indeed, the slopes overlooking the Medway, as well as the deep brick-earth of the valley stretching from Canterbury to Chatham, are famous for fruit production. Brick-earth, however, is not absent from drift, for it occurs in Middlesex, Essex, Hertfordshire, and many other counties. Brick-earth on the north of the Thames differs from that south of that river in that it was transported, and the soil is more or less mixed. Wherever alluvial or brick-earth soils occur on favourable exposures, those are apple-producing staples. The reason is that a mixing of two or more different soils effects improvement in their staple and constituents.

The soil formed at the outcrop together of two rock formations, as carboniferous limestone and lower limestone shale, oolite and lias, chalk and upper greensand, magnesian limestone and new red sandstone, is more fertile than the soil of any one of those formations by itself. What nature has left undone, cultivators strive to effect in the operations of chalking, liming, marling, claying, and sometimes paring and burning, namely, the mixing of soils, and thus render some hitherto unsatisfactory capable of higher production.

The apple tree requires 12 to 18 inches in depth of ameliorated substantial loam, and a similar thickness of good staple below it, the whole open and accessible to air by efficient drainage. Marly soils afford the greatest wealth in apple crops, because they are rich in all the ash elements of apples, and the trees are healthy through lime being abundant, apple-wood ash containing 63·60 per cent. of lime. Clay marls and all clay soils are richer in, and make better use of, potash than light soils, and apple-wood ash contains 19·24 per cent. of potash; therefore, clayey soils produce healthier apple trees than are those of a brashy nature. Alluvium and drift soils that have long been cropped are improved for apple culture by liming, and light soils are benefited by marling.

The apple does not succeed in hot sandy soils, shallow loam on chalk, in water-logged land, or a medium soured by stagnant organic acids and pan-forming iron oxides. These
require aeration and lime. Remember that sweet soil only produces healthy, fruitful trees with large, handsome, juicy, full-flavoured fruit.

Preparing Ground.—The directions given on pages 36-40 should be followed out according to circumstances and requirements of the soil. Draining ought to be first seen to, then trenching or stirring the soil. Instructions for preparing stations will be found on pages 40-41, borders, pages 72-75, orchards, pages 82-90. These have special reference to hardy fruits, including apples.

Distances for Planting.—These must be determined by circumstances, habit of the trees, and mode of cultivation. For walls or wood fences: the height of these, and the stock in which the trees are worked, must be considered in determining the distances between the trees. Choice dessert apples do well in the northern parts of England, in Scotland, and in cold situations against south walls; and in the Midlands the fruits attain a perfection in size, colour, and clearness of skin on low walls with south aspects which enhances their value for dessert and exhibition. Apples are also much finer grown against walls or fences with east or west aspects than on trees in the open. Grown against north walls we have found the trees crop well, but the fruit was wanting in colour, and increased in acidity.

Trees on free stocks.—Fan or horizontal trained. Walls, 12 feet or more high: trees, 18 feet apart; walls, 9 or 10 feet high: trees, 24 feet apart; walls, 6 to 8 feet high: trees, 15 to 18 feet apart.

Espaliers.—Fan or horizontal trained. On free stocks:—moderate-growing varieties, 18 to 24 feet apart; vigorous kinds, 24 to 30 feet apart. On Paradise stocks:—moderate-growing sorts, 12 feet apart; strong-growing varieties, 15 to 18 feet apart.

Dwarfs.—Bushes or pyramids. On free stocks:—12 to 18 feet apart. On Paradise stocks:—6 to 12 feet apart. Modifications of these distances are necessitated by different modes of culture and forms of trees, as indicated on pages 334-336.

Standards.—Low standards on dwarfing stocks:—12 feet apart; tall standards on free stocks:—18 to 30 feet apart. For varieties and distances of planting them according to vigour, see pages 335, 336.

Planting.—Details for the successful performance of this important operation are given on pages 137-154, and need not be repeated here.

END OF VOL. I.
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