MINISTRY OF AGRICULTURE AND FISHERIES

BULLETIN No. 2

FRUIT PRODUCTION
TREE FRUITS

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FOREWORD

ALTHOUGH within modern times there has been rapid extension of the fruit industry, and marked improvement in the character of the fruit produced, much knowledge that has been laboriously acquired by research workers remains to be spread among growers. This Bulletin is designed to place at the service of growers, in a clear and concise form, the extent of our present knowledge as regards tree fruits, and it is believed that the information it contains will help growers to avoid risks to which they might otherwise be exposed. Tree fruits only are included in this volume, soft fruits being dealt with in Bulletin No. 4 (for particulars see p. iv).

The benefits of good production may be largely lost unless there is equal efficiency in marketing. The National Mark grading schemes now in operation provide standards that are practicable for the grower and suited to market requirements. Brief references to these schemes have been included, but for fuller information on the important matters of marketing, grading and packing, readers are referred to Orange Book No. 15, *Marketing of Fruit*,* and to the Marketing Leaflets, while the attention of commercial apple growers is particularly directed to the Ministry's Bulletin *Apple Packing*.*

Since the present Bulletin was first issued in 1930 the Ministry has published other Bulletins on various aspects of fruit production. Particulars of these, together with details of the Ministry's Volumes of Collected Leaflets dealing with insect and fungus pests of fruit crops, will be found overleaf. The notes on these aspects of fruit production are, in the present Bulletin, of a brief and general nature, and growers requiring more detailed information are advised to consult these other publications, which have been contributed by specialists in the various subjects.

H. V. TAYLOR,
Horticulture Commissioner.

10, Whitehall Place,
London, S.W.1.
March, 1935.

Fruit Production: *Soft Fruits*	BULLETIN No. 4. 1s. (1s. 2d.)
Commercial Fruit Tree Spraying and What it Costs	BULLETIN No. 5. 9d. (10d.)
Intensive Systems of Apple Production	BULLETIN No. 49. 9d. (10d.)
Apple Packing	BULLETIN No. 84. 1s. 3d. (1s. 5d.)
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Fruit Marketing	ECONOMIC SERIES REPORT No. 15. 6d. (9d.)

The above publications are obtainable through any bookseller or from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. The prices shown in brackets are the post free prices.

CONTENTS

FRUIT PRODUCTION: TREE FRUITS

PLANNING AND PLANTING ORCHARDS

There are many considerations that should guide an intending planter in planning an orchard of any type. Having the land available, the planter has to decide the type of plantation that he needs and the kinds of fruit to be grown; he can then approach the problem of how the trees shall be set out.

Factors Influencing a Decision as to Type of Orchard.—*Soil.*—The soil is of fundamental importance to a fruit planter, and he must plan his orchard and choose his varieties of trees accordingly. Fruit Soil Surveys, completed for some areas*, and proceeding in others, are designed to provide a fund of knowledge which can be drawn upon by those interested. At present it is not possible to lay down general principles, and information must be sought from the local Horticultural Officer†. It is essential to obtain all the help possible in making a detailed survey of any field that is to be planted with fruit.

Climate.—Climate influences the planning of an orchard in several ways. In wet districts, grass orchards predominate.

Location.—Nearness to a railway or a good road and rapid transport to consuming areas are great advantages in the successful marketing of the best grades of all fruits, although modern packages and cold storage may largely discount these factors. Orchards remote from transport services are best devoted to the production of varieties with exceptional travelling qualities, or for the growing of fruit for jam or fermentation purposes.

Aspect (or Slope).—Aspect is an important factor in relation to earliness. Exposure to east winds and south-westerly gales is to be avoided.

Water Supply.—An essential in the production of first-class fruits is pest control, and this can be carried out satisfactorily only where a supply of water is available for making washes.

Specialization.—The specialist can expect to attain a perfection that is not possible to a general farmer, who has to

* Bulletin No. 15, *A Survey of the Soils and Fruit in the West Midlands (Old Red Sandstone Area).* 3s. (3s. 3d.); Bulletin No. 61, *West Cambridgeshire Fruit and Soil Survey.* 1s. 6d. (1s. 8d.); Bulletin No. 80, *Lower Greensand, Kent, Fruit Soil Survey.* 3s. (3s. 3d.); Research Monograph No. 6, *A Survey of the Soils and Fruit of the Wisbech Area.* 3s. 6d. (3s. 8d.).

† See Form A.705/T.G., "Technical Advice for Farmers," obtainable from the Ministry.

give attention to other crops also, and whose fruit crop may consequently suffer in quality. The general farmer should not, therefore, plan a fruit plantation that needs a system of culture that the specialist alone can carry out.

Labour Supply.—It is very necessary that an intending planter should satisfy himself that an adequate supply of labour will be available for the plan adopted, particularly for spraying, cultivating and picking.

Tenure of the Land.—A tenant planter must satisfy himself that his lease gives him adequate protection in the case of disturbance. It may be mentioned here that the different types of fruit trees have varying periods of productivity. Bush trees on dwarfing stocks have a shorter, whilst standards on vigorous stocks have a longer, life. Consequently the planter should plan in accordance with the terms of his lease and any other factors that might influence his tenure of the land.

Circumstances thus impose certain conditions which the would-be orchardist may be powerless to alter, but which, nevertheless, he should not ignore. His first step therefore must be to understand what those limitations are in his particular case, and then decide the trade demand he can supply and the varieties and mode of culture he will adopt in the circumstances. An effort should be made to learn what are the main distributive needs and preferences in the branch of the fruit industry which appears to be most suitable. A planter who has approached the subject of fruit growing along these lines should at this stage be ready to make a selection from among the following broad systems of orcharding.

Grass Orchards.—Experiments clearly show that grass exercises some influence on fruit trees—checking their growth by robbing them of water and plant foods—so that where young trees are set out in grass they must be carefully looked after during the early years. After the tenth year or so they usually manage to grow away well.

Grass orcharding is suitable for (*a*) apples; (*b*) plums and damsons, and (*c*) cherries.

(*a*) *Apples.*—Before planting, the land should be brought to a good condition capable of carrying a good head of stock. If the grass is rough and poor, planting should be delayed pending improvement by liming, manuring and stock feeding.*

The varieties selected should be few in number. Perhaps the best method is to restrict the varieties to two, such as Bramley's

* See Bulletin No. 3, "The Improvement of Grass land," price 1s. 2d., post free from H.M. Stationery Office.

Seedling and either Newton Wonder or Annie Elizabeth. The trees should be standards worked on Seedling Crab or Free Stocks, or better still on to one of the vegetatively propagated Free Stocks such as the Bristol No. 5, or the East Malling No. 12 or No. 13. The trees should be planted on the square leaving a space of 36-40 ft. between the trees.

Such trees do not commence to bear very early, but they should have a profitable life up to 80 years or so.

(*b*) *Plums.*—Culinary Plums and Damsons grow moderately well in grass. The trees should be standards, and be planted 20-30 ft. apart. The trees should commence to bear early and remain profitable up to 35 years.

A similar type of tree is recommended where the planting is done on arable land designed to be grassed down. The arable land should be cultivated for four or five years, after which it may be seeded with a mixture very similar to that specially recommended for grass orchards. (See p. 6.)

(*c*) *Cherries.*—Particulars of the planting out of a cherry orchard may be found on pp. 59 and 60.

Plantations.—When the limitations imposed by the soil and situation have been ascertained and the kinds and varieties of top fruits to be grown, and for which there is a good demand, have been decided, there are still many difficulties to be faced before the plantation can be planned. There is a mass of information available to intending planters, but new knowledge is being obtained almost from day to day, and it is impossible in a Bulletin of this kind to do more that refer briefly to some of the salient points.

It would be convenient, if it were possible, to plant each variety by itself, so that it could be given the most suitable soil and methods of cultivation. Apart from other reasons, the need for pollination alone prevents this, and so it is necessary to mix varieties. Mixtures lead to difficulties, unless the varieties that are planted together can be sprayed, manured and cultivated in the same way.

Further difficulties occur with trees requiring a large amount of space when they mature, owing to the many years that must elapse before they can yield profitable returns. This led to the now discredited system of " Mixed Plantations ", a mixture not only of different varieties, but also of different kinds of fruit and even vegetables and flowers. The production of the high-grade fruit now required is impossible under such a system and it is no

longer advised. The difficulty is by no means completely solved, but if a mixture must be made, it is at least essential to choose varieties as much alike as possible in their requirements. For example, cherries, plums and black currants should on no account be mixed with apples and gooseberries, and there are even varieties of the same kind of fruit that require different spraying and manuring.

An alternative method for apples, for use when soil and methods of cultivation are suitable, has been suggested by East Malling Research Station. It is to plant together two or three varieties only, but on different stocks. For example, permanent trees on very vigorous stocks might be planted at 48 ft. square, with one in the middle (quincunx system), and filler trees in between at 12 ft. apart.

Apples.—Strong growing varieties, such as Bramley's Seedling and Newton Wonder, on strong stocks, require to be 36-40 ft. apart. They may also be planted 48 ft. square with a tree of a smaller variety in the centre of each square. On Broad Leaf and Doucin they require at least 24 ft., and on Jaune de Metz 12 ft.

Varieties of medium growth, such as Cox's Orange and Worcester Pearmain, require 20-24 ft. on vigorous stocks, 14-16 ft. on Broad Leaf and Doucin, and 10 ft. on Jaune de Metz.

Cordon trees and other intensive systems of production are discussed in Bulletin No. 49.*

Cherries.—Methods of planting are described on pp. 59 and 60.

Pears.—Pear trees on quince stock are generally planted at 12ft. square, though more room is required for very strong growers and less for those that are weak.

Plums.—Plum trees suffer less from close planting than other kinds of fruit, nevertheless they are frequently allowed insufficient room. From 15 to 20 ft. is required, according to variety, soil and treatment.

Varieties for Planting.—For information on this subject, reference should be made to p. 40 (Apples), p. 46 (Pears), p. 56 (Plums and Damsons), p. 76 (Cider Apples), p. 66 (Cherries). Before anything is decided, however, the planter should again seek local expert advice. He will thus be able to find out how the listed reputations of the varieties are affected by local conditions.

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* Bulletin No. 49, *Intensive Systems of Apple Production*, price 9d. (by post 10d.).

Orchard Plan.—As a link between the work of planning and the operations of planting, a detailed plan of the proposed orchard should be prepared. This plan will be useful in the planting operations, and will be invaluable in after years for reference. No general system can be suggested, but it must ensure the economic working of all kinds of labour. This mainly resolves itself into the reduction to a minimum of the manhandling of everything pertaining to the production of fruit. Headlands must be amply wide for the turning of ploughs, drays, etc., without damage to the trees. In extensive orchards there should be cross tracks, so that spraying machinery, ladders, baskets, fruit, etc., can be drawn to and from the scene of operations. Drainage, water mains, etc., are best seen to before planting. Everything underground should be carefully marked on a permanent plan, or its location may be lost.

Arrangements of Trees.—The positions of the trees can be marked on the plan when the method of arrangement has been decided. Only four methods need be mentioned.

1. Square, i.e., rows at right angles, trees equidistant in rows, and from row to row. This form is suitable for either filler or permanent trees; cultivation is facilitated, and the type is easy to lay out.

2. Quincunx, i.e., trees on the square with one in the middle of each square.

3. Triangular or Hexagonal, with the trees the same distance in all directions. This system is not suitable for plantations including " filler " trees that it is intended to grub out later on.

4. Cordons at close distances in closely spaced rows.

These will be referred to again under " Setting out " (p. 8), but are detailed here since the method of arrangement affects the number of trees required per acre.

Types of Trees.—Some brief notes on this subject will enable the planter to know what to order from the nurseryman. (The questions of stocks and propagation are dealt with more fully later, see pp. 10 to 20).

Standards have their heads worked or made from 5 ft. 6 in. to 7 ft. from the ground. They are specially suitable for grass orchards. Cherries are worked solely on standards. The stocks should be selected seedlings for all sorts, except for plums, which will be on their own roots or on vegetative stocks.

Half-Standards have their heads worked or made at 4 ft. 6 in. from the ground, and are suitable for permanent trees in plantations. The stocks should be selected seedlings, except for plums, which should be on their own roots or on vegetative stocks.

Bush Trees have a stem from 2 ft. to 3 ft., the latter height being very serviceable. Permanent bush apple trees should be worked on selected seedling stocks or on strong types of Paradise (type I), while those intended as fillers should be on the semi-dwarfing or very dwarfing types II or IX. Bush pears are usually worked or double worked on Quince.

Cordons for apples consist of a single stem trained obliquely, but they may be upright for pears. They are best on a dwarfing stock for the production of dessert fruit.

Purchase of Trees.—Before trees are purchased they should be inspected in the nursery. The trees should be of the following ages according to type:—

Cordons ...	...	Maidens, i.e., 1 year from the bud or graft.
Bush trees	...	Maidens, or cut backs, i.e., a maiden cut back and a further season's growth.
Half-standards ...		Two-years' old feathered trees, i.e., an uncut maiden after a further season's growth.
Standards	...	Three or four years old.

Older trees can always be purchased for more money, but the younger a tree is when it is planted the better progress it makes. Points to be remembered when selecting trees are—

(1) Growth should be strong and typical of the variety.
(2) The union between the stock and scion should be strong and complete.
(3) The stocks must be guaranteed true to name.
(4) The trees must be free from pests and diseases.

Preparation of the Site.—*Grass Orchards.*—The grass must be brought to high stock-carrying condition before the trees are planted. Particular attention should be given to clover population. A pasture comparable to one produced by seeding with a mixture such as the following is an ideal at which to aim:—

12-14 lb.	Perennial Ryegrass.
6 lb.	Cocksfoot.
4-6 lb.	Timothy.
4-6 lb.	Suffolk or Montgomery Late Flowering Red Clover.
1-2 lb.	Wild White Clover.
4 lb.	Crested Dogstail (on light land), *or*
4 lb.	Rough Stalked Meadow Grass (on heavy land).

The maximum benefit of such a mixture is obtained only by judicious manuring and heavy grazing. Perennial weeds, particularly docks, nettles and creeping thistle, should be absent.

Plantations.—The land must carry one or two cleaning crops, and should be in a good state of fertility and cultivation. Perennial weeds should be absent. During the period of preparation a thorough sub-soiling with steam tackle may be advisable, but local expert opinion should be obtained. In any event, early in the autumn before planting, the land will have to be deeply ploughed. No manure need be applied before planting.

Shelter.—In exposed situations, a windbreak is necessary. The least expensive shelter is poplar, but its liability to infection by the Silver Leaf fungus has discouraged its use. Hawthorn is slow growing, and so is beech. The habit of the latter of retaining its dead leaves during the winter, however, makes it one of the best deciduous windbreaks. Scotch Fir, *Thuja gigantica* and *Cupressus macrocarpa* are efficient but expensive. In some districts hardy plums, damsons or vintage pears are planted in the outside rows as windbreaks.

Fencing and Guarding.—All preparations for the protection of the trees against vermin and stock should be completed before planting commences. A single night's damage by a horse or rabbits can completely ruin a newly planted orchard. Grass orchard trees are best protected by a combined vermin and stock guard. An economical type consists of a cylinder of $1\frac{1}{4}$ in. mesh, gauge 16 galvanized wire netting, 6 ft. high and 3 ft. 6 in. in circumference, 6 in. of this measurement overlapping. Such a guard can be made either from 3 ft. 6 in. netting cut into 6 ft. lengths or from 6 ft. netting cut into 3 ft. 6 in. pieces. The former method saves labour of cutting and the cut ends can be bent outward as a protection against stock reaching up to the head of the tree. This guard is further protected by strands of thick-set barbed wire laced vertically or wound spirally on the cylinder.

The cylinder is kept rigid around the tree by attaching it with staples to a stout stake at the overlapped edges. (See Fig. 1.) The tree is also secured to this stake by means of wire, protection against rubbing being provided by passing the wire through old rubber tubing. Old bicycle tyres can be used, in suitable lengths, to secure the tree to the stake. Somerset growers use a hay rope and then no protection is needed. The stake should be 8-9 ft. long, and preferably of sawn wood 2 to

$2\frac{1}{2}$ in. square in section. Stakes should be creosoted. The cost of such a guard without the stake is as follows:—

	s.	d.
Wire netting, gauge 16, $1\frac{1}{4}$ in. mesh, 3ft. 6 in. × 6 ft. ...	1	6
Best thick-set barbed wire 8 yds. spiral		5
Cutting and fixing		3
	2	2

Stakes vary much in price, depending upon whether new sawn stakes, stakes sawn from old railway sleepers, or poles cut from undergrowth are used, but in this matter durability is worth extra expense. Each guard should be so erected that the bottom of the wire cylinder is an inch or so in the ground to protect the tree from vermin.

It is cheapest and best to make the boundaries of a plantation vermin and stock proof. Galvanized netting, $1\frac{1}{2}$ in. mesh, $4\frac{1}{2}$ ft. high and of 18 gauge, buried 4 in. in the ground and turned under, is a reasonable vermin guard. All gates should be made vermin proof by netting the lower halves to ground level.

Planting.—*Setting out.*—In setting out a plantation the plan should not be departed from in any particular.

The equipment necessary is a surveyor's tape, one or more surveyor's chains, wire pegs, sighting poles and a sufficient supply of stakes to mark the positions of the trees. The first step is to set out on the site one of the outer rows with the sighting poles. The position of each tree in this row should be measured out and marked by a stake or peg. The other outer rows can then be marked off. This is done by setting off two lines at right angles to the base line. The easiest method of chaining a right angle is as follows:—The 24th link is pegged at the point from which the right angle is to be set out, the nought end of the chain and the 96th link are pegged together, back along the base line, so that the piece of chain 0-24 is taut. If the 56th link is taken in the direction required until both the sections 24-56 and 56-96 are taut then the point reached will be at right angles to the base line. The side is then completed by alignment and the tree sites marked off. By aligning with sighting poles and measurement, all the parallels can be obtained. It is desirable to mark the tape in some very obvious manner at the required distances from tree to tree. Coloured strips of cloth answer very well.

The outer rows of a hexagonal arrangement can be set out in a similar way to the above, the tree positions in the body of the plantation being decided by striking off arcs from adjacent

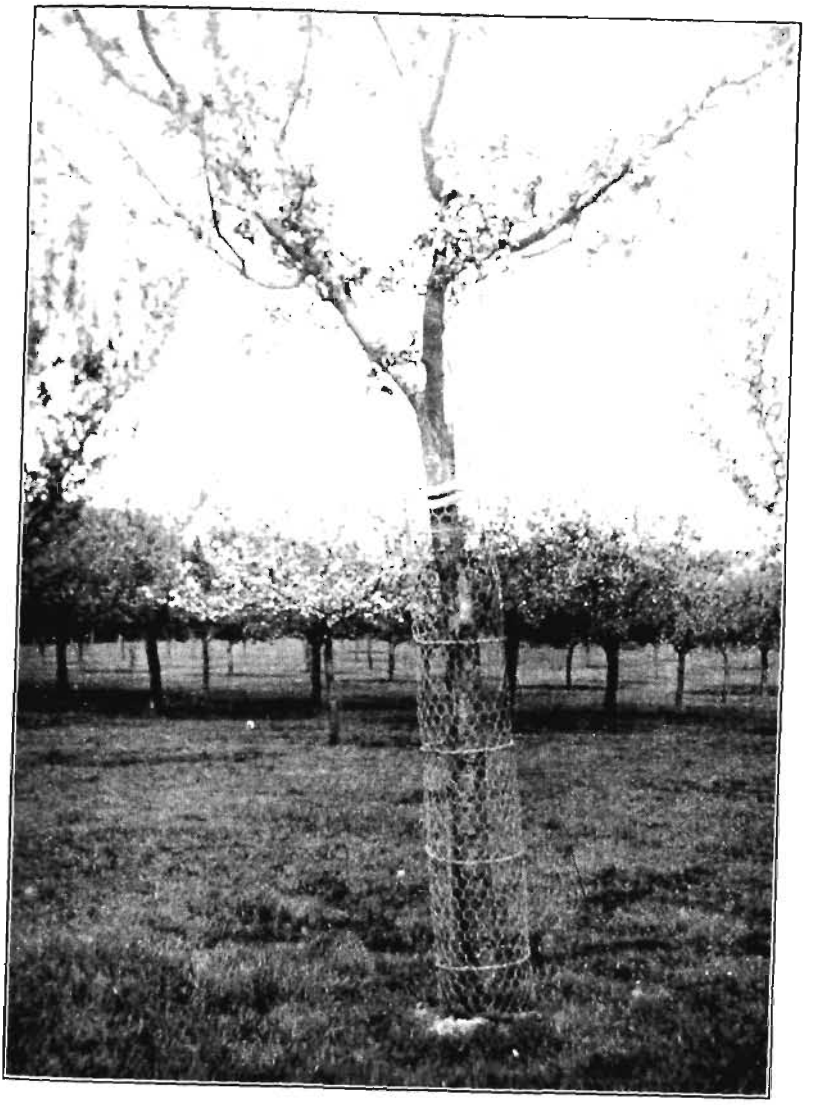

FIG. 1.—COMBINED VERMIN AND STOCK GUARD.

pegs in the base line by means of a wire peg stuck through the chain or tape at the required distance. The point of intersection is the position of the tree in the next row.

General.—None of the operations connected with planting should be performed prior to the existence of suitable planting conditions, i.e., the soil fairly dry, and a spell of settled, fine but not frosty weather in prospect. Such periods occur in the autumn. Planting, however, should be finished before growth is due to start. Recent research has shown that some recommendations for successful planting have been overstressed in the past. It has not been found that loss of root in lifting has seriously affected subsequent progress. Fibrous roots, while capable of further growth, do not again function as fibrous roots.

Trees should not be planted too near the subsoil, or they will never make satisfactory headway. If planted " on the top " there is a chance of damage if drought follows soon afterwards. In light soils the highest roots should be covered with 6 in. of soil, and in heavy soils with 3 in. Such planting is deep enough. It is essential that, between the operations of lifting and planting, the trees should not be exposed to drying winds. If not planted immediately after lifting, the trees should be " heeled in " in loose soil, deeply and separately.

Size of Holes.—When conditions are right for planting, holes some 3 ft. across (1 ft. 6 in. for maidens and 5 ft. for grass planting), and, as a general recommendation, 9-12 in. deep, should be dug out on the positions allotted. The bottom of the hole should be broken up with a fork. The turf from the surface may be chopped up and thrown into the bottom of the hole.

Planting.—In the actual planting, frequent reference should be made to the plan to see that varieties are in their correct positions. Broken roots should first be pruned to facilitate healing. The tree to be planted is then roughly balanced on a small mound of loose earth in the middle of the hole. Loose earth is then shovelled among the roots until they are just covered. The tree is then gently raised up and down to work the soil well among the fibres. More soil is thrown in until the main roots are just covered, the soil is trodden, further soil is shovelled in and trodden, and so on until the hole is filled. It has been shown at East Malling that *very* firm planting is not necessary under the conditions prevailing at the Station. The remainder of the excavated soil should be thrown lightly over the surface of the filled hole.

Operations after Planting.—*Staking.*—This should be done immediately. For standards in grass, a single stout stake should be driven within the tree guard mentioned above. Two ties, one on to the stake and one on to the guard stake, passing around the tree and within rubber tubing will be found to be efficient. For large trees in tillage, two stakes should be driven in 6 in. from the tree and on opposite sides of it. These must be joined by a cross piece of wood to which the tree is tied, the bark being protected by sacking or rubber piping. A single stake will suffice for a bush tree.

Pruning after Planting.—Maidens and 2-year-old trees may be pruned after planting, if growth conditions are favourable, but this operation should be deferred for a year if the trees are 3 or 4 years old, or if growth conditions are not suitable.

Cultivation of Newly Planted Trees.—A mulch put round the trees in April prevents the soil from cracking, and helps the young trees considerably. In plantations the soil must be kept moved by scuffling lightly. On grass the young trees grow better if a circular area 5 ft. in diameter around each tree is kept cultivated and free from grass and weeds; but this counsel of perfection is rather more than the average farmer can follow. In any case, it is wise to feed the young trees, and especially those that are growing none too well, by giving an annual dressing of dung or sulphate of ammonia spread around the tree to a distance of 15 ft. Such treatment should be discontinued when trees have been brought into a good growing state.

Loans to Defray Cost of Planting.—A note on this subject is given on page 97.

PROPAGATION

Suckers are used for raising several kinds of plums, the chief of which are the Pershore or Yellow Egg Plum, Kentish Bush Plum, the Willingham Greengage and many others, and cuttings are employed for a few of the lesser known apples, such as Fillingham Pippin and Oslin; but with these exceptions the cultivated varieties are propagated by budding or grafting them on an established root stock.

The stocks used for budding or grafting are raised from shoot or root cuttings, layers or from seed. The seed method is unsatisfactory, because the seedlings exhibit great variations in vigour of growth and other characters. For want of a better method, however, " Crab " and " Free " apple stocks,

" Free " pear stocks, and Myrobalan, St. Julien and Black Damas plum stocks and Gean and Mahaleb cherry stocks are raised in this way.

Selection of Stocks and Scions

Influence of Stock on Scion.—It is probable that grafted and budded trees retain most of their fundamental characters, such as shape of leaf and fruit, and general habit of growth; but, with apples and pears, it is possible to suit special soil conditions and situations by varying the type of root-stock to influence such characteristics as size of tree, health, vigour, fruitfulness, and especially the time at which the fruit-producing stage is reached. The stock may even influence the intensity of colour and flavour of the fruit.

The nature of the control that is obtained in this way appears to be in direct relationship to the type of the root system which the stock develops. Thus, generally speaking, stocks that have a more or less dwarf habit of growth tend to reduce vigour and to increase fruitfulness. The root systems of such stocks tend to consist either of a mass of somewhat surface rooting fibre or of a few coarse roots noticeably lacking in root fibres, the bulk and vigour being considerably less than in the free growing stocks. By their use, strong growing varieties, which are inclined to bear shyly during the first 10 or 15 years after planting, can be made to fruit at an earlier age and the growth of the trees can be restrained to allow closer planting.

Conversely, by using strong growing stocks having extensive and deep root systems, the vigour and vitality of the weaker growing sorts is increased and the tendency to overcrop and produce insufficient wood-growth is counteracted. Great care is needed, therefore, in choosing a stock that will suit the form in which the tree is to be grown and also local soil and climatic conditions.

Many of the stocks used for plums and cherries do not vary greatly in their vigour, and, therefore, there is not such a marked difference in the effect that they produce on the scions. It is possible, however, through stock, to control the growth of the stone fruits more than has heretofore been supposed. Nevertheless, with plums it is most important to know which is the best stock to use, for some varieties do much better on one kind of stock than another and actual instances of incompatibility of stock and scion are not infrequent. There are at the present time far too many varieties used without discrimination.

The necessity for obtaining uniformity and the standardization of pure strains of the most suitable stocks of all kinds has long been felt. The needless multiplication of types at present in existence, some of which are wholly bad, requires urgent attention. To meet this need, the classification of existing varieties and the selection of new varieties were commenced simultaneously in 1912 at the Fruit Research Stations at East Malling, in Kent, and at Long Ashton, near Bristol. The work of classifying the stocks is now completed, and the results should be of great value to nurserymen and growers and have a marked effect on fruit growing in this country.

Choice of Stocks.—To obtain the desired results it is essential that the trees purchased from nurserymen should be worked on the particular stock required. In the past there has been difficulty in obtaining particulars of the stock used. In many nurseries there has been confusion of the names, and the stock beds have become mixed with rogues. Steps have now been taken annually to rogue the stock beds of those nurserymen who desire it. The trees worked on stocks grown by these nurserymen will, therefore, be of known parentage, and the grower will be able to obtain a guarantee of the variety of stock that has been used. Maiden trees on guaranteed and selected stocks are on the market in increasing quantities, and anyone who is contemplating planting will do well to make sure that he obtains this guarantee with the trees he buys.

Apple Stocks.—The trials undertaken at East Malling have now proceeded far enough to show that the various types of Apple Stock in commercial use can be grouped readily into four classes, namely:—

(*a*) VERY DWARFING CLASS.—Stocks in this group have a special use where very dwarf trees are required for gardens, for cordon growing, for fruiting varieties quickly, and possibly even for closely planted " filler " trees of short life.

The stocks are of the " Paradise " Class and can be raised readily by vegetative methods. The French Paradise (Malling Type VIII), and the Jaune de Metz Paradise (Malling Type IX), are the chief representatives. Type VIII has long been known and used on the Continent, but in this climate it is very unhealthy and is not generally to be recommended to the public, though it may have special value for the plant breeder.

Type IX, the Jaune de Metz, or Yellow Metz Paradise is almost equally dwarfing, far more healthy, and worthy of the consideration of those requiring really dwarf trees. Those using it must remember that its root system is restricted, hence it has no very firm anchorage to stand alone. For trained cordons and very dwarf trees it is almost unique in forcing quick returns.

(*b*) SEMI-DWARFING CLASS.—Stocks in this group are very widely in demand amongst commercial growers who interplant bush fillers, designed to stand for 15 to 20 years, between more permanent trees. Like class (*a*) they would usually be described under the general term "Paradise," the significance of which name is, however, practically lost to-day unless it be understood to mean stock capable of ready vegetative production.

The Doucin (Malling Type II), commonly called "English Paradise" and the "Doucin Ameliore" (Malling Type V), commonly called "Improved Doucin" are the most important representatives of this class.

The Doucin (Malling Type II) is widely distributed all over Europe, and by far the largest percentage of our commercial bush trees have been worked on this variety in the past. It is a hardy stock capable of fairly ready vegetative reproduction, and if properly treated serves its purpose admirably. The *Improved Doucin* (Malling Type V), is very similar, rather more readily reproduced, and a "cleaner" stock for budding, also, possibly, better anchored, but otherwise hardly an improvement on the Doucin.

The Doucin will produce good market bush trees, suitable for planting at from 14 to 20 feet apart, and if they are pruned lightly, most of these will begin to yield some returns about the fourth year. It is suitable for the general run of bush apples, such as Worcester Pearmain, James Grieve, Allington Pippin, Beauty of Bath, Gladstone, Rival and Cox's Orange Pippin, all of more or less medium vigour. Its life is probably longer than often supposed, but in 15 to 20 years it should have fully justified its existence. Where weaker growing varieties, such as Lane's Prince Albert, Grenadier, Stirling Castle, or the Codlins are being planted as more or less durable fillers a more free growing stock is to be recommended.

Where very vigorous varieties, such as Bramley's Seedling, which makes a heavy spreading head, are to be planted, this group of stocks has hardly sufficient anchorage, especially in exposed positions.

The roots of the Doucin are few and coarse, but somewhat brittle, and if used for Bramley's Seedling the trees are apt to be blown about in certain soils.

There are several other types of Paradise Stock that fall into this group and are unfortunately frequently to be found mixed with types II and V, but they possess one or more undesirable characteristics such as exceptional suckering,

liability to Crown Gall disease, &c., and they are therefore better avoided.

(*c*) VIGOROUS CLASS.—Stocks of this group are suitable where large permanent bush trees are required, or where the weaker growing varieties of apple, as mentioned above, are required as bush trees. For the latter, trees such as Lane's Prince Albert, Early Victoria or Grenadier worked on these stocks could be planted at 14-18 ft. apart, but the strong sorts should not be closer than 20 feet and often as far apart as 30 feet. They will produce large well anchored trees.

The best stock of this class is the true *Broad Leaved English Paradise* (Malling Type I), which at one time was supposed to be far more widely distributed and used than it actually was. The stock is raised very readily vegetatively, and is quite healthy and " clean " to work. Trees on this stock must not be planted too closely or pruned too drastically, or their period of cropping is likely to be over delayed. Quite good half standard trees are to be seen here and there on this type.

The Nonsuch Paradise (Malling Type VI) is another of the same class though probably not so vigorous as the Broad Leaved Paradise. It is extremely ready rooting, but a rather coarser stock for working than the Broad Leaf. Both these stocks were simply selected seedling stocks chosen by Thomas Rivers about 1860 because they showed signs of ready rooting. They were vegetatively propagated and distributed by his firm, and probably for the first time really " free-growing " stocks, not propagated by seed, were placed on the market in bulk.

(*d*) VERY VIGOROUS CLASS.—The need for a fourth class of stocks such as this is only for large trees, for very weak varieties or for trees on poor land. Up to the present only seedling apple stocks have been used to supply this need. In the trade there are supposed to be two kinds:—

(1) " Crab Stocks," which are raised from the pips of " Wild Crabs " and are supposed to be preferable because of more uniform growth and hardier constitution.

(2) " Free Stocks," which are raised from the pips obtained from cider pomace.

In practice to-day all seedling stocks may be grouped as " Free Stocks ", for nearly every district has its own distinct " Wild Crabs," which are obviously mere chance wildings. The Agricultural and Horticultural Research Station at Long Ashton studied the types of roots to be found in large collections of free and crab stocks and found them to be extremely

FIG. 2.—LANE'S PRINCE ALBERT. 7 years old, on Jaune de Metz stock (Malling Type IX), produces a dwarf but healthy tree which fruits early.

FIG. 3.—LANE'S PRINCE ALBERT. 7 years old, on a vegetatively raised vigorous stock (Malling Type XIII), produces a very vigorous growing tree which comes into bearing later.

FIG. 4.—VICTORIA. 4 years old, on (*a*) Myrobolan, a vigorous stock; (*b*) Pershore, a vigorous stock; (*c*) Brussels, a medium stock; (*d*) St. Julien, a variable stock.

variable. This was confirmed by the investigations at East Malling, where very varying types of " Free " and " Crab " stocks were grown on to demonstrate the extreme differences in vigour. Both these factors, root variation and vigour, are to be found in all beds of seedling apple stocks to a greater or smaller degree and they show themselves in the trees subsequently worked thereon. For this reason the use of seedling free stocks is not altogether satisfactory, though it is a cheap method of raising. Either a considerable number of poor trees should be picked out and destroyed or some method of raising seed that will breed true to type must be found. There appears to be a much simpler way out of the difficulty. The researches at East Malling showed that many of this very vigorous group of stocks were capable of easy vegetative propagation and quick multiplication. Several varieties of so-called " Paradise Stocks " such as Malling Types X, XII, XIII, XV and XVI, are easily raised from layers, yet show considerable vigour and deep anchorage. These or similar selected vigorous sorts can be raised in quantity to replace the seedling stocks. In this way uniform root systems can be obtained for all classes of apples.

For all practical purposes four types of apple stock should suit all requirements; and the fewer the types that are necessary the better. The Jaune de Metz (Malling IX), the Doucin (Malling II), the Broad Leaved English (Malling I), and a very vigorous stock such as Malling XIII, or XVI, should be a good selection. (Figs. 2 and 3.)

It is still necessary to utter a caution about obtaining stocks true to name, since amongst many of the foreign consignments especially, undesirable stocks are mixed in with the Doucin or sold under a wrong name such as " English Paradise." It is, however, fairly easy with care to pick out and identify " rogue " stocks during the vegetative season.

Pear Stocks.—Different genera of *Rosaceae* have been used from time to time as stocks upon which to bud or graft pears. In the past, stocks such as Wild Service (*Pyrus torminalis* Ehrh.), Mountain Ash (*Pyrus Aucuparia* Gaert) and Hawthorn (*Crataegus Oxyacantha* L.) have been used, and it is still not an uncommon sight in old orchards to see pears worked upon the last named. However, little is at present definitely known about the effects for good or ill of such stocks as these.

For *Dwarfing Purposes* to-day the Quince (*Cydonia vulgaris* Pers.) is almost universally used.

There are at least four types or varieties of Quince in fairly common circulation as stocks, and several others that have been recommended for trial from time to time.

Probably the best type for general use is the true Angers Quince (Malling Type A). It roots readily from layers; it is healthy and of moderate vigour; and generally strong, well-united trees are to be found upon it. The Common Quince (Malling Type B) approaches the Angers fairly closely, but is not quite so vigorous. Another type often sent over from the Continent as De Foutenay (Malling Type D) has darker green, more oblong leaves and a spreading habit. This type should be avoided as the stocks root far less readily from layers. They develop a weak root system later and seem to produce but inferior trees somewhat poorly united.

The Apple-shaped, Pear-shaped and Portugal Quinces (Malling Types F, G and E respectively) are of much more vigorous growth, and it has been thought that they might therefore make more desirable stocks for bush pears.

At East Malling they have proved much more difficult to raise vegetatively, and even when raised and worked, the subsequent trees have not so far always compared very favourably with those on the Angers (Type A) or Common (Type B). A high percentage of young trees break away at the union on these stocks.

It must be remembered that there is at least one disadvantage in having to resort to Quince as a dwarfing stock for pears. Certain varieties of pear, such as Marie Louise, Souvenir du Congrès, Josephine de Malines, &c., will not " take " directly on Quince, but have to be double worked upon some intermediate variety which will readily unite and form a strong union. Intermediates such as Beurre d'Amanlis, Uvedales St. Germain, or Pitmaston Duchess, of strong growth and hardy nature are usually chosen. This process, however, means that in many cases where trees are commonly budded it takes at least 30 months to raise a maiden tree that requires double working. Such a tree is necessarily expensive.

Other varieties of pear, such as Dr. Jules Guyot and Williams Bon Chrétien, although they will unite with the Quince, make much more satisfactory trees if double worked.

Nothing equivalent to the dwarf forms of " Paradise " apple appears so far to have been introduced into commerce from amongst the wild and seedling pears in use as " free stocks." If such a stock could be found and propagated by vegetative methods the necessity of double working might be eliminated.

The *Free Growing Stocks* for pears are at present wholly provided for from the collections of seedling pears, the seed being obtained mostly from Perry pomace, though it is claimed that, as with apples, some are raised from the seed of wildings.

Regarded as a class, these " free " pear stocks are on the whole vigorous, but like most seedling stocks they show considerable differences, not only in vegetative characters, but in root systems.

There are even considerable differences in vigour, though it is as yet uncertain whether such a complete range could be found as in the apple. Many of these stocks are capable of vegetative reproduction, however, and there seems no reason why good stocks should not be selected and tried for this purpose. They are being raised at East Malling Research Station. Pears on " free " stocks have a reputation for coming into bearing very slowly and also for causing some varieties, such as Fertility, to canker badly on certain soils. With the present use of indiscriminate seedling stocks, however, it is difficult to prove the general value of such assertions.

Plum Stocks. (Fig. 4.)—At the present time representatives of at least three species of Prunus are in common use as plum stocks in this country. Considerable numbers of varieties of these are being used without any very apparent reason for their choice except their ready availability. Those in general commercial circulation include some stocks that are raised vegetatively, either by layers or root cuttings, and others that are raised from seed, though they are also quite capable of vegetative propagation. These seedling stocks show considerable variation. It has from time to time been stated that the plum stocks in use are all of similar vigour and that it is impossible to dwarf a plum. It may be true that at present there has not been found a range of dwarfingness and vigour comparable with that of the apple stocks, but sufficient evidence has been collected at East Malling Research Station to prove that some of the stocks already in common use are at least semi-dwarfing for certain varieties of plum.

Again, the indiscriminate use of misnamed or unrecognized plum stocks has frequently led to considerable financial loss, because the fact is not yet fully realized that certain buds or grafts will not " take " upon certain stocks. Czar and most of the damsons, for instance, will not " take " upon Common Plum.

The greatest care should therefore be exercised in trying to select stocks suitable to particular scions.

For this reason, as well as owing to the risk of working stocks infected with Silver Leaf (*Stereum purpureum*), it is not wise to rely upon the suckers grubbed up in commercial plantations unless the greatest care has been exercised in their selection. The good and bad sorts are thus frequently mixed together; in the leafless stage it is not possible to detect Silver Leaf on a living sucker, and thus the disease frequently gets carried into the nursery and infected stocks are unconsciously used for grafting. At the present time there is insufficient evidence to show whether the use of a very vigorous or a more dwarfing stock can increase or decrease the liability of a tree worked thereon to Silver Leaf. It is not even known whether an immune stock, if such could be found, would convey its immunity to the tree. At any rate, the use of even highly resistant stocks would be an additional precaution. Several local plums, of which the Pershore or Yellow Egg Plum is the best known, are reputed to show considerable resistance to the disease. These plums are nearly always grown on their own roots and the suckers therefrom are in considerable demand as stocks.

The MOST VIGOROUS GROUP of stocks includes the following:—

The *Myrobalan,* often wrongly misnamed " Mirabelle ", and commonly called Cherry Plum. This stock has several distinct advantages from the nurseryman's point of view. It produces an exceedingly vigorous and saleable-looking young tree. Moreover, most varieties of plum take very readily upon it. The Myrobalan undoubtedly produces very big trees which are reputed to be very slow in coming into bearing. The stock also frequently sends up suckers, but not more so than many other sorts. The stocks of Myrobalan on the market are generally variable seedlings.

The *Brompton,* generally speaking, is not quite so vigorous as the Myrobalan though it produces very vigorous trees. Most varieties seem to take well upon it, but it is not nearly so widely used as formerly owing to a supposed liability to Silver Leaf. It is raised from layers and root cuttings.

The *Pershore* or *Yellow Egg Plum* is also a vigorous stock. Most varieties of plum take very readily upon it, but in the past the use of the stock has been somewhat limited by the fact that the only source of supply has been that of suckers. It can also be raised vegetatively by layering like any other plum stock.

The *Brussels* would seem to impart a more medium growth upon varieties worked thereon. Its use has been extremely widespread, as is shown by the suckers of it to be found in nearly every plum plantation, where good-sized trees are to be seen upon it. It is a stock that requires to be budded early in the season or it is apt to " get dry," with the result that buds that would normally " take " upon it frequently fail.

Stocks are very readily raised from layers.

A LESS VIGOROUS GROUP comprises the following:—

The *Mussels,* of which two distinct sorts are in very common use. The Broad Leaved Shining Mussel has acquired a special reputation for peaches. The Common Mussel is a somewhat spiny and branched stock, but it appears to be hardy and well rooted, and certainly tends to check the growth of some varieties worked upon it. These stocks can be raised from layers but are largely propagated from root cuttings.

The *Common Plum* is a distinct variety largely raised from layers in the Surrey districts.

Trees of some size and considerable age are frequently to be seen upon it, but in the early stages at least it gives a slight check to the vigour of the tree. It is a nice clean stock to work but must be used with care, since certain varieties, as already mentioned, take very badly upon it. Peaches also fail on this stock.

The *St. Julien* stocks to-day are unfortunately nearly all raised from seed and are therefore very variable. Most varieties appear to take well upon good selected St. Juliens, and again these stocks give slightly more restricted trees. They are also favoured as a peach stock.

The St. Juliens can be raised readily by layering, and a St. Julien de Toulouse raised in this method is sometimes obtainable.

The *Damas* or Damask stocks, like the last, are almost entirely raised from seed to-day, and seedlings of both " Black " and " White " Damas are readily bought on the Continent.

In effect they appear to be very similar to the St. Julien, and good types can be raised vegetatively quite as readily.

Numerous lesser known and local sorts are also often used as plum stocks.

Cherries.—*Sweet Cherries,* if required for standard trees, are usually worked " standard high " (6 ft. from the ground) on " Gean " or wild sweet cherry (*Prunus Avium*) stocks. These stocks are obtained either by planting seed of sweet cherries

in the nursery, or by digging young wild cherries in the woods, and occasionally by digging suckers in old orchards.

Acid Cherries, if required for standard trees, are also usually worked on Gean stocks; for bush and trained trees they are more often worked on Mahaleb (*Prunus Mahaleb*), or " Common," so-called " Cerasus Austera " stocks, which appear to be seedlings of some form of acid cherry (*Prunus Cerasus*).

All these cherry stocks, except the few obtained as suckers, are seedlings. Experiments at East Malling have clearly shown that " Gean " and " Common " cherry stocks may be raised from layers; it is expected that this method will produce greater uniformity in the resulting trees. No satisfactory outdoor method of propagating Mahaleb stocks vegetatively has yet been found, but it is believed they can readily be raised from softwood cuttings under glass.

Supply of Stocks.—Raising stocks is a special industry in itself and requires a sandy soil favouring rapid root development. There are extensive stock-raising nurseries in Surrey, around Woking and Guildford. The home supply was formerly supplemented annually by large quantities imported from nurseries around Orleans in France, but these importations are no longer allowed since the Colorado Beetle has become established in France.

Stocks of all kinds are sold graded according to their size and age, and whether they have been transplanted. The size grade refers to the circumference at ground level. For example, the measurement for first grade yearling stocks varies from 6 to 10 millimetres, while for two-year-old transplanted material the sizes would be from 12 to 16 millimetres.

Choice of Scions.—Scions for budding or grafting should be cut from selected prolific and healthy trees. For budding, firm wood of the current year's growth should be cut just prior to use, and kept fresh by being stood in a pail containing a little water. For grafting, well ripened yearling wood should be cut in the winter prior to pruning, and after being labelled as to variety, bedded in a shady position. In this way the buds will remain dormant until after the stocks have commenced growth.

GRAFTING AND BUDDING

General.—The union between the stock and the scion is generally considered more perfect in budded than in grafted trees, particularly with plums and cherries. For pears and apples, however, it is difficult to say which is the better method.

By the use of both methods it is possible to make certain of a good " take," i.e., by budding the stocks in August or September, and grafting any that have failed to take in the following spring.

All stocks, and particularly those that are dwarfing, should be grafted or budded as closely to the ground level as possible. There is then no difficulty in planting the young trees so that the union between the graft and stock is below ground level.

Grafting.—The season for grafting is in the spring during March and April, when the stocks have just commenced growth, but while the scions are still dormant.

Success in grafting can be accomplished only by making clean square cuts so that the exposed surfaces of the graft and stock correspond in size and fit together tightly. Layers of cambium cells just below the rind are responsible for the union between the stock and scion. It is most important that the layers of this tissue which are exposed on the graft should be applied closely to those of the stock and over as great a length as possible. The rapidity and completeness of the union depend on the extent to which these cambium layers coincide. Union takes place very slowly or not at all when the cambium layers touch the hard wood.

The various kinds of stocks become ready for grafting with the spring in the following order:—Plum, quince and pear, cherry, Paradise apple, free apple.

NOTE.—As a rule, trees for top grafting are ready slightly later than stocks of the same fruit.

Requisites.—A pruning knife, a budding knife, a whetstone, a shallow basket to hold the tools, a kneeler, raffia for binding, and wax or grafting clay (" pug "). For top grafting a saw also is required.

Grafting wax can be bought readily prepared or can be made at home according to the following recipes:—

(1)	Black pitch	14 parts.
	Burgundy pitch	14 ,,
	Beeswax	8 ,,
	Tallow	7 ,,
	Yellow ochre	14 ,,

Melt the black and Burgundy pitch, beeswax and tallow together and stir in the ochre whilst the mixture is still liquid. This wax should be used warm.

(2)	Tallow	1 part.
	Beeswax	2 parts.
	Resin	4 ,,

Melt together and use warm.

(3)	Burgundy pitch	1 part.
	Paraffin wax	1 ,,
	Tallow	1 ,,

Melt together and use either hot or cold.

The first and second recipes are the most satisfactory, and should be painted over all the cuts with a brush while still hot and liquid. They should not be applied boiling or the grafts may be damaged.

"Pug" is prepared by mixing together two parts of clay and one of cow dung with a little chaff or cavings for binding purposes, and watering until a consistency of putty is obtained. Many consider grafts take better with "Pug" than with Wax, but the method is too slow if many stocks have to be treated.

TONGUE OR WHIP GRAFTING.—(a) *When the Stock and Scion are of the same size* (Fig. 5).—First remove all the side shoots from the base of the stock. Then cut it off 2 in. or 3 in. from ground level by an upward oblique stroke 1½ to 2 in. long (Fig. 5. A.). Across the middle of this cut surface, and by means of a downward stroke of the knife, raise a thin tongue pointing upwards (Fig. 5 A^1.).

Next cut a graft containing three or four well-developed wood buds from a piece of the wood selected for the scions. The uppermost cut should be made slightly obliquely across the wood just above the top bud. The lower cut should be about ¾ in. below the lowest bud of the graft, which is known as the stock bud (Fig. 5 B^1.). With a downward stroke of the knife make an oblique cut 1½ in. to 2 in. long across the graft on the opposite side to the stock bud so that the exposed surface corresponds in size to that of the stock (Fig. 5 B^2.). Finally, by an upward cut across the middle of the cut surface raise a thin tongue pointing downwards (Fig. 5 C^1.).

The graft is then applied to the stock, and the two tongues are fitted together tightly, so that the rinds of each coincide as far as possible (Fig. 5 D). Now bind the graft and stock tightly together (Fig. 5 E) with raffia, leaving the stock bud free (Fig. 5 E^1), and complete the operation by covering all the cut surfaces with a grafting wax (Fig. 5 F) or clay (pug) to prevent drying.

(*b*) *When the Stock is larger than the Graft* (Fig. 6).—The graft (Fig. 6 A) is prepared in the same way as in (a), except that the tongue is made at the top instead of across the middle of the oblique cut surface.

The stock, after trimming, is cut off almost square across 2 to 3 in. above ground level (Fig. 6 B^1.). By an upward stroke of the knife expose a clean surface on the longest side of the stock slightly wider than that cut on the graft (Fig. 6 B^2.). At the top of this surface make a tongue to receive the graft (Fig. 6 B^3.). Apply the graft to the stock so that the tongues fit together closely and the rinds coincide (Fig. 6 C.). Complete the operation as before by binding tightly with raffia and covering all the cut surfaces with wax or clay.

After-treatment of the Grafts.—As soon as the grafts begin to grow, it is a good plan to tie the main shoots to sticks to prevent the wind breaking them and to secure straight main stems. The raffia ties must also be cut as soon as growth commences, otherwise the ties will cut into the wood and severely damage the young trees. Fig. 9 shows a young tree damaged in this way.

When the main shoots are from 18 in. to 2 ft. long, all the lateral growths from the grafts should be stopped by pinching out the growing points. The suckers sent up from the stock should also be removed two or three times during the summer, to concentrate all the energy of the stocks into the growth of strong single-stemmed trees.

A close watch must be kept throughout the summer for the first signs of such insect pests as caterpillar, aphis or capsid bug, so that the attack can be overcome before damage has occurred.

Budding.—The season for budding is from the end of July to the beginning of September.

The requisites for this operation are a bone-handled budding knife, a pail in which to keep the scions, and a supply of raffia for binding.

Stout well-ripened buds from the current year's growth should be used for budding, and all fruit buds or young unripened buds should be discarded. It is usual to cut off lengths of yearling wood-growth to provide a supply of these buds. This material should not be removed until a short time before the buds are required and should always be kept fresh by being stood in a pail with a little water.

The method usually adopted is known as " Shield " or " T " budding.

The bud is removed from the selected wood growth together with a semi-circular shield of wood and rind, about $\frac{3}{4}$ inch in length (Fig. 8A). To remove this shield, the cut should

commence about ½ inch below the bud and finish about ¼ inch above it. The blade of the leaf is then removed leaving the leafstalk intact for pressing the bud under the rind of the stock and preserving it from damage. Next, the portion of wood cut away with the shield is removed from the rind with the point of the knife (Fig. 8C), but leaving the bud undamaged. In removing this piece of wood great care must be taken to leave undamaged the small protuberance at the base of the bud, inside the rind (Fig. 8B).

To prepare the stock, all suckers and side growths are removed within 6 inches of the ground. Next, a " T "-shaped cut is made in the rind as close to the ground level as possible. The down stroke of the "T " should be about 1 in. long and the cross-cut about ½ in. The bark on both sides of the downward cut is then raised slightly with the back of the budding knife (Fig. 10).

The bud shield thus prepared is slipped beneath the lips of the downward cut on the stock (Fig. 11) until the top of the shield is below the cross-cut of the " T " (Fig. 12).

To complete the operation raffia is lightly tied over all the cuts, but the bud is left uncovered (Fig. 13).

After-treatment of the Buds.—Later in the autumn, as soon as the buds have taken, the ties of raffia should be cut to allow the stock to swell normally. Fig. 14 shows the budded stock after the raffia has been removed. In commercial practice the stocks are cut down or " snagged " to within 6 inches above the bud, leaving a snag which serves as a stake to which the bud growth can be tied (Fig 15). Towards the end of the following summer this " snag " is removed completely.

Suckers or shoots arising from the stock must be removed two or three times during the summer.

Top Grafting.—This operation is one of the most useful methods by which unfruitful established trees can be brought into a profitable condition.

Rind or *Crown Grafting* is the method recommended for top grafting. Trees that are selected for this purpose should have their main branches sawn off during the winter and the faggot wood removed. Fig. 16 shows the trees cut back in this way.

At grafting time, that is, when the rind peels quite easily from the wood, the branches are sawn square across where they are stout enough to support the large branches which will grow from vigorous grafts.

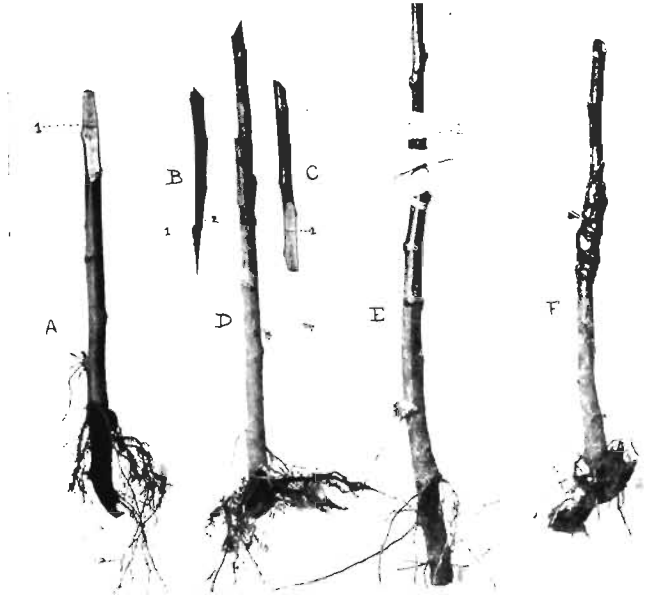

FIG. 5.—WHIP GRAFTING—(*a*) Graft and Stock the same size. A, the *Stock* cut to receive the graft ; A^1, the position of the tongue. B and C, *Grafts* ready for applying to Stocks ; B^1, the Stock bud ; B^2, the long oblique cut surface ; C^1, the position of the tongue. D, Graft and Stock fitted together. E, Graft and Stock bound together with raffia; E^1, the Stock-bud which is left uncovered. F, the operation completed ; all the cut surfaces covered with grafting wax.

FIG. 6.—WHIP GRAFTING—(*b*) Stock larger than Graft. A, the *Graft* ready prepared; A^1 the position of the tongue. B, the *Stock* cut to receive the Graft ; B^1, the square cut ; B^2, the long oblique cut ; B^3, the tongue. C, Graft applied to the Stock, the tongues fitted together.

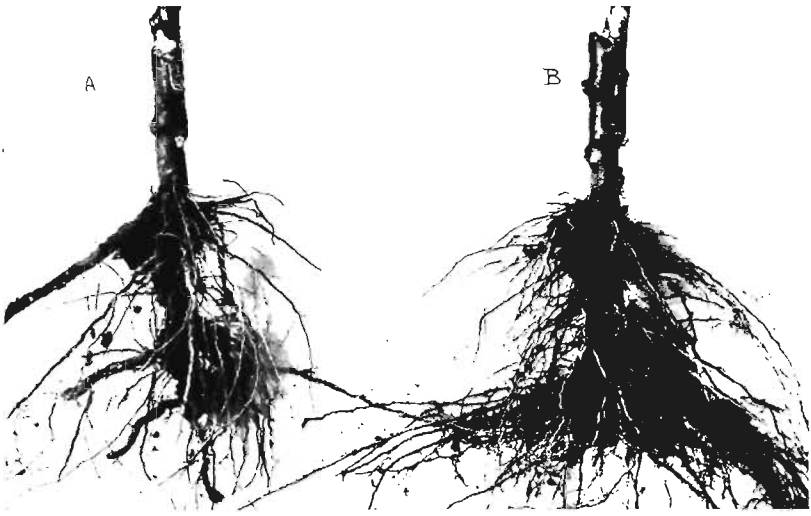

FIG. 7.—Maiden trees showing the union between Graft and Stock after one year's growth. In A the Graft and Stock were the same size and the union is more complete than in B, where the Graft was smaller than the Stock.

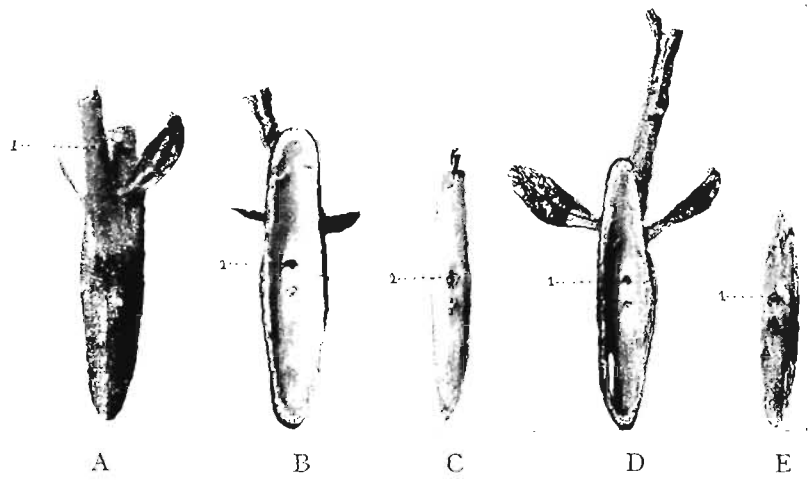

FIG. 8.—PREPARATION OF THE BUD. A, the *Bud Shield* as cut from the selected wood growth; A', the leafstalk with the leafblade cut off. B, the *Bud Shield* prepared ready for applying to the Stock. The piece of hard wood C has been removed by means of the knife. The basal bud protuberance B' is intact. C, the piece of hard wood removed from the bud shield B. There is a slight depression at C' the original point of contact with the basal bud protuberance B'. D, a useless bud shield. The basal bud protuberance has been removed with the hard wood E, leaving a depression instead, D'. E, the piece of hard wood removed from the bud shield D, together with the basal bud protuberance E'.

FIG. 9.—A GRAFT SEARED BY RAFFIA.

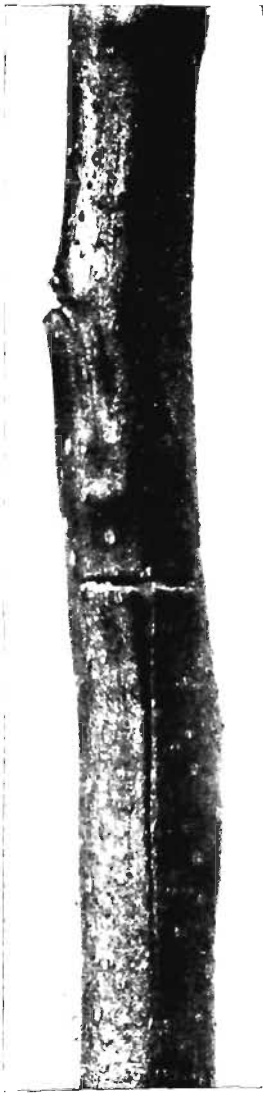

FIG. 10.—BUDDING. The "T" shaped cut on the Stock.

FIG. 11.—BUDDING. The Bud Shield slipped under the rind of the Stock.

FIG. 12.—BUDDING. The Bud Shield in its final position pressed completely beneath the rind of the Stock.

FIG. 13.—BUDDING. The operation completed by binding the bud shield tightly to the Stock with raffia.

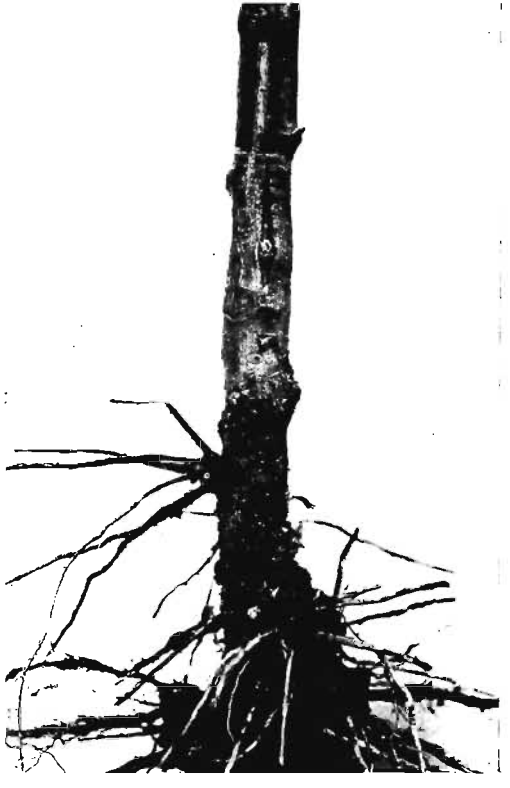

FIG. 14.—BUDDING. A bud which has "taken," *i.e.*, united with the Stock, after the raffia has been removed.

FIG. 15.—BUDDING. The "Snag," with the growth from the bud tied to it.

FIG. 16.—TOP GRAFTING. A tree to be top grafted, cut back in the winter and with the faggot wood removed.

FIG. 16.—TOP GRAFTING. A tree to be top grafted, cut back in the winter and with the faggot wood removed.

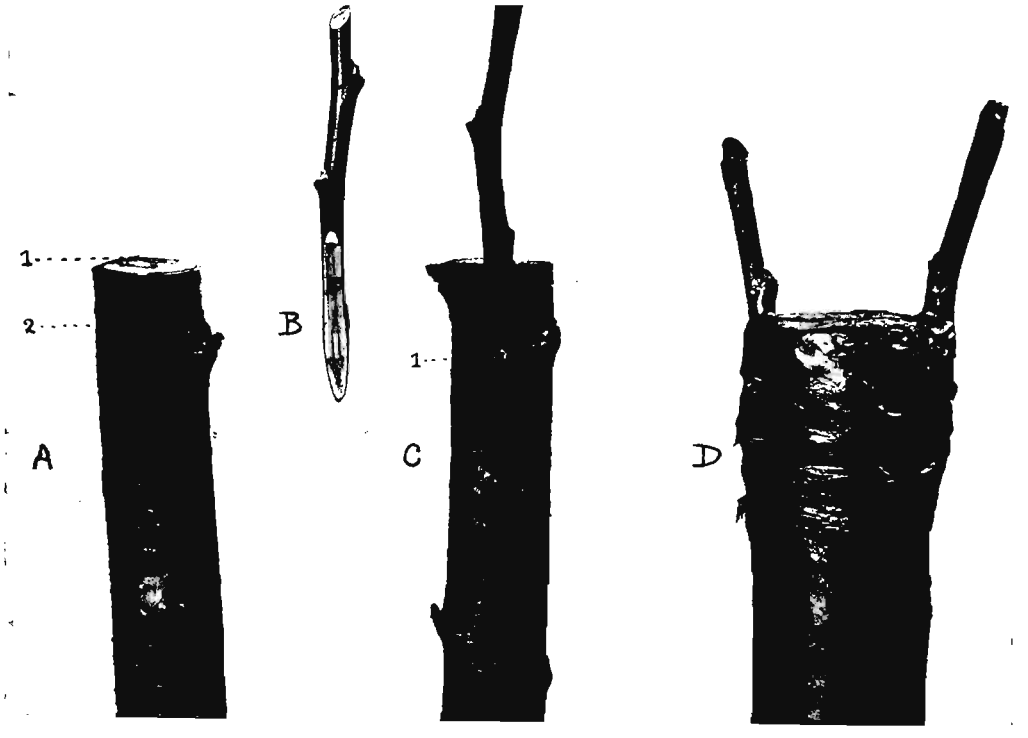

FIG. 17.—TOP GRAFTING.—RIND OR CROWN GRAFTING. A, a branch of the Stock prepared to receive the graft; A^1 the pared surface at the top of the branch; A^2 the longitudinal cut in the rind. B, the Graft. C, the Graft slipped beneath the rind of the Stock; C^1 the Stock bud. D, the operation completed. The grafts have been bound to the Stock with raffia and all the cut surfaces have been waxed.

FIG. 18.—TOP GRAFTING. The tree depicted in Fig. 16 after top grafting. Note the length of the branches of the Stock. "Pug" has been used for covering the cut surfaces.

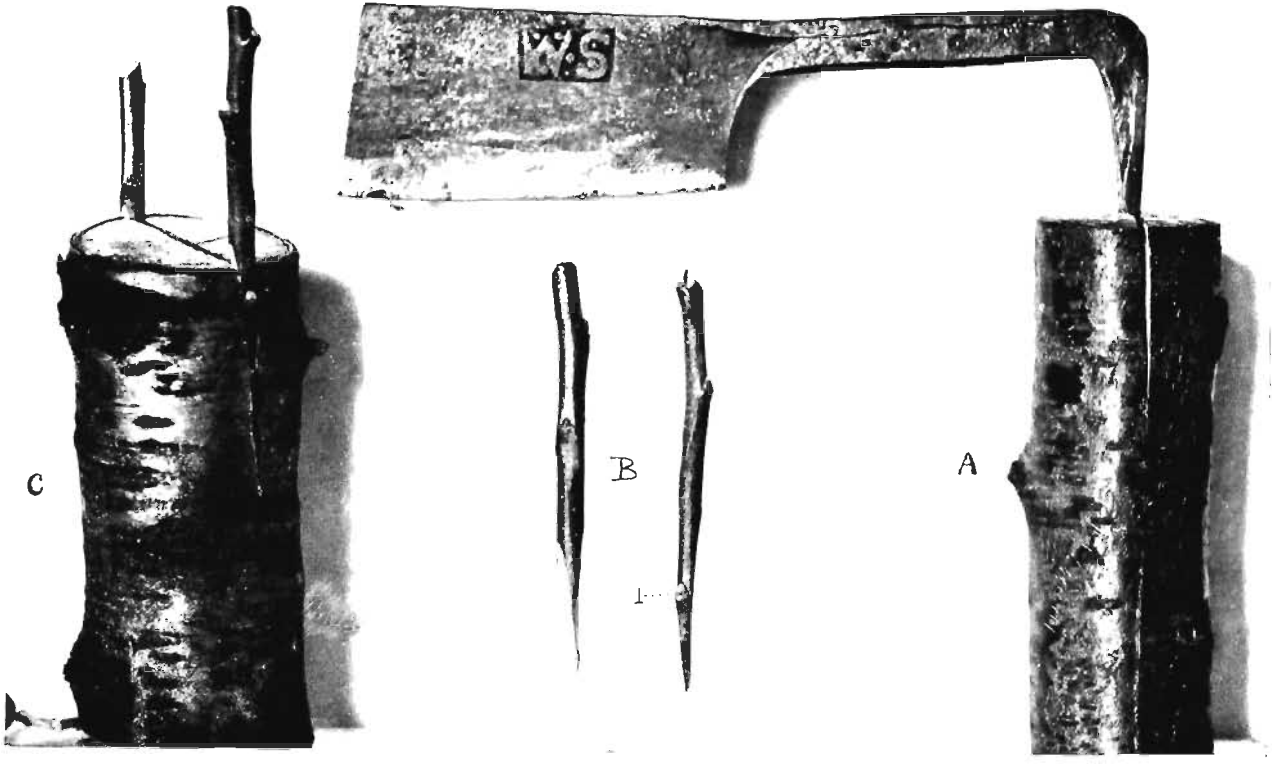

FIG. 19.—TOP GRAFTING.—CLEFT GRAFTING. A, the branch of the Stock is split transversely with a chisel or chopper. B, the Grafts with long oblique surfaces cut on each side of the Stock bud, B¹. These are inserted in the cleft in the Stock C, bound with raffia and then waxed or "pugged."

The sawn surface at the end of each branch is then pared smooth with the pruning knife to facilitate healing (Fig. 17A[1]). Afterwards a longitudinal cut 2 in. to 3 in. long is made in the bark and the rind at the top of this cut is raised slightly on either side (Fig. 17A[2]).

A graft (Fig. 17B) containing 3 or 4 buds, similar to that used for Whip grafting but with no tongue, is cut and slipped beneath the raised lips of the rind on the stock. It is then pressed downwards until the long cut surface is level with the top of the branch (Fig. 17C). The graft is then bound tightly to the stock with raffia but the stock bud is left uncovered. It is important that the top tie should be as tight as possible to effect a perfect union at this point and so prevent the graft from breaking when first it commences to bear fruit. The operation is completed by covering all the cut surfaces round the graft with wax or " pug " (Fig. 17D).

One graft is sufficient for branches under 4 in. in diameter. Above this size two or even three grafts should be used. If these are found to be too close after a year or two, one or even two can be removed.

Fig. 18 shows the tree depicted in Fig. 16, with the top grafting completed.

Cleft Grafting (Fig. 19) is another method of top grafting but it is not recommended as the cleft in the branch of the stock (Fig. 19C), besides weakening it, takes several years to heal, and serves as a shelter for insect pests.

After-treatment of the Top Grafts.—It is usual to allow a few lateral branches to remain on the stock to encourage the flow of sap until the grafts have made 18 in. to 2 ft. of growth. All growth from the stock should then be removed completely.

If the trees are in an exposed position the " leaders " or main shoots from the grafts should be stopped when they have made two to three feet of growth. This will prevent the grafts " blowing out " before they are firmly united with the stock. An alternative method is to steady these leaders during the first year by tying them loosely to stakes bound tightly to the branches of the stock.

WINTER PRUNING BUSH AND HALF-STANDARD APPLE TREES

The main object of pruning changes gradually with the development of the tree. For the first few years the aim is to establish the main branch system of the tree. As soon as the tree has been formed and commenced to crop, the maintenance

of growth and prevention of over-cropping become of primary importance. The object of pruning is then to ensure sufficient vigour for the production of a healthy tree and heavy crops of *large* fruit throughout a long life.

The following subsidiary reasons for pruning are important and must always be borne in mind:—

(1) The centre of the trees must be kept open and not allowed to become overcrowded with unnecessary wood-growth. As a result the fruit colours and ripens better, and spraying and other cultural operations can be carried out more effectively. Conditions generally are also less suitable for fungus diseases.

(2) Fungus attacks are lessened by the removal of diseased wood.

(3) To improve the quality of the fruit, particularly in size, colour, etc.

Relationship between Growth and Fruit Production.—As a general rule, trees growing very freely do not produce many fruit buds or much fruit; on the other hand, trees cropping heavily produce fruit buds excessively and do not form sufficient growth to keep them healthy and bring their crops to full maturity.

The balance or want of balance between growth and fruit production depends to a very large extent on the relationship which the " above-ground " parts of the tree bear to the root system. The chief means of regulating this balance are the choice of suitable stocks, cultivation, manuring, and pruning. The vigour of the scion may be increased by the use of strong stocks, which produce extensive root systems, or decreased by means of dwarfing fibrous-rooting stocks of some forms of the Paradise type.

It should be every apple grower's endeavour, after the foundation of the tree has been laid, to maintain a state of balance between the root and stem growth by pruning, manuring and appropriate cultural operations.

Owing to the influence that the root system of the tree exerts on this relationship, it is desirable to refer to the joint effect of pruning and manuring.

Effect of Manures.—As a general rule nitrogenous manures and hard pruning induce wood growth. Under these circumstances many wood buds become active and produce growth which in the normal course of events would either change into fruit buds or remain dormant. Trees which have been treated in this manner grow strongly, produce little fruit and are subject

to canker and other fungus diseases. The few fruits produced are large, but usually lack flavour and colour. Growth is encouraged at the expense of fruit production, and the trees will not become prolific until excessive wood production has been checked by an alteration in cultural methods.

On the other hand, phosphatic and potassic manures and a minimum amount of pruning may induce excessive fruit production. Large numbers of fruit buds are formed, but there is comparatively little wood growth and a lack of vigour. As a result the tree sets more fruit than it is capable of carrying to maturity, and the crop consists of small and unattractive fruits. If nothing is done to check this excessive fruit production the tree becomes greatly weakened, a prey to diseases, and is soon worthless.

An intermediate course must therefore be pursued. If the tree is growing very strongly and not fruiting sufficiently, cultivation and nitrogenous manures should be withheld, phosphatic and potassic manures given, and pruning should be reduced to a minimum; if the tree is over-fruiting, nitrogenous manures and clean cultivation should be given, and pruning should be directed to inducing wood growth and to thinning out the fruit spurs.

Pruning Young Trees.—Apples to be trained as bush trees should be planted as " maidens "* or as " two-year cut backs "**, but half-standard trees are most easily formed from "two-year feathered " trees***.

A bush tree should have a clean main stem at least two feet high before the head is reached, to permit of easy cultivation of the land, and to allow a grease-band to be placed high enough up the stem to prevent it becoming splashed with earth. The head of a half-standard tree should be 4 feet 6 inches from the ground.

If a " maiden " is planted for training into a bush tree, the central growth or leader should be " headed back " after being planted, to a prominent wood bud at the desired height; at the same time all short lateral growths should be removed

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* *A " Maiden " tree* is a one-year-old tree, and consists of the growth formed during one growing season from the time the stock was budded or grafted.

** *A " Two-year-old Cutback " tree* has two complete seasons' growth from the time the tree was budded or grafted. If a maiden has its " leader " or main shoot cut back in the winter following its formation a two-year-old cutback tree is obtained in the second year.

*** " Maiden " trees which are allowed to remain unpruned in the winter following their formation become after the second year *" Two-year Feathered " trees.*

completely from the main stem. In the following year, as a result of this pruning, three or four strong growths will be obtained.

" Two-year-cutback " trees to be trained as bush trees should have been " headed back " at this height in the nursery. These trees will be approximately the same size as trees planted as " maidens," which have made a year's growth in their permanent positions.

" Two-year feathered " trees for training into half-standards should be " headed back " after being planted, to a good prominent wood bud 5 ft. from the ground level so as to obtain a head in a similar manner. At the same time the lower lateral growths not required for branches should be cut back to three or four buds and must be removed entirely in the following year.

Pruning in the next few seasons will still have for its object the formation of the head of the tree. Each season all the strong main growths or " leaders " should be cut back for from one-half to two-thirds their length to a prominent bud pointing towards the direction in which the growth is required, so as to increase the number of main branches. All the weak lateral growths should be shortened back to 3 to 4 in. Strong growths not required for main branches must be removed entirely and any suckers which are sent up from the stocks must be cut clean away as well as all lateral growths arising from the main stem. When 8 to 10 strong main branches have been obtained, the head of the tree has been formed and fruiting may commence.

In forming the tree every effort must be made to secure three or four main branches radiating at properly-spaced intervals from the main stem. These in their turn should be furnished with suitable laterals. The centre of the tree must be kept as open as possible by the removal of all crossing branches. The main branches must also be kept even in height and length to prevent the tree from becoming lop-sided. To secure this, it is often necessary when pruning to cut the strongest leaders somewhat harder in proportion to their length than the weaker ones. Young trees of Beauty of Bath are especially liable to become lop-sided and the tendency must be checked early.

The methods of pruning young trees just described are generally accepted as the best for securing stout and evenly placed main branches. In some districts, however, training is not commenced until one year has elapsed after planting. Growers who adopt this practice consider that it allows the

root system of the tree to become established before it is required to maintain much growth, and they assert that the amount of growth lost in the first year after planting is more than made up in the second, third and fourth years. This is often true, but it should be remembered that trees allowed to remain unpruned the first season after planting usually make little initial growth, and must, therefore, be cut right back to a wood bud on the two-year-old wood.

Young trees should always be pruned in the autumn so that the buds selected to act as terminal buds to the pruned shoots may receive a full supply of sap.

Pruning Established Apple Trees.—When 8 to 10 main branches have been obtained, and the tree has become firmly established in its permanent position, pruning proper must commence.

The pruning at this stage resolves itself into—

(*a*) *Treatment of the "Leaders."*—It may be necessary to shorten the main branches annually in order:—

(1) To ensure growth sufficiently stout to carry heavy crops of fruit without breakage; or

(2) To cause the buds to break so as to avoid bare wood; or

(3) To remove the terminal fruit bud which is formed in many varieties; or

(4) To maintain the vigour of the tree while producing crops.

No more should be taken off than is necessary to achieve the object desired, or fruiting will be delayed unnecessarily.

With trees planted as fillers, where strong trees would be a disadvantage and an early crop is the main object, the leaders may be left unpruned for a year or two.

Great care should be taken not to overmanure with nitrogenous manures during this period, or fruit production will be delayed.

(*b*) *Treatment of Lateral Growths.*—The pruning of lateral growths is quite simple and need seldom be varied. All lateral growths which are required to furnish branches should be treated as "leaders." The remainder may be cut back to form spurs 3 to 4 in. long when variety, soil and situation are suitable, otherwise they should be cut right out.

Removing Large Branches.—However carefully shaped, trees, as they grow older, have a habit of growing too thick in the centre (see illustrations of unpruned trees) and some

pruning becomes necessary to correct this. The centres must be kept open to allow light, sunshine, and even sprays to reach all parts, and thus it may become necessary from time to time to cut out quite large branches. These should be removed by sawing the branches off as close to the main branch as possible. The wound should be pared with a knife and then covered with white paint or grafting wax to protect the wood against the entry of fungus spores and also to facilitate the natural healing process.

Pruning " Filler " Trees.—Filler trees are planted between the permanent trees and are expected to crop during the early life of the orchard and finally be grubbed up as the permanent trees come into cropping. The " filler " trees need not have so stout a framework or as good a shape as is desired for permanent trees, so " leader " tipping, or, at any rate, " severe " tipping is unnecessary. In fact, leader tipping, which nearly always delays cropping, should be reduced to a minimum.

Pruning out Diseased Wood.—Wood infected with Scab, Canker, Mildew or other fungus diseases, should be pruned out, and the pruning should be thoroughly done to remove all traces of infection. Such diseases often attack the leaders, and where leader tipping is practised consistently, trees are freer of these diseases than are the untipped trees.

Special Apple Varieties.—GENERAL.—No hard or fast rules can be laid down for pruning fruit trees. Shapely, productive trees can only be obtained if the principles of pruning are thoroughly understood, so that the operation can be modified judiciously, in accordance with local soil and climatic conditions, the age of the tree, and the systems of manuring and cultivation which have been adopted. Besides this, each variety of apple has its own special characteristic growth, and the system of pruning must be in accord with these peculiarities. The following are a few notes on the individual characteristics and special peculiarities of the chief commercial varieties, but even these may be modified by conditions of soil and climate.

STRONG GROWING VARIETIES.—*Bramley's Seedling and Newton Wonder.*—Both are vigorous, Bramley's Seedling more than Newton Wonder. For the first three or four years after planting, the tree should be pruned hard, so as to obtain sufficient main branches. After this the " leaders " should be pruned as lightly as possible. Not more than one-quarter to one-third of the annual growth should be removed from Newton Wonder trees.

In most situations Bramley's Seedling spurs well, and the leaders should not be shortened after the tree is formed. Four or five lateral wood growths often arise at very close intervals from the apical buds on unpruned " leaders "; these growths should be thinned out so that only those required for main branches are retained.

All other strong and vigorous varieties should be pruned in a similar manner.

WEAK GROWING VARIETIES.—*Early Victoria, Lane's Prince Albert, Stirling Castle.*—These varieties have little vigour and should as a general rule be worked on a free stock both for bush or half-standard trees, otherwise they make poor growth and are liable to over-crop. The " leaders " should be cut hard whilst the head of the tree is under formation—not less than half the annual growth being removed—but when the head of the tree is formed the pruning should be less severe and " tipping " will usually suffice.

Shapely trees of these varieties are easily obtained, as natural fruit spurs are produced readily on the " two-year-old " wood, and no difficulty is experienced in obtaining artificial fruit spurs by the usual methods of " spur " pruning.

The production of fruit buds on the " one-year-old " wood is characteristic of these varieties and is a sign of a marked tendency to over-crop. Spurs should be thinned occasionally as the trees grow older, especially if they are on Paradise stocks.

Other weak-growing varieties should be treated similarly, but Grenadier and Gladstone, however, require rather more latitude.

Lane's Prince Albert and to some extent Stirling Castle form spreading trees, and the drooping tendency of the lower branches should be corrected by pruning them to an upper bud.

INTERMEDIATE VARIETIES.—*Lord Derby, James Grieve, Rival, Prince Bismarck and Cox's Orange Pippin.*—Bush trees of these varieties may be worked on either a free or a dwarfing stock, although the latter is to be preferred; half-standard trees should be worked on a free stock.

These varieties are intermediate in vigour between Early Victoria and Bramley's Seedling classes, but in growth they behave very similarly to the weaker-growing varieties.

The main pruning should, therefore, be on similar lines to that advised for the latter class, with the exception that the " leaders " should not be pruned so hard on account of the increased vigour which these varieties possess. As a general rule, one-third to one-half the annual growth should be removed from the " leaders " whilst the head of the tree is

under formation. This should be gradually reduced as the tree becomes older until " tipping " is sufficient. In the event of any of the varieties producing too much wood growth the " leaders " should be allowed to remain unpruned for a year or two, after which " tipping " should be recommenced.

Lord Derby, James Grieve and Cox's Orange Pippin are very subject to Blossom Wilt, and all spurs attacked by this disease must be removed during the summer.

Worcester Pearmain and Allington Pippin.—Bush trees of these varieties may be grown on either a free or a dwarfing stock, whilst half-standard trees should be worked only on a free stock. These varieties come within the Lord Derby class as regards vigour of growth, and the " leaders " should be pruned in a similar manner. (See Figs. 27 and 29.)

Although these varieties produce many natural fruit spurs, a large proportion of the fruit buds form at the end of lateral growths 4 to 8 inches in length. Care must be taken to leave these long spurs for a year or so, in order that they may fruit; later, as sufficient normal fruit spurs develop, the long spurs should be removed entirely.

Beauty of Bath.—This variety has slightly more vigour of growth than the Lord Derby class, and bush trees should therefore be worked on a dwarfing stock, whilst half-standard trees should be on a free stock. " Leaders " should be cut back about one-third their length, but at the same time care must be taken to prevent the tree becoming lop-sided. Beauty of Bath is often somewhat shy in fruiting, and as soon as the head of the tree has been formed it is well to allow the " leaders " to remain unpruned for a year or two in order to induce fruit bud formation. The " leaders " left in this manner become fairly well covered with fruit spurs, but at the same time a number of lateral growths are certain to arise from the apical buds of these unpruned " leaders "—these must be carefully thinned out during winter pruning.

This variety should be " spur " pruned in the usual way, but artificial spurs do not form at all readily if the tree is very vigorous. The strong lateral growths should not be " spurred " but should be cut clean out.

PRUNING OF STONE FRUIT TREES

The general principles underlying the pruning of the stone fruit trees—cherry, plum, peach, etc.—are the same as for apples (see p. 25) and pears, but the application of such principles in practice is modified in some respects.

The first object of pruning young fruit trees is to produce the kind of tree required. For orchards or plantations this should be a vigorous tree with strong limbs, capable of supporting heavy crops and so spaced as to facilitate cultural operations. For trees grown on a wall or trellis, what is required is a tree so trained that all its limbs are equally vigorous and productive. Once the foundations of a good tree have been laid, it is necessary to prune so as to maintain it in health and productiveness.

Cherries and plums are usually grown as standards or half-standards, and the minimum of pruning is given after the tree has been formed. Peaches, nectarines and apricots are usually grown in England as fan-trained trees on a wall or trellis, and require constant care. Morello cherries are grown as standards or half-standards and bushes, but they are also grown as hard-pruned trained dwarf trees.

The difference between fruit buds and wood buds is not always obvious in the plum, but examination of a spur in summer shows that the single terminal bud was a wood bud, and that the double or triple buds were fruit buds. The fruit buds of the sweet cherry are round and conspicuous, and occur in clusters on spurs, and at the bases of shoots. Peaches do not bear on spurs, but on the last year's wood. Single buds are wood buds, double buds are one wood and one fruit bud, and triple buds are two fruit buds with one wood bud in the centre. Morello cherries also fruit on the last year's wood. On weak growths all the buds except the terminal are usually fruit buds, but on strong growths many of the buds are triple buds (two wood buds with a fruit bud in the centre). In forming the young Morello cherry tree, therefore, it is essential to ensure vigorous growth by adequate manuring, cultivation and pruning, so as to secure wood buds in the right places for the production of branches.

Pruning the Young Tree.—The exact methods to be pursued in laying the foundations of a young tree depend chiefly upon the shape of tree that it is desired to produce. First it is pruned severely so as to produce strong branches in the required positions. Too many are produced, and it has to be decided which are the most suitable. The remainder are cut out at their point of origin and the selected branches are shortened back for the purposes of strengthening them and increasing their number. For some fancy forms of tree, such as espaliers, they may be left full length.

The first treatment of the tree after planting depends, as already stated, partly upon the shape of tree required. The

main branches of a standard tree are usually started at a height of six feet, of a half-standard at three to five feet, of a bush tree two feet, and of a fan-trained tree at one foot from the ground. For a tree that is to be grown in pyramid or modified leader form, however, branches are not originated at one height, but at intervals up the stem.

The newly planted tree may not be tall enough to receive its first pruning for the production of branches, and in that event it will require some preliminary treatment. If it is tall enough and has not yet produced good well-placed branches suitable for a foundation, its first treatment should be that described below under " first pruning." Again, it may already

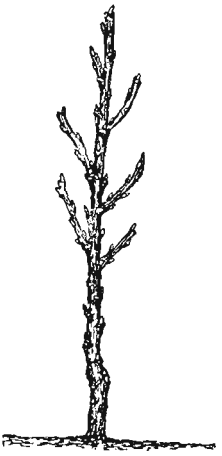


FIG. 20.

possess a good foundation as the result of previous pruning, and the first pruning that it actually requires after planting is described as the " second pruning."

Preliminary Treatment.—If the tree has not one clean stem of sufficient height at the time of planting, any other stems are cut right out and all side branches are cut back to one bud. If the selected stem is strong and vigorous no more pruning is required at this time, but if it lacks vigour it should be shortened by a quarter (see Fig. 20). If after growing for a year it is still too short, this procedure is repeated as often as is necessary to secure the desired height.

The First Pruning.—When it is desired to originate the limbs at a definite height, whether on a tree that is tall enough at the time of planting or on one that has attained that height later, the pruning consists in shortening the main stem to a height

about six inches above the point at which it is desired the branches should originate, and cutting back all side branches to one bud. Under this treatment even the tiny wood buds on the weak laterals of plums will produce good strong growths for some distance down the stem. If it is desired to grow the tree with a central stem, it is merely shortened a little (more if weak, less if strong) and side shoots are shortened back to one bud. If this pruning is properly done, the tree will produce a number of good strong branches in the following summer.

Some attention in the summer is desirable in order to assist branches which are in the right place and to check any that are out of place or too vigorous. This and subsequent treatment are given with due regard to the shape of tree required.

The Second Pruning of Orchard and Plantation Trees.—A popular form for the foundation of such trees—whether standard, half-standard, or bush shape—in England is illustrated

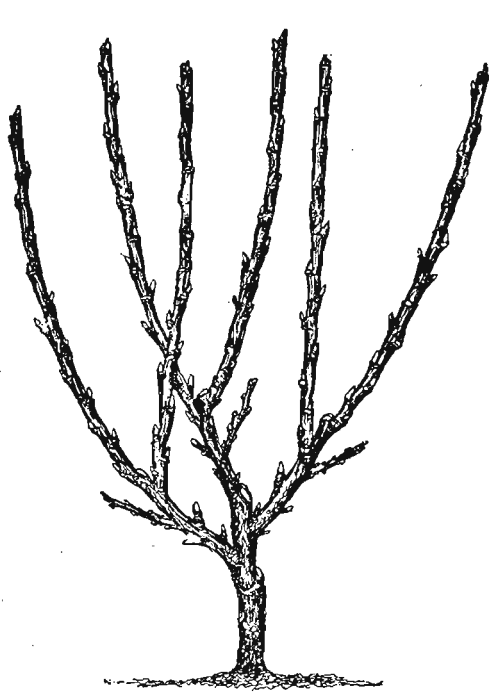


FIG. 21a.

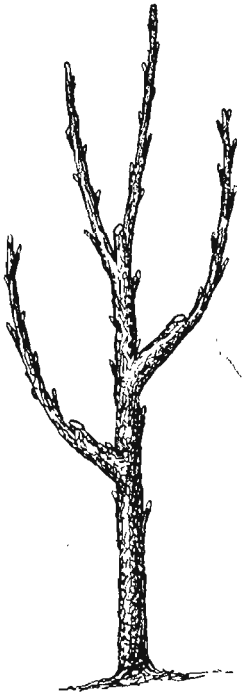


FIG. 21b.

in Fig. 21a. Another form, which is sometimes preferred for plums, is the pyramid. For this a central stem is retained and branches are originated from it at regular intervals (see Fig. 21b). Sometimes the central stem is discontinued at the

height of six feet and this is generally known as the " modified leader " system. These forms cannot be obtained as the result of the first pruning and at least one more is necessary.

At the time of the second pruning, the branches which have been made as a result of the first pruning should be carefully examined. Three or four which are of equal vigour, spaced equally around the tree, and growing at a similar angle in suitable positions should be selected as the first branches of the tree. The remainder should be cut right out. The selected branches should then be shortened, for an open-centred tree (Fig. 21a), to about a foot, but for a tree with a central stem, the leading shoot should be left distinctly longer than the others. If for any reason there are not sufficient suitable branches available for making a good foundation, every branch must be cut back to three or four buds and the selection of foundation branches deferred for a year.

As a result of this " second " pruning, whenever it takes place, the tree should produce at least six good branches, which are sufficient to form a foundation on which a strong well-balanced head will grow. If sufficient suitable branches have not been made a third general shortening back of the branches will be required.

With vigorous varieties on good land and with the best treatment, no further severe pruning may be necessary; but with heavy cropping plums of weak growth, such as Victoria and Pershore, it is generally desirable to shorten back once or twice more (though not so severely, generally about half-way). The pruner must use his discretion and be guided by the condition of the tree. It is better at this stage to do a little more rather than a little less than is necessary, so as to ensure a good strong tree.

Pruning Established Orchard or Plantation Trees.—Once a good foundation has been laid, cherries and plums require very little pruning, but that little should be given annually. Nothing is worse for a tree than severe spasmodic pruning, which upsets the habit of the tree, throws it out of bearing and may lead to disease.

A point in pruning that seldom receives sufficient attention is the risk of infection by diseases—particularly Silver Leaf disease in plums—at the newly-cut surface. In order to minimize this risk, it is very desirable to prune in dry weather only, as spores are then produced much less freely and germinate with great difficulty. Cuts should be covered

immediately with a thick tacky paint so as to exclude spores. If it is impossible to do all the pruning in dry weather, it is at least necessary that such susceptible varieties as Victoria and Czar plums should be done then. Large cuts are more likely to become infected than small cuts, and the greatest care should be taken to see that branches that have to be removed are removed when small. Any unnecessary branches that have been allowed to become large should be removed in the month of June only—which is the safest time.

The main branches should not be shortened except when (after a few years) there may be room for more branches than are produced naturally. Any growths that are strong enough, or appear likely to become strong enough, to compete with the permanent branches should be cut right out. Any badly placed lateral branches, such as those which grow inwards or across other branches, or which rub against each other, should be removed. Any dead or diseased wood should also be cut out and burnt. (*Vide* Article 2 of the Silver Leaf Order of 1923.) Finally, it is important to prevent the tree *becoming too thick*, for if it does fruiting spurs and laterals will die out.

Morello cherries may be pruned in the manner described, but they also give good results if pruned severely for the production of young wood. For this they must be on the Mahaleb stock, and must be kept growing vigorously in order that there may be plenty of wood buds as well as fruit buds. The main branches are shortened annually until the trees are full-grown, when they are shortened back to one bud. Laterals that have fruited are cut right back, and new laterals are allowed to fill their places, in much the same way as with peaches.

Second and Subsequent Prunings of Fan-trained Trees.—Peaches, nectarines and apricots are usually grown as fan-trained trees tied to walls or trellises. Maiden trees are planted and cut down to leave about one foot. This will produce a large number of strong branches. Summer treatment should aim at removing those growing at the back and front, and securing five well-placed equally vigorous branches tied in as shown in Fig. 22. At the second winter pruning these five shoots are shortened by one half. During the following summer at least ten strong branches will be produced (see Fig. 23) others being treated in summer as laterals (*q.v.*).

At the third winter pruning these ten branches are shortened by a quarter (as shown in Fig. 23) and twenty

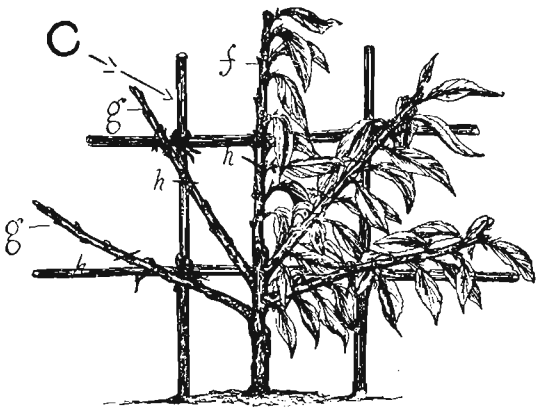


FIG. 22.—Second year Peach tree:—(C), tree with five shoots, usual form of fan-trained tree, but not a true old English fan, which has no leader; (*f*), leading or central shoot; (*g*), side shoots to form branches, all others being rubbed off while quite small; (*h*), points of shortening to cause strong growths to push at the desired points.

branches are secured. These twenty branches form the permanent framework of the tree. They are not again shortened, but are tied in as they extend, and are used for producing the lateral shoots which bear the fruit.

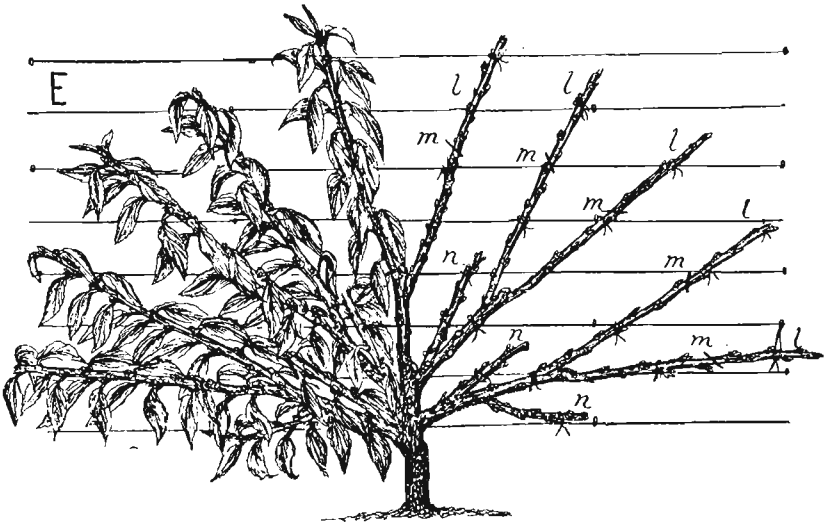


FIG. 23.—(E), third year Peach tree, fig. 22 C; (*l*), extension growths (laterals, if any, being pinched at the first joint, and at the winter pruning cut clean off to the shoot); (*m*), points of shortening the extensions; (*n*), bearing shoots, not closer than 1 ft. on the extensions, stopped at 12 to 14 in. length, and cut back to firm, ripe wood and to a wood bud at the winter pruning.

Treatment of Laterals of Peaches, etc.—The peach and nectarine bear fruit on the slender side shoots (known as laterals or breast-wood) formed in the previous year. As these bear only once, they are cut out after fruiting, and new shoots (which must have been grown for the purpose) are tied in in their places, and bear fruit the following year. The grower has therefore to manage both (*a*) the bearing shoots, and (*b*) the new or succession shoots. This is done in summer.

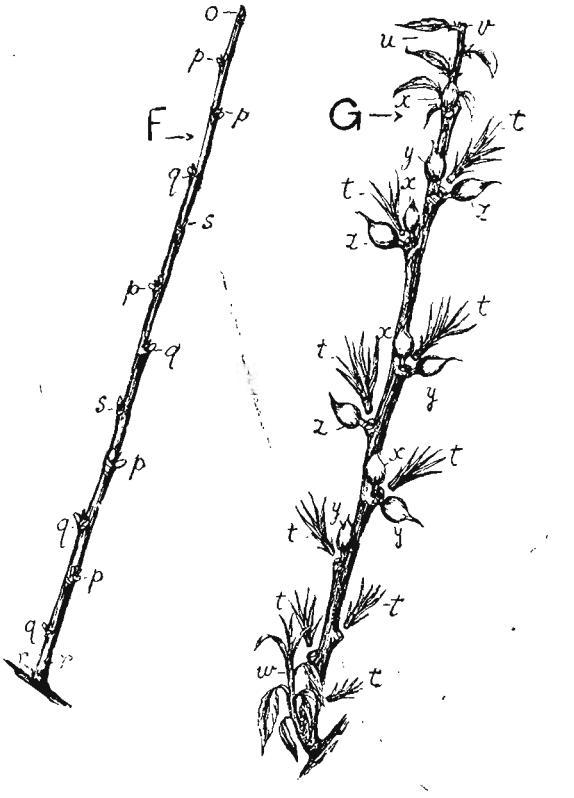


FIG. 24.—**Peach.** (F), fruiting shoot with various buds: (*o*), terminal wood bud; (*p*), triple buds (two blossom buds with wood bud in the centre); (*q*), double buds (one blossom bud and one wood bud); (*r*), basal wood buds; (*s*), wood buds without blossom buds.

FIG. 25.—**Peach.** Disbudding: (G), a bearing shoot: (*t*), disbudded growths; (*u*), growth to attract sap to the fruit; (*v*), point of pinching to the third good leaf; (*w*), successional bearing shoot, not to be stopped; (*x*), fruit to be removed at the first thinning; (*y*), fruit to be rubbed off at the second thinning; (*z*), fruit left for the crop.

Bearing shoots are not required nearer than one foot apart along the branches. During the previous summer therefore the new shoots selected for bearing in the following year will have been tied in and the rest cut out. All bearing shoots should spring from the upper and under sides of the branches —not from the back or front.

In the winter these shoots carry a large number of buds, as shown in Fig. 24. Under favourable conditions every wood bud will grow and every fruit bud set fruit. It is therefore necessary to reduce the number both of fruits and shoots. This work should be begun as soon as growth commences and the trees will have to be gone over several times, as shown in Fig. 25. The fruits are reduced to one at each bud at the first thinning and to three or four inches apart after stoning. If large fruit is wanted, it may be left considerably further apart. All the new shoots, except one at the base and one at the tip, are pinched out when quite small. That left at the base is to form the succession shoot, and is not tipped unless and until it reaches a length of two feet. The terminal shoot helps to draw the sap and swell the fruit but is of no further use. It is therefore stopped at three leaves and as many more times as are necessary. After the fruit has been gathered the shoots which have borne fruit are cut out just in front of the basal shoots and these are tied in in their places.

Apricots bear both on spurs and on laterals, and the laterals are managed in the same way as the laterals of peaches.

APPLES

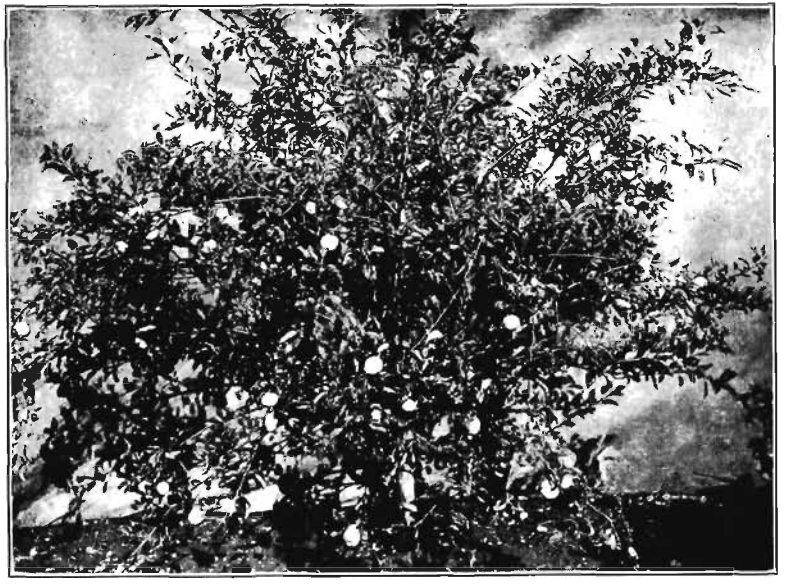
Selecting the right varieties of apples to grow for sale in the markets is no easy matter. There are many varieties, and whilst quite a number have many good features, none is ideal in every respect. It is, therefore, a question of weighing up the merits and defects of each and choosing those that on balance seem to be superior. One factor that must be regarded as important is the market " likes and dislikes ". Cox's Orange Pippin and Worcester Pearmain (dessert) and Bramley's Seedling (cooking) enjoy a great popularity on the English market, whereas some other varieties are quite in disfavour and only find buyers at low prices. It is evident, therefore, that a grower has to consider the problem of selection from two aspects, (*a*) which varieties give the best crops in any particular area, and (*b*) which varieties are preferred by market buyers. Where possible it is always wise to follow the inclinations of the market

Photo, E. Malling Research Station.]

FIG. 26.—WORCESTER PEARMAIN. Natural habit unpruned, 6 years old.

Photo, E. Malling Research Station.]

FIG. 27.—WORCESTER PEARMAIN. Leader tipped and "spur" pruned, 6 years old.



Photo, E. Malling Research Station.]

FIG. 28.—ALLINGTON PIPPIN. Natural habit unpruned, 6 years old.

Photo, E. Malling Research Station.]

FIG. 29.—ALLINGTON PIPPIN. Leader tipped and "spur" pruned, 6 years old.

and to be in the fortunate position of producing just the kinds required.

Popular and New Varieties.—Anticipation of future demands is, perhaps, the biggest problem of all. Apple trees take many years to come into full bearing and although a variety may be a popular market sort when planted, taste may alter, or a better kind may have been introduced and the popularity of the old favourite may have waned. Ribston Pippin gave way to Cox's Orange Pippin and the Wellington to Bramley's Seedling. Whilst following closely the market favourites of the present day, thought should be given to the new introductions, and their merits and possible success in the market should be considered.

The market favourites of to-day are Beauty of Bath, Cox's Orange Pippin and Worcester Pearmain (dessert), and Bramley's Seedling, Early Victoria and Grenadier (cooking). Other varieties that are well known but do not enjoy the same great popularity are Allington Pippin, Blenheim Orange, James Grieve, King of the Pippins and Lady Sudeley (dessert), and Annie Elizabeth, Bismarck, Lord Grosvenor, Newton Wonder, Lord Derby, Lane's Prince Albert and Stirling Castle (cooking). These may be regarded as market varieties which have just escaped the popularity of the first rank.

Of the newer kinds, Lord Lamborne, Ellison's Orange, Laxton's Superb, Laxton's Exquisite (dessert), Edward VII, and Arthur Turner (cooking) show some promise as market apples.

The selection to be made from the aforesaid varieties depends on the kind of orcharding to be adopted. The very vigorous growing sorts are to be preferred for growing in orchards permanently planted to grass; the highest class varieties are recommended where " cordon " trees are grown. This may be summarized as follows:—

A. *Varieties suitable for Standards.*

Culinary.

Bramley's Seedling Newton Wonder Annie Elizabeth Lord Derby	all on very vigorous stock.

B. *Varieties suitable for Half-Standards.*

Culinary.

Early Victoria, on vigorous stock.
Grenadier, on vigorous stock.
Lord Derby, on Broadleaf Paradise.
Bramley's Seedling, on vigorous stock.
Newton Wonder, on vigorous stock.
Lane's Prince Albert, on vigorous stock.

Dessert.

Beauty of Bath, Worcester Pearmain } all on vigorous stock.

C. *Varieties suitable for Bushes.*

Culinary.

Early Victoria, on Doucin stock.
Grenadier, on Broadleaf Paradise.
Lane's Prince Albert, on Broadleaf Paradise.

Dessert.

James Grieve, Worcester Pearmain, Ellison's Orange, Laxton's Superb, Cox's Orange Pippin, Beauty of Bath } all on Doucin stock.

D. *Varieties suitable for Cordons.*

Dessert.

Cox's Orange Pippin, James Grieve, Lord Lamborne, Ellison's Orange, Laxton's Superb } all on Jaune de Metz stock.

Pollination.—Varieties such as James Grieve and Worcester Pearmain are somewhat self-fertile and are able to pollinate their own blossom and develop fruit; but others, e.g., Beauty of Bath and Cox's Orange Pippin do not set fruit with their own pollen but become productive only when pollinated by other varieties which happen to be in blossom at the time. Where self-sterile varieties are selected for planting, they should be interplanted with others that bloom at much the same period. The period of blossoming varies with the weather and the type of root stock, but the following order of flowering will prove sufficiently accurate for most purposes.

The letters after the names of the apples signify that the variety is (S) self-sterile, (F1) partially self-fertile, (F2) occasionally self-fertile, (F3) very rarely self-fertile.

Early.—Beauty of Bath (S), Stirling Castle (F1).

Mid-season.—James Grieve (F3), Gladstone (F3), Allington Pippin (F2), Rival (F2), Cox's Orange Pippin (S), Early Victoria (F1), Bramley's Seedling (F3), Lord Grosvenor (F1), Worcester Pearmain (F3), Grenadier (F3).

Late.—Lord Derby (F1), Lane's Prince Albert (F3), Newton Wonder (F3), Annie Elizabeth (F3), Blenheim Orange (S).

CHIEF VARIETIES OF APPLES

Beauty of Bath.—The best early dessert variety. Small to medium, orange, prettily striped and spotted with red. Quality excellent, but the fruit ripens unevenly and should be picked over several times. Carries well, but must be marketed soon after picking. Inclined to be a shy cropper. Succeeds on either " free " or dwarfing stock, but does best as a bush on Paradise stock. Growth strong, spreading and irregular, often causing trees to be one-sided. It has a tendency to bear blossom and fruit on the tips of the shoots. Season—August.

Bramley's Seedling.—The best late market culinary apple. Large, flat green, sometimes with a dull red check. Excellent quality and commands the highest price of all culinary apples. Carries and keeps well, especially the smaller samples, which if stored until after Christmas, command a high price. A heavy cropper when trees are formed. A very strong grower and forms a large spreading tree. Succeeds best as standard or half-standard on " free " stock. Succeeds over a wide range of soils and situations, and is the best variety with which to top-graft unsuitable sorts. This should not be confused with Crimson Bramley, which is inferior. Season—Nov. to Mar.

Cox's Orange Pippin.—The best quality dessert apple and sells at top prices in British markets. Well adapted for growing as " cordon " or " bush " on dwarfing stock. Crops regularly if well managed. A medium grower, moderately erect ; the pale pink blossoms come out in mid-season—these are self-sterile and need pollen from other varieties for fertilization. Season—November to January.

Early Victoria or *Emneth Early.*—Good quality early cooker. Medium size, green (Codlin type). Bears freely at an early age and is liable to overcrop. Pays to thin when the thinnings are large enough to sell. Growth of medium strength and of upright habit. Requires free stock and naturally forms a good bush, but will also do as half-standard. More suitable as a " filler " than for a permanent tree. Usually free from both apple scab and canker. Season—August and September.

Grenadier.—Good quality early cooker, in season immediately after Early Victoria. Large, light green, travels well. Crops in 5-6 years and thereafter bears heavily. Often pays for thinning. Growth moderately strong and inclined to be upright. Usually best as half-standard or bush on " free " stock. On dwarfing stock can be used as a filler. Bears freely on tips if not " headed in." Season—September and October.

Lane's Prince Albert.—Excellent cooker for market, in season after Lord Derby. Large green, flushed and somewhat striped with red when exposed to sun. Quality and flavour good. Needs careful handling. Quick bearing and very heavy cropper. Often pays to thin. Must be worked on " free " stock. Growth weak, spreading and crossing. Not suitable for standard or half-standard but only as bush (permanent or filler). Usually free from scab and canker, but rather subject to mildew. Succeeds in most localities. Season—November and December.

Lord Derby.—Culinary, very large, green. Season follows Grenadier. Quality good. Crops heavily and carries well. Upright in habit and suitable for permanent tree as standard, half-standard or bush. Sometimes used as a filler. Usually best on " free " stock. Very subject to Brown

Rot Canker (Blossom Wilt) on twigs, and on some soils inclined to canke: Should not be planted unless known to thrive locally. Sells especiall well in Northern markets. Hard spur pruning essential to keep dow Brown Rot Canker and to maintain size of fruit. Season—October an November.

Worcester Pearmain.—Popular and valuable dessert apple of fair quality Medium to small in size. Orange, often completely flushed into scarle Carries well, crops heavily and regularly, and is in great demand. A mode ately strong grower of upright habit. Best grown as bush or half-standar on "free" stock. Cankers badly on some soils and is inclined to scal Always sells well owing to brilliant colour. Season—September and Octobe

Marketing.—The need for reform in the marketing of Englis apples has long been recognized, and many growers no practise methods that ensure that their fruit compares favourabl with the well graded and attractively packed supplies receive from abroad. To assist English growers, standard grades, pack and packages under the National Mark were introduced in th autumn of 1928 for the principal commercial varieties of home grown apples. Three grades are prescribed—*Extra Fancy Fancy* and *Domestic*—for both culinary and dessert fruit. Th National Mark may not, however, be applied to *Domestic* grad dessert apples. The grades are based *inter alia* on size, colou and degree of blemish. In the *Extra Fancy* grade blemish i not permitted, and for the other two grades the amount of ski blemish is strictly defined. The scheme requires the use o standard methods of packing, and all packages must be o approved types and dimensions. The contents of the package have to be declared by count and/or net weight.

Authority to use the National Mark is granted to grower whose total output of apples of approved dessert or culinar varieties is at least 750 bushels or 15 tons (normally the pro duction from 3 acres), or to approved associations of growers no minimum output being prescribed. Full details of the schem are contained in Marketing Leaflet No. 59, free copies of whic may be obtained from the Ministry. Growers should also writ for a free copy of Marketing Leaflet No. 56, giving th experiences of a successful grower in the production of Nationa Mark apples.

PEARS

In all parts of the country pear trees are to be found growin in private gardens, and on these a large volume of fruit is pro duced for home domestic consumption, whilst from a few of th larger private gardens the surplus fruits, including choice speci mens from cordon and espalier trees, are sent to the wholesal markets—a practice that has increased considerably since th

war. For purely commercial production, old pear trees are found growing in many parts of the country; a great many are grown in orchards; some remain scattered amongst other fruit trees in cultivated fruit plantations, whilst a still smaller number are grown in hedgerows. These old pear trees are mainly early, small, sweet varieties, such as *Lammas, Chalk, Hessle* and *Jargonelle.* They are prolific in bearing, and the production of these varieties is probably equal to the present demand for such pears. In addition, a few plantations of the better kinds of pears are in existence, but the acreage under these, though increasing, is still small, so that the markets have to rely for supplies on the pear-producing centres of other countries, e.g., France, Belgium and the United States of America, whence over one million cwt. are imported annually into the United Kingdom. It must not be assumed that all these imported pears could be produced in this country; many of the varieties need a climate less rigorous than our own and more sunshine than is usually experienced in the British Isles. Many tender varieties grow well in sheltered places and within the seclusion of walled-in private gardens, but fail to crop under field conditions.

Commercial pear growing is speculative, and it is of the greatest importance for planters to choose the right situation, interplant suitable varieties to help cross-pollination, and limit the planting to varieties for which the market has shown a demand. Notes on the more important of such varieties are given on pp. 46 and 47.

The Tree.—The form of tree for new plantations is a matter for careful consideration. As indicated on pp. 5 and 6 the trees can be trained as half-standards, pyramids, bushes or cordons. Where shelter to plantations must be provided, varieties such as *Beurre Capiaumont, Beurre Clairgeau,* and *Fertility,* which grow well as half-standards, will perform creditably the function of wind-breaks. The better class of pears should be trained either as cordons, pyramids or bushes, and should be worked on quince stocks (see pp. 15-17).

Pollination.—Though insufficient research work on the pollination of pears has been done for authoritative decisions to be taken, it is highly probable that many varieties of our pears, as, for instance, *Doyenné du Comice, Emile d'Heyst, Louise Bonne* and *Clapp's Favourite,* when grown under normal conditions, are self-sterile. Varieties such as *Dr. Jules Guyot* and *Durondeau* are occasionally self-fertile, whilst *Conference* and *Marguerite Marrilat* are distinctly self-fertile. No

cases of intersterility in pears have been found, and any varieties overlapping in the blooming period may be expected to pollinate each other. In all varieties pollen is usually very plentiful.

Trees of different varieties that either bloom at the same time or have an overlapping period should be interplanted, though little latitude is possible since the blooming period of most pears—with the exception of Williams—is comparatively short. The exact period of blooming fluctuates somewhat according to the conditions—soil, aspect and stock—but from observations made by Mr. F. J. Chittenden at Wisley, Mr. Udale in Worcestershire, Mr. Cecil Hooper in Kent, and others, it appears that the varieties come into blossom in the following order:—

Earliest.	Jargonelle.
Early.	Conference (F_2), Beurre d'Amanlis (S), Marguerite Marrilat (F_2), Durondeau (F_3), Beurre Clairgeau (S).
Mid Season.	Louise Bonne of Jersey (S), Emile d'Heyst (S), Clapp's Favourite (S), Marie Louise d'Uccle (S), Catillac (S).
Late.	Hessle (F_3), Dr. Jules Guyot (F_3), Glou Morceau (S), Doyenné du Comice (S).

(The letters after the names signify that the variety is (S) self-sterile, (F_2) occasionally self-fertile, and (F_3) very rarely self-fertile).

Varieties of Pears

Class I.—Dessert Pears

Beurre d'Amanlis.—Large round pyriform pear, fairly regular, 3¼ by 3 in. Yellowish-green colour, bronze cheek with small russet patches and dots—slight flush. Eye open. Stem slender and woody. Flesh melting, yellowish white, very juicy and pleasantly sweet. Ripe early September. A vigorous and hardy grower, suitable for growing in the North where the better sorts fail.

Clapp's Favourite.—Pyriform-shaped pear 3½ by 2½ in., tapering to eye. Colour pale yellow with bright scarlet flush and stripes. Eye open. Stem about 1¼ inches. Flesh tender, a little sweet, watery flavour. Ripe early September. A strong upright grower. Self-sterile, but crops well when cross pollinated.

Conference.—Medium size, calabash shape. The slightly rough skin is coloured dark green fading to pale yellow with much russet spotting. Eye open. Stem long and woody. Flesh pale yellow, slight pink tinge, melting, very juicy and sweet. Ripe end October. A moderate grower on quince stock. Self-fertile. A good cropper and in every way the best commercial pear for this country.

Dr. Jules Guyot.—A large oval-pyriform pear (similar to a William), 3¼ by 4½ in. Colour pale yellow, with russet patches and slight flush. Eye open. Stem stout and short. Flesh pale yellow, very juicy and melting, poor flavour. Ripe early September. An upright grower, occasionally self-fertile, good cropper. This is a good market variety; the fruits should be harvested before they are ripe and stored in a cool place to avoid mealiness.

Doyenné du Comice.—Large oval-pyriform pear, 3½ by 4 in. Skin pale yellow, slight flush and very fine russet over most of the fruit. Eye closed. Stem stout and fleshy. Flesh pale yellow, extremely melting and of the most delicious and unequalled flavour. Ripe in November. Growth moderately upright. Blossoms are late and self-sterile. Crop light unless cross pollinated. These delicious pears are held in high esteem in all markets.

Emile d'Heyst.—A long oval pear, 2¾ by 4¼ in. Pale yellow colour, dotted with russet. Eye very small. Stem long. Flesh melting; pleasant flavour. Ripe end October. Dwarf grower. Self-sterile. When cross pollinated crops well. Especially suitable for the Eastern counties.

Glou Morceau.—Large oval-pyriform pear, pea-green changing to yellow colour. Eye large, open. Stem long. Flesh melting, white, excellent flavour. Ripe end December. A valuable late pear. Also useful as a pollinator for Doyenne du Comice.

Louise Bonne of Jersey.—Fairly long conical-shaped pear, 2¾ by 3¼ in. Yellowish-green colour, with red flush and prominent red spots. Eye open. Stem long. Flesh white, melting and good distinctive flavour. Ripe October. A good grower and makes shapely trees. Self-sterile. A well-known market variety.

Marguerite Marrilat. Very large long calabash-shaped pear, 3½ by 5 in. Golden-yellow coloured skin bearing brilliant flush. Eye small and open. Stem short and very stout. Flesh pale yellow, very juicy, pleasant flavour. Ripe September. A stout upright grower. Occasionally self-fertile. Good cropper; in fact, unless hard prunned it often overcrops and ceases growth.

Marie Louise d'Uccle.—Medium size oval pear, golden-yellow colour, bearing russet drops and patches. Eye closed. Stem rather long. Flesh very juicy, delicious flavour. Ripe October. Growth slender, blossoms self-sterile. A good, though not largely grown pear.

Class II.—Stewing Pears.

Beurre Clairgeau.—Large, oval shape 3½ by 4½ in. Golden-brown colour, with flush. Eye very large. Stem short and thick. A vigorous upright grower that makes a good standard on pear stock. Culinary during November.

Catillac.—Bergamotte shape, large, 3½ by 3½ in. Dull green colour with brown flush. Eye open. Stem stout. A vigorous grower of stout limbs. The best of the stewing pears.

Class III.—Cheap Pears.

Beurre Capiaumont.—Small oval pear, 2½ by 3½ in. Brown-red in colour, though almost covered with fine russet and red flush. Eye large. Stem short. Flesh melting and sweet. Ripe in October. Also good for cooking. A cheap market pear.

Chalk.—Small round pear, 2½ by 1⅝ in. Pale green, slight flush, little russet. Eye open. Stem long. Flesh juicy but very poor flavour. Ripe October. The chief asset of the variety is its cropping capacity.

Hessle.—Small round yellowish-brown pear, bearing numerous russet dots. Eye open. Stem stout. Flesh juicy and sweet. Ripe October.

Jargonelle.—Very long conical pear, greenish-yellow colour, faint flush. Eye open. Stem long and slender. Flesh very tender, juicy and sweet. Ripe August. A good cropper.

Marketing.—Home-grown pears were made the subject of a National Mark scheme at the same time as apples, and the details of the scheme follow closely on those prescribed for

apples, there being three grades, *Extra Fancy, Fancy* and *Domestic.*

Authority to apply the National Mark may be granted to growers whose total output of pears of approved dessert or culinary varieties is at least 400 bushels (or 8 tons) or, in the case of the variety Doyenné du Comice, 200 bushels. Approved associations of growers may also be formed, in which instance no minimum output is prescribed for individual growers.

Marketing Leaflet No. 59 which contains full details of the scheme, may be obtained free of charge from the Ministry.

THE STORAGE OF APPLES AND PEARS

Commercial Storage

Apples.—The storage of apples for commercial purposes is exciting attention amongst growers, and the following are practical suggestions based upon experience and the results of recent research.

Experience has persuaded growers that the early varieties of apples are best marketed as soon as possible after picking, but that the same course cannot be followed with late varieties without considerable sacrifice in price. When the impact of importations from the United States of America and from the Overseas Dominions was first felt, it had two direct effects upon practice in this country. One effect was to hurry on to the markets all kinds of apples during the early months of the autumn, so as to clear the crop before imports from overseas arrived. The other effect was to discourage somewhat the planting of English varieties of commercial apples that matured after the end of November. This policy, pursued during a period of considerable activity in commercial planting, has resulted in the risk of over-production in the earlier autumn months, whilst at the same time leaving the field completely open to the imported fruit, and neglecting the considerable demand which undoubtedly exists for home-grown fruit of the later varieties.

The home-grown fruit, to compete successfully with the imported, must have like characteristics of soundness, evenness of grade, and attractiveness. When fruit is stored it must be borne in mind that a fruit is a living and breathing organism, that the process of ripening continues after it is picked from the tree, and that all fruit, no matter how sound and perfect it may be when picked, will eventually die of old age. The process of ripening and decay may be accelerated or retarded by the external conditions after the fruit has been taken from

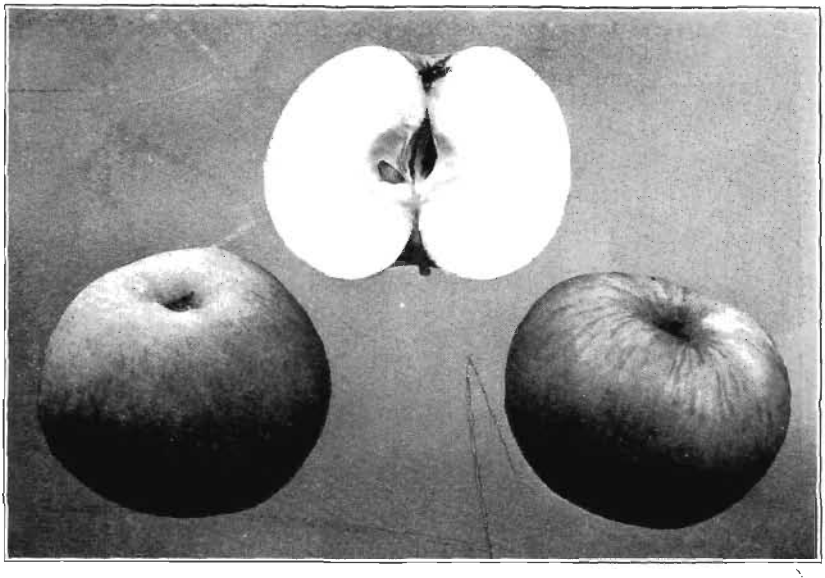


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FIG. 30.—LANE'S PRINCE ALBERT.

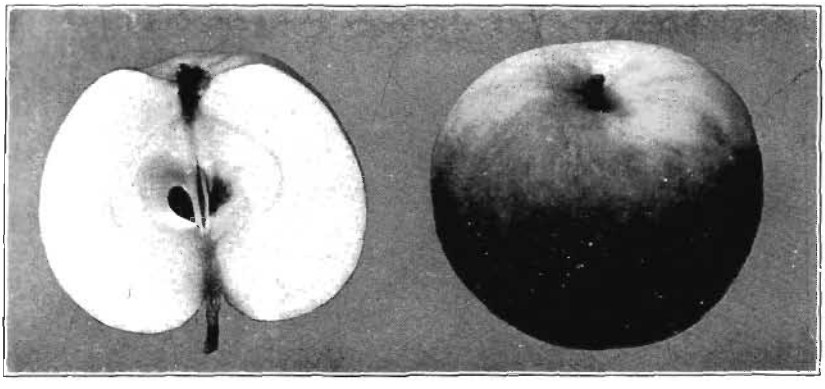

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FIG. 31.—COX'S ORANGE PIPPIN.

FIG. 34.—DOYENNÉ DU COMICE.

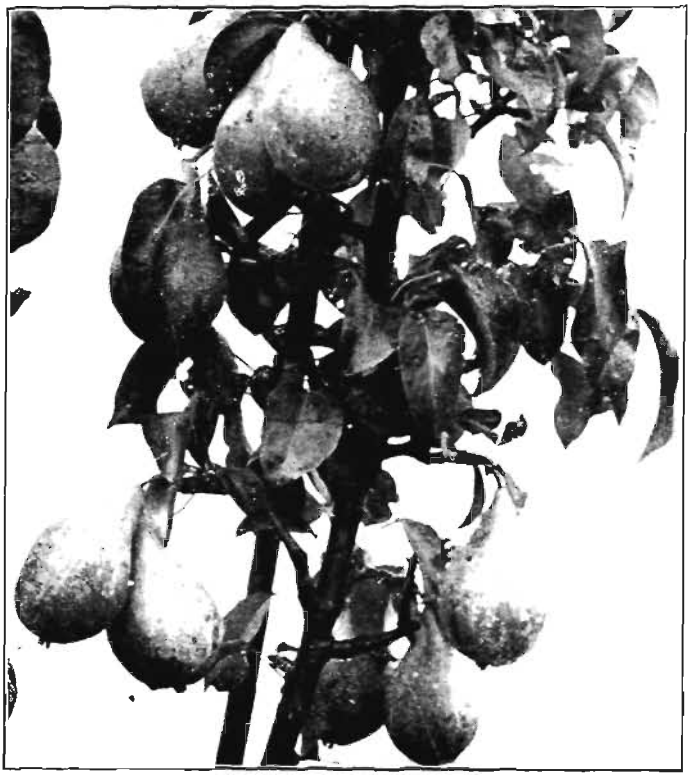


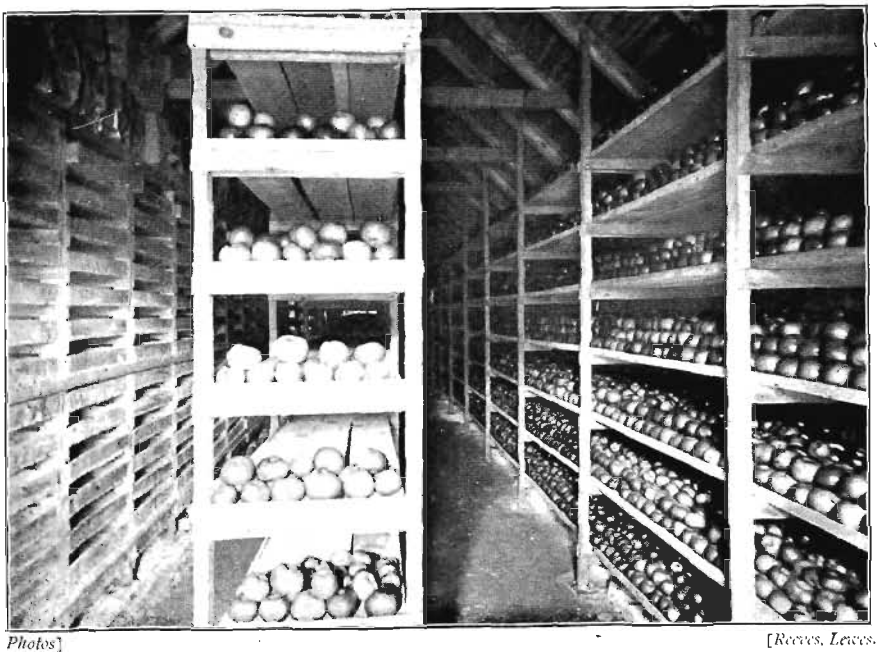
FIG. 35.—CONFERENCE.

FIG. 36.—CATILLAC.

FIG. 37.—DR. JULES GUYOT.

FIG. 38.—MARGUERITE MARILLAT.

FIG. 39 (*a*).—A Thatched Fruit Store in use on a Small Holding.



Photos] [*Reeves, Leeves.*

FIG. 39 (*b*).—Interior of Thatched Fruit Store, showing the arrangement of the shelves.

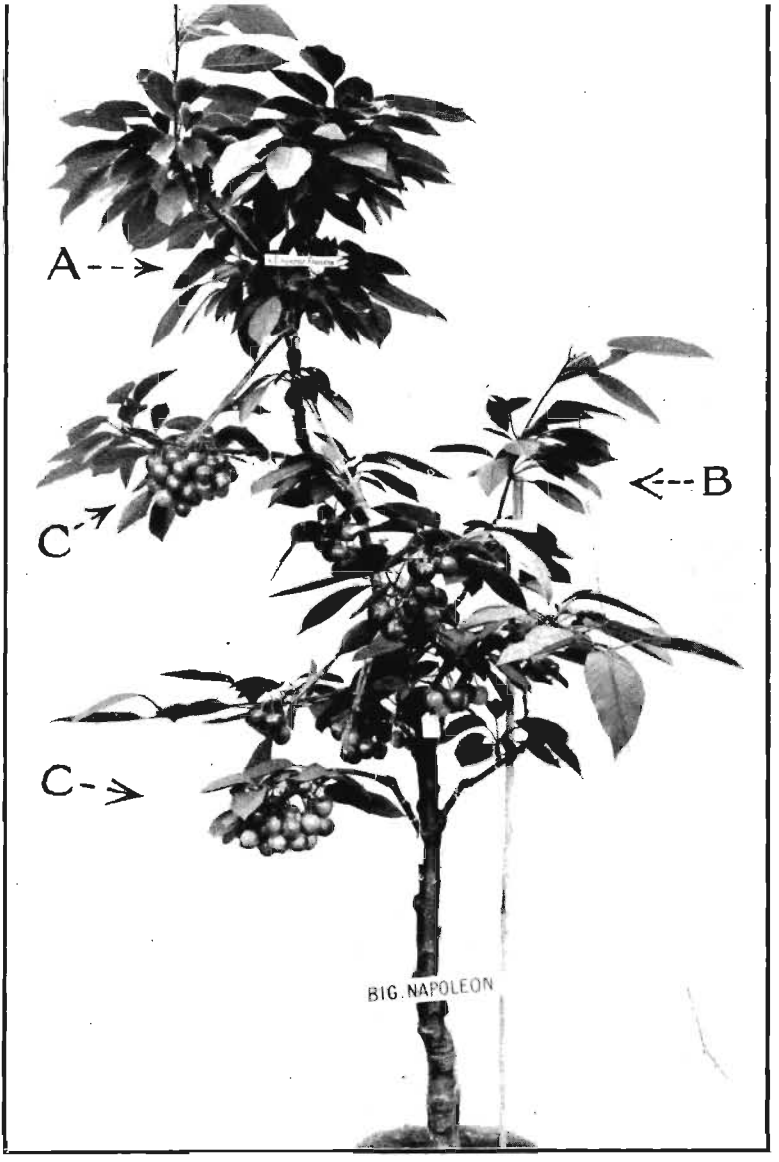


FIG. 40.—BIGARREAU NAPOLEON.

A=258 flowers pollinated with Emperor Francis, no fruit set. B=34 flowers self pollinated, no fruit set. C=compatible pollinations, 154 fruits matured from 273 flowers pollinated, i.e. 86 flowers × Guigne de Winkler, 42 fruits set; 37 flowers × Big. de Schrecken, 19 fruits set; 36 flowers × Roundel, 19 fruits set; 60 flowers × Belle D'Orleans, 41 fruits set; 54 flowers × Early Purple Guigne, 33 fruits set. (Reproduced from *Journ. Pomology,* Vol. VI.)

FIG. 41.—EARLY RIVERS.

(At top of tree) 490 flowers self pollinated, no fruit set. 226 flowers × Bedford Prolific, no fruit set. 23 flowers × Black Eagle, no fruit set. 140 flowers × Knight's Early Black, no fruit set.

(Bottom of tree) 82 flowers × Late Black Big., 29 fruits set. 25 flowers × Waterloo, 14 fruits set. 60 flowers × Governor Wood, 19 fruits set. 43 flowers × Early Purple Guigne, 20 fruits set. 97 flowers × Big. Noir de Schmidt, 43 fruits set. 75 flowers × Guigne de Winkler, 18 fruits set. A few of the matured fruits had fallen from this tree before it was photographed.

(Reproduced from *Journ. Pomology*, Vol. VI. and *Journ. Genetics*, Vol. V. 1925.)

the trees. The object of storing is to delay the process as much as possible so as to prolong the period during which the fruit is available for use.

There are now three possible methods of storage.

1. GAS STORAGE.—The experiments carried out under the direction of the Food Investigation Board have shown that the storage life of apples is extended if they are kept in an atmosphere containing 5 to 8 per cent. oxygen as compared with 21 per cent. in normal air, and 12 to 15 per cent. carbon dioxide, as compared with minute traces found in normal air. When apples are enclosed in a gas-tight chamber, the respiration of the living fruit itself changes the normal atmosphere, absorbing oxygen and giving off carbon dioxide. By means of an instrument called a katharometer the percentage of carbon dioxide present in the chamber can be read on a scale. When there is sufficient present, small ventilating ports communicating with the outside are opened to admit the air and thus maintain the amount of carbon dioxide at 12 per cent. It must never rise above 15 per cent. The results of these experiments have been very encouraging. The few large stores erected on this principle combined with cold storage are giving very satisfactory results.

Information as to the methods of construction of the gas store, and further information as to the process, can be obtained on application to the Food Investigation Board, 16, Old Queen Street, Westminster, London, S.W.1.

2. COLD STORAGE.—This well-known method of preservation is effected by maintaining a consistent low temperature, not low enough to destroy the fruit, but low enough to retard respiration and also the ripening process. This method is of necessity largely adopted by countries that export to this country, and on ships in transit. In England it has been adopted by a number of commercial growers. Further information may be obtained on application to the Low Temperature Research Station, Cambridge.

3. NATURAL STORAGE.—The fruit, both prior to storage and in storage, must be treated in such a manner as to make the fullest use of natural conditions in order to achieve the same result as in the two forms of storing already referred to, namely, the retarding of the ripening process.

Effect of Soils and Manuring on Keeping Qualities.—The keeping qualities of fruit vary considerably according to the nature of the soil on which they have been grown. In a table

published by the Fruit and Vegetable Committee of the Food Investigation Board, it is shown that, both under the conditions of storage in apple sheds and in cold storage, after six months in store the keeping qualities of Bramley's Seedling apples stood in order of merit as under:—

1. Those grown on heavy silt.
2. ,, ,, ,, clay grass land.
3. ,, ,, ,, greensand.
4. ,, ,, ,, chalk.

It was found that the keeping qualities of apples grown upon fen land was low. Apples grown on grass land nearly always possess superior keeping qualities to those grown on cultivated land, but it is in those from the silt and alluvial subsoils that the superiority is most marked. Stocks, also, have a certain influence on keeping conditions. Apples from trees worked on the crab and free stocks are known to retain their characteristics for a longer period than those grown on the Paradise and dwarfing stocks. Good examples of this are to be seen in markets situated in the grass-orchard districts of the West Country. Manuring, especially with nitrogen, has a very marked effect, and must be carefully regulated.

Preparation for Storage.—The preparation for successful storage must begin during the growing season, for it has been conclusively proved by both American and home experiments, that apples from trees that have been efficiently sprayed are capable of being kept in storage much longer and with much less percentage of loss than are apples from trees that have been left unsprayed. A leaflet published in the United States on the subject says " No fruit should ever be placed in storage that has not been thoroughly sprayed." The Report of the Fruit and Vegetable Committee of the Food Investigation Board, already referred to, says, upon the same subject " Fungal diseases appear to be due to spores present on the surface of the apple at the time of storage. The nature and extent of the ' rot ' is therefore, to a large extent, determined by conditions in the orchards and by infection in the packing sheds."

Picking.—It is important to give careful attention to the time of picking. The apple that will keep best in store is the one that is full grown, hard when picked, and almost fully developed. The familiar test of lifting the apple gently to see if it parts easily from the tree may generally be followed. Bruising must be carefully guarded against. The apples should be taken in the palm of the hand, gently lifted, and then placed carefully into a basket or other receptacle that has been

padded at the bottom and the sides as a precaution against bruising.

Apples that are to be stored should be looked over carefully by the pickers when they are emptying their picking baskets, or other receptacles. Wounded, damaged, ill-formed or small fruits should not be retained. It is wise also to exclude the extra large fruit, and reserve for storing only those that are of the convenient packing size. It is an advantage if the fruit is sized as far as possible before being placed in store, as not only can the various sizes be kept separate, but with some varieties the smaller sizes will retain their condition for a longer period than the large-sized specimens. Before being placed in store, apples should be allowed to cool off in a convenient place well open to the air. *Transport to the store* is an exceedingly important matter. Care should be taken to prevent shaking and rubbing of the apples while under this operation.

Storing.—When the apples are fit for storing they can be looked over again, and each one that is sound can be wrapped in a piece of tissue paper and placed in a box. (The North American oiled paper wrappers have been used for this purpose for some years past, and with good results.) The best box for the purpose is the crate or orchard box, which allows of ample air space even when stacked closely in tiers. The dimensions of this box are 20 x 14 x 10 in. It holds about a bushel.

Conditions for Natural Storage.—The conditions most likely to result in successful storage are:—

(1) The atmosphere should be rather moist, but should not be allowed to become stagnant.

(2) There must be considerable ventilation during the first three weeks, but afterwards the amount of ventilation can be materially reduced.

(3) A cool and even temperature is desirable. The temperatures at which apples keep best are from 36° to 46° F. in summer, and from 32° to 35° F. in winter.

(4) Complete or partial darkness should be preserved.

Constructing an Apple Store.—In designing a special house for storing apples, natural advantages should be taken into consideration. Useful cheap houses may be constructed by roofing over pits made by the excavation of gravel, sand or chalk. If a building has to be made, then a portion should be placed below ground level, provided always there is adequate drainage to remove superfluous water. The site selected should be such that the store is naturally sheltered from the sun, or shaded by a belt of trees. Bare earth is sufficient for the floor of the store, and the soil removed in excavating should be banked

up against the outside of the walls. The roof should be heavily thatched with heather, reeds or straw. Adequate provision for ventilation should be made by leaving a gap under the eaves, which may be filled with straw during frosty weather, and by providing a door at each end of the building. A lining of small-mesh wire netting on the top, sides and bottom of the store will be sufficient protection against rats, mice and other vermin. Mice in particular will do much damage amongst apples, unless adequate precautions are taken. It is an advantage to have the netting outside the straw roof as a protection against birds. The orchard boxes referred to above can be stacked up one above another in tiers; but care should be taken to leave air space around the tiers.

When the time for marketing comes, it will be necessary to look at each apple before finally packing it, but if the sorting before storing was done carefully there should not be many to throw out.

Storage of Cooking Varieties.—For cooking varieties, and particularly if it is expected that the time of storage will be short, there are two methods that have secured the support of long usage:—

(1) On a well-drained site dig out a shallow pit about 5 ft. wide, as for potatoes; line the bottom and sides with straw. Place the apples carefully in a ridged head. At the highest point (about 3 ft. 6 in.) insert some 3-in. drain pipes at the top of the heap every 6 ft. for ventilation; cover the apples with straw and case with soil to a depth of 6 in.

(2) Place the apples in boxes or crates and stack them in the open air, covering the top with boards and straw as a thatch, or stack the cases and boxes in a barn or oast house. Alternatively, the apples may be placed in bulk on the floor of barn or oast house, and in severe weather covered with straw.

It must be borne in mind that no matter what method of storage is adopted, the nearer the fundamental conditions of fruit storage (as set out in previous paragraphs) are realized, the better is the chance of success.

With each of these methods, precautions must be taken against damage by rats, mice and other vermin, and care exercised to exclude all damaged, diseased, or bruised fruit.

Pears.—Whilst the general instructions regarding apple storage apply to the storage of pears, there are modifications that must be made to bring out the full characteristics of this fruit. The unripe pear is usually hard, dry, almost without flavour and very poor to eat; but in the process of ripening, the flesh becomes both soft and melting, the juice plentiful, sweet and delicately flavoured. These characteristics have made

the ripe pear such a popular fruit with the discerning public. Few pears are ready for eating when freshly gathered, and pears only develop these pleasing qualities when ripening under certain well-defined storage conditions. The bulk of the early varieties such as Chalk, Lammas, Clapp's Favourite, Dr. Jules Guyot and Williams, are more conveniently marketed direct from the tree, as they will become ripe almost as soon as they reach the shop; though a few of the best samples of these varieties can be stored with advantage for a few weeks in the manner described. The mid-season varieties, and the few late kinds, must be stored for a time, as they are by no means ready for marketing direct from the tree.

Only sound and unblemished fruit will keep in storage, and it is both waste of time and fruit to select other than the best fruits for this purpose. These should be wrapped separately in tissue paper, and spread out in the store-room in shallow boxes. Periodic inspection is imperative because of the importance of knowing exactly when the fruit has reached the right condition for marketing, which is usually attained a few days before the fruit is really ripe. Unfortunately, time-tables are of less use for pears than for apples, because individual pears of the same variety ripen at different times, and the ripening pear is at its best for but a few days, after which it rapidly deteriorates into a sleepy, useless condition. Fortunately, there are external changes which indicate when the ripening stage is approaching. The crimson or scarlet flush, if present, will assume a brighter colour, and in most varieties the skin becomes more golden in appearance. It is important that these changes are not missed, for the ripening period is too short to permit of a second chance. In some of the greener varieties, the changes in colour are extremely slight, almost imperceptible, and this makes successful storage of pears a somewhat difficult business.

The store previously described for apples is quite suitable for pears, though a drier atmosphere is required: the general remarks on spraying, packing and transport apply to pears even more strongly than to apples.

Varieties to Store.—Apples, such as Mr. Gladstone, Beauty of Bath, James Grieve, Early Victoria, Stirling Castle, &c., and pears such as Clapp's Favourite and Fertility should be used direct from the tree. Their season could be prolonged by storage, but few people would wish to do so; for storage purposes choice is usually confined to those varieties which ripen under natural conditions much later in the season. The

lists following give the names of varieties which are suitable for storing, with the dates at which the fruit should be gathered and at which it may be expected to mature under normal conditions.

Variety.	*Ready for picking.*	*In season.*
DESSERT APPLES.		
Allington Pippin	September 4th week ...	Oct.—Nov.
Blenheim Orange ...	October 1st ,, ...	Dec.—Jan.
Cox's Orange Pippin ...	September 4th ,, ...	Nov.—Jan.
Ellison's Orange	,, 4th ,, ...	Oct.—Nov.
King of Pippins	,, 4th ,, ...	Oct.—Nov.
Laxton's Exquisite ...	,, 2nd ,, ...	Sept.—Oct.
Laxton's Superb	,, 3rd ,, ...	Dec.
Lord Hindlip	October 1st ,, ...	Apl.—May
Miller's Seedling	September 1st ,, ...	Sept.
Sturmer Pippin	October 3rd ,, ...	Apl.—May.
CULINARY APPLES.		
Arthur Turner	September 1st ,, ...	Sept.
Annie Elizabeth	October 1st ,, ...	Mar.—May
Bramley's Seedling ...	,, 1st ,, ...	Nov.—Mar.
Crawley Beauty	,, 1st ,, ...	Mar.—April.
Edward VII	,, 1st ,, ...	Feb.—April
Lane's Prince Albert ...	September 4th ,, ...	Nov.—Dec.
Lord Derby	,, 2nd ,, ...	Oct.—Dec.
Newton Wonder	October 3rd ,, ...	Jan.—Mar.
Warner's King	September 4th ,, ...	Oct.—Nov.
PEARS.		
Calebasse	September 4th ,, ...	Oct.
Beurre Clairgeau	,, 4th ,, ...	Nov.
Catillac	October 2nd ,, ...	Dec.—April
Conference	September 4th ,, ...	Oct.—Nov.
Doyenné du Comice ...	October 1st ,, ...	Nov.
Durondeau	September 4th ,, ...	Oct.—Nov.
Emile d'Heyst	,, 4th ,, ...	Oct.—Nov.
Glou Morceau	October 1st ,, ...	Dec.—Jan.
Josephine de Malines ...	,, 1st ,, ...	Feb.
Louise Bonne of Jersey ...	September 4th ,, ...	Oct.
Marie Benoist	October 1st ,, ...	Feb.
Pitmaston Duchess ...	September 4th ,, ...	Oct.—Dec.
Roosevelt	October 2nd ,, ...	Nov.
Uvedale's St. Germain ...	,, 2nd ,, ...	March
Winter Nelis	,, 1st ,, ...	Jan.

STORAGE FOR HOME USE

Those who desire to store small quantities of fruit for home use will naturally make use of existing sheds or other accommodation for the purpose. A cool cellar, or any building with an earthen or even a concrete or brick floor and with a good roof, will suffice, provided proper ventilation can be given when necessary and the temperature can be kept fairly low and stable. Buildings with wooden floors and rooms in the

dwelling-house are too dry for apples, but prove more satisfactory for pears. Each fruit should be wrapped in clean tissue paper, or oiled paper specially prepared for fruit storage may be used; supplies of these wrappers, cut to convenient size, can be purchased from most horticultural sundriesmen. The wrapped pears should be laid out singly on shelves or in trays. Apples may be stored in a similar manner or they may be packed several rows deep on shelves or in boxes. The conditions otherwise are similar to those previously described for commercial storage.

PLUMS AND DAMSONS

The varieties that are extensively grown in this country for market are mainly in demand for their culinary or preserving properties, but some are grown to provide dessert fruit.

The growing of dessert plums or gages is no doubt profitable under special conditions, but these are so seldom found that it is desirable to experiment with caution before planting on a commercial scale in other than proved districts.

There is no doubt that under suitable conditions the best market varieties give satisfactory returns—sometimes even greater than those derived from apples—but, as is only to be expected, many plantations exist which, owing to injudicious planning and planting, can never be made profitable. Where they do succeed, plums are particularly useful to the smaller grower, as, though their profitable life is considerably shorter than that of apples, they crop more heavily and most varieties give a paying crop in the 6th or 7th instead of the 8th to 10th year.

The basis of profitable plum growing, as with all market fruit, provided conditions of soil and aspect are suitable, is the proper choice of varieties, and, as the requisite conditions vary with the variety, it is the object of this section to draw attention to some, at any rate, of their peculiarities so that those intending to plant should be forewarned.

While reputed varieties are confined to certain districts, there is no reason to suppose that they would not prove equally successful elsewhere. However, in districts where the success or otherwise of a variety has not been definitely proved, it is always wise to plant only a small number for trial at first, and to confine general planting to the varieties marked with an asterisk in the list below.

Factors Influencing the Choice of Varieties.—(1) *Marketing.*—When growing for sale in the wholesale markets or for canning, as few varieties as possible and only those that are in demand should be chosen. They should be in succession so as to prolong picking over the longest period possible. Where, however, the grower sells direct to retailers, it is essential to maintain a regular supply, and local preferences as regards varieties should be considered.

(2) *Method of Cultivation.*—Owing to their early bearing, comparatively short life, and liability to disease, plums are largely grown as fillers either on grass or cultivated land. On the latter their life may be shorter, but greater crops will be obtained from the trees while in bearing. Where plums are grown as the principal crop, cultivated land is preferable owing to the ease in applying manures and the heavier crops obtained thereby. On some strong soils in the West of England, plums do equally well on grass.

(3) *Locality and Soils.*—Many of the chief market varieties are somewhat fastidious both as to the situation and the nature of the soil, and these points must be considered fully. Notes are appended as to the likes and dislikes of particular varieties, but these should only be taken as a general guide, and should be supplemented by local experience. Generally speaking, the greatest care must be taken to avoid low damp sites and frost holes. The best situations are on slopes, where there is usually ample air circulation; shelter from north and east winds is also necessary.

(4) *Pollination.*—It is essential to avoid planting large blocks of a single variety, as many plums are self-sterile, and varieties blooming at the same time should be interplanted.

DESCRIPTION OF COMMERCIAL VARIETIES

Aylesbury Prune.—A small plum. Seldom grown outside the Vale of Aylesbury. Propagated from suckers. Forms a large spreading tree. Very late, October—November.

Bradley's King of the Damsons.—Medium size, rich flavour. Chiefly grown in Kent. Forms a close round-headed tree of medium size with small leaf. Rather subject to aphis attack. Season—September.

Belle de Louvain.—A good culinary plum; large; reddish-purple. Almost self-sterile. A free cropper in Wisbech district where it is largely grown. It is late in coming into bearing. Tree attains a large size. Season—end August.

Blaisdon Red.—Medium size; red; suitable for jam, fruit carries very well. Grown in the Forest of Dean area, where it is propagated from suckers. It is very hardy, and little troubled with pests. Valuable as an orchard plum on grass. Season—September to October.

*Czar.**—A medium dark, culinary plum, unsuited for jam, but suitable for dessert when ripe. Self-fertile and a heavy and reliable cropper, though

* Specially recommended.

rather susceptible to Silver Leaf. A very popular market variety, does well on any good medium loam and forms a sturdy tree. Fruit is not liable to crack. Season—mid-August.

*Farleigh Damson** (*Crittenden Cluster*, &c.).—Small, but larger than the common damson, black. An immense bearer, hardy. Grown mainly in Kent. Season—mid-September.

Gisborne's.—Medium size ; yellow. Cooking or jam. An early and heavy bearer. Does well on a chalky clay, and also on light soils. It was at one time much planted in the Eastern counties in place of Pershore. Season—mid-August.

Kentish Bush (*Waterloo*).—A medium dark culinary and jam plum much grown in Kent. Makes a large, strong tree carrying heavy crops. Very hardy and useful as a windscreen. Self-fertile. Season—September-October.

Merryweather Damson.—The largest damson. Introduced in 1907, has been widely tried and has usually proved prolific. It forms a vigorous spreading tree. Season—September.

Monarch.—A very large dark purple plum and one of the best for cooking. The tree crops when young, but is rather uncertain except in districts which suit it. Self-fertile. The tree should be kept regularly pruned to keep branches thinly disposed and centre open. It blossoms early, and sometimes crops when other varieties fail. Season—September.

Pershore†.*—A medium sized yellow plum, suitable for cooking or preserving. Fruit rather dry and travels well. An enormous and regular cropper ; self-fertile ; very hardy. Raised from suckers ; forms a small tree apt to break with heavy crops. Prefers a good holding soil. The chief plum grown in the Vale of Evesham, where it is known as the Egg Plum. Season—late August.

Pond's Seedling.—A very large, long, dark red, culinary plum also used for dessert. Sometimes sells well in chips. Self-fertile. Crops well where it is at home, but not everywhere. Tree somewhat spreading and very subject to Brown Rot. Fruit liable to crack in wet weather. Season—September.

*Purple Egg** (*Martin's Seedling*).—A comparatively recent introduction similar to Pershore, except that it is of better quality and dark purple colour. It is being largely planted for market. Self-fertile.

River's Early Prolific.†—A small to medium sized dark purple plum for dessert or preserving. Very hardy ; tree rather pendulous and branches brittle ; but almost self-sterile and unfortunately does not crop regularly in most districts. Prefers a calcareous clay mixed with gravel. Should be interplanted with other early blooming varieties to secure effective pollination. Season—end of July.

Shropshire Damson † (*Prune, &c.*).—Large for a damson, good for culinary and jam purposes. A good bearer in Shropshire. The best damson for canning. Season—mid-September.

Victoria.†—The well-known large red plum, useful for cooking, preserving, or dessert. Self-fertile and an enormous cropper almost everywhere, perhaps does best on a chalky clay soil, although it also flourishes on the loams of Middlesex. Is susceptible to Silver Leaf. Excellent for canning. Season—end of August.

Westmorland Damson.†—Medium size. Very similar to the Shropshire damson. Much grown in the Kendal district. Strong grower, more or less upright.

Wyedale.—A very dark, rather small, cooking or preserving plum, really between a damson and a plum. Very late, very hardy, and a favourite in Yorkshire and further North. Self-sterile. Season—October.

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* Specially recommended.

† Varieties suitable for canning. See Bulletin No. 45.

Marketing.—The considerable seasonal variations in the plum crop, apart from other factors, render it essential for growers to practise standard methods of grading and packing if they wish to obtain the best possible return. A scheme for the application of the National Mark to specified varieties of home-grown plums that conform to certain quality requirements was introduced in the spring of 1932. One grade only is prescribed —*Selected*, the minimum weight for each fruit ranging from $\frac{5}{16}$ oz. for Rivers' Early Prolific to $1\frac{3}{4}$ oz. for Belle de Louvain. The scheme requires the use of standard methods of packing and standard packages, together with a declaration of net weights. Authority to use the National Mark is granted to growers or packers with an anticipated output of not less than 10 tons of plums of approved varieties, or with at least $1\frac{1}{2}$ acres of plum trees of approved varieties; or to associations of growers without any output qualification. Full details of the scheme are contained in a Marketing Leaflet No. 59, free copies of which are obtainable from the Ministry.

CHERRIES

Cultivated cherries fall roughly into two main groups, usually referred to as sweet and sour Cherries, which differ from each other in many respects. The former comprise the Gean and Bigarreau, classed as dessert cherries, and the latter, the Flemish, Kentish and Morello varieties, classed as cooking cherries. The sweet cherries appear to have been derived from the wild Gean (*Prunus avium*) and the sour cherries from the common wild cherry (*Prunus cerasus*). Both these natural species are believed to be indigenous to this country.

Sweet Cherries

By far the greater proportion of sweet cherry trees are grown as standards in grass orchards, and there is no doubt that this method of culture is most suitable. It is true that they may be grown on cultivated land, but the attendant difficulties are many, and, unless there are reasons against it, all cherry orchards should be grassed down after the tenth or twelfth year. On grass the trees do not tend to make rank growth and can be kept in a better fruiting condition. There is also less inclination to "gumming", so marked where trees are on cultivated land. Another and even more important reason in favour of grass is the fact that cherries are largely surface rooting and are adversely affected by root disturbances.

Soil and Situation.—Cherries prefer light, well-drained soils, and undoubtedly such soils as so-called "brick-earth" and light medium loams are the best when there is a good under-drainage. The trees succeed well on the true chalk formations where there is a good top depth of loam. They do not thrive on cold heavy clay such as Wealden clay, or on badly drained soil of any kind.

Situation is very important, and the various aspects of the land to be planted should be carefully considered. Cherries blossom very early in the season, hence the necessity for choosing an open situation. A site where the sun will come gradually on to the blossoming trees will mitigate the risk of damage from frost scald. Deep valleys and sites where the configuration of the land tends to form frost pockets should be avoided.

Bleak, wind-swept situations open to the south-west are undesirable unless a wind break of poplar or other quick-growing timber can be planted. Access is required to a water supply both for tree-washing and for the grazing stock.

Propagation.—Sweet cherries for orchard growth are usually worked on the Gean or Gaskin stock (*P. avium*). The stocks are grown from seed by continental nurserymen and imported into this country. They are generally top grafted, worked at 6 ft. high if standard trees are required. Some growers prefer to plant the stocks in their permanent tree position and to delay grafting until the stocks have become established. This is only possible where a supply of Geans can be obtained in the local woods, but there is a decided balance in favour of raising the trees in a nursery or purchasing them ready for planting from a reputable nurseryman. Standard trees for planting out should be the usual trained standards 3 to 4 years old and from 5 ft. 6 in. to 6 ft. in height. They should never be less than 5 ft. 3 in. in height.

The Mahaleb as a stock for cherries was thought to have advantages over the Gean, where less vigorous growth was desired, but recent investigations have shown that this stock is just as vigorous as the Gean; it is not much employed.

Planting.—There are at least three methods that may be employed in establishing a cherry orchard. The first, and perhaps the method most frequently adopted, is to interplant the cherries with fillers of plums, with bush fruit occupying the ground beneath. This mixed fruit plantation is then managed, and the land cultivated, in the usual way for upwards of ten

years, when the bush fruit is taken out and the land grassed down. As the cherry trees develop, the plums also are removed to give room. This method is the most economical and can be recommended, as the plantation receives proper cultivation and constant manuring, and the cherries secure a good start and produce strong, well-balanced trees.

The trees may also be planted direct on existing grass land, but growth is then much slower.

The third plan is to plant the trees amongst hops, but experience has shown that this is the least satisfactory method, for when the hops are grubbed and the land is grassed down, the quickly grown and succulent cherry trees experience a severe check.

Whichever method is adopted, the correct spacing of the trees is all important, for cherry trees grow to a considerable size and last in a profitable condition for over 60 years, and, when fully grown, must not become overcrowded. The tree cannot be restricted by cutting, for cherries will not tolerate such treatment. Economy of space may be obtained and more trees planted to the acre by planting the less vigorous and more upright growing varieties alternately with the strong growing, spreading sorts.

As a rule most varieties on standards should be spaced from 30 to 40 ft. apart each way, but never closer than 30 ft. A satisfactory distance, when trees are judiciously arranged as described above, has been found to be 32 ft., giving 50 trees to the acre.

The actual cultivation of the land, as well as the general planting procedure, which is the same for cherries as for all other fruit trees, is fully described on pp. 1 to 10, and will not, therefore, be described in detail here. The following salient points, however, are worthy of special mention:—

1. The equilateral triangle system is, on the whole, the most suitable one for cherry trees grown as standards.
2. Good large holes, 3 ft. square and 2 ft. deep, should be dug. The trees must not be planted too deeply, the nearer to the surface the better. The soil must be well trodden.
3. The trees should be staked at once, two stout creosoted stakes being employed for preference, with a cross piece to which the tree should be securely tied with proper protection against chafing.

Choice of Varieties.—The choice of varieties requires careful consideration. There are many advantages to be gained by choosing varieties that will ripen in succession. In this

way the picking can be spread over a longer period, and the market more regularly supplied.

A list of varieties of proved merit is given on pages 66-70 with notes as to class, season of ripening, etc. As far as possible the names employed are the authentic ones, but a good deal of confusion exists as to the nomenclature of cherries, especially amongst growers in different localities. To avoid confusion and disappointment, trees should be purchased from reliable raisers who employ the names indicated, and who preserve their stocks free from mixture.

Self- and Cross-sterility in Cherry Varieties.—The experiments carried out at the John Innes Horticultural Institution amply confirm the belief that many varieties of cherries are self-sterile and wholly fail to set fruit with their own pollen. It has also been shown that many varieties of cherries, in addition to being self-sterile, fail to form fruits when pollinated with certain other varieties. It is not within the scope of this work to enter into a detailed discussion as to the reasons for this, but merely to place on record data that will provide the grower with some knowledge of successful pollinating varieties.

The experiments at the above Institution provide this data, which is most conveniently set out in Table I. Figs. 40 and 41 illustrate in an interesting manner the results obtained by compatible and non-compatible pollination of blossoms on trees of the varieties Bigarreau Napoleon and Early Rivers. The table and figures have been reproduced from an article* by Mr. M. B. Crane, of the John Innes Horticultural Institution.

For efficient pollination there is nothing that necessitates the planting of varieties which are of but little commercial value, but the varieties selected should be so interplanted as to make cross pollination by insects easy, and cherry growers should regard hive bees as an essential part of their equipment. That bees travel a considerable distance is well known, but they are in search of nectar and pollen, and are not primarily concerned with cross pollination, and if there is a large block of one variety abundantly supplying their needs there is nothing to induce them to do otherwise than work between the hive and this block. To effect cross pollination there must be some overlapping of the period of flowering, so that a knowledge of the blossoming periods is essential. A good deal remains to be done in the determination of the flowering

* CRANE, M. B. Self and cross sterility in fruit trees. *J. Pomol.*, 1927 ; 6 : 157.

Table I. Pollination Results (Cherries)

In this table the numbers following the names of the varieties indicate those varieties which have proved to be effective pollinators, e.g., Black Heart Cherry has produced good crops when pollinated with number 12, Big. Frogmore, 3, Elton, etc.

Self-Sterile.

1. Black Heart, 2, 3, 12, 33.
2. Early Rivers, 6, 12, 15, 22, 24, 25, 31, 33.
3. Elton, 1, 4, 5, 10, 12, 14, 15, 23, 30, 33, 37.
4. Emperor Francis, 2, 3, 5, 6, 7, 10, 11, 12, 22, 23, 24, 25, 27, 31, 33.
5. Turkey Heart, 4, 11, 15.
6. Governor Wood, 2, 4, 5, 7, 9, 10, 11, 12, 13, 19, 20, 21, 26, 28, 29, 31, 33.
7. Knight's Early Black, 6, 12, 13, 23, 27, 31, 33.
8. Early Purple Guigne, 2.
9. Black Eagle, 12, 13, 16.
10. Black Tartarian "B," 3, 13, 19, 27.
11. Bedford Prolific, 3, 5, 6, 8, 12, 13, 20, 22, 24, 27, 28, 31, 33.
12. Big. Frogmore, 1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 16, 20, 21, 24, 25, 27, 29.
13. Big. Napoleon, 2, 6, 7, 8, 11, 12, 16, 18, 21, 23, 24, 26, 30, 31, 33.

Self-Sterile.

14. Monstreuse de Mezel.
15. Waterloo, 16.
16. Amber Heart (Kentish Big.), 13, 19, 30.
17. Florence, 16.
18. Kentish Red, 40.
19. Big. Noir de Guben, 2, 6, 12, 22, 23, 28, 33.
20. Noble, 4, 5, 6, 10, 11, 12, 29, 31.
21. Belle d'Orleans, 2, 13, 26.
22. Belle de St. Tronc, 7, 11, 13, 19, 23.
23. Big. Jaboulay, 2, 4, 7, 11, 12, 18, 19, 22, 28, 33.
24. Late Black Big., 4, 6, 11, 12, 15, 22.
25. Big. Noir de Schmidt, 2, 4, 6, 8, 12, 20, 23, 24.
26. Black Tartarian "A," 6, 20, 24.
27. Black Tartarian "E," 6, 13.
28. Bohemian Black, 2, 4, 19, 24, 29, 41.
29. Géant d'Hedelfingen, 17, 28.
30. Guigne d'Annonay, 2, 4, 18, 33.

Self-Sterile.

31. Guigne de Winkler, 2, 4, 6, 7, 8, 9, 10, 11, 13, 23, 24, 26.
32. White Heart, 2, 18, 33.
33. Big. de Schrecken, 1, 2, 3, 4, 5, 6, 7, 11, 13, 20, 21, 22, 23, 26, 29, 30.
34. Toussaint.

Partially Self-Fertile.

35. May Duke, 18, 40.
36. Archduke.
37. Royal Duke.
38. Empress Eugenie, 11.

Self-Fertile.

39. Flemish Red.
40. Morello.
41. Kentish Red "A."
42. Late Duke.
43. Wye Morello.

The order of flowering of most of these varieties is given on page 64.

The relative flowering period of the remainder has not been ascertained.

period of many varieties, and their fluctuations. In Table II are set out the relative flowering periods of cherries as recorded by Mr. C. H. Hooper of Wye College.* This information enables the interplanting of varieties to be made on surer and sounder lines.

Pruning.—Sweet cherries are spur bearers and fruit without encouragement from the pruning knife. After the tree is once shaped, which will be in three or four years after planting, the trees will thrive best if not pruned at all. If the branches become too crowded in after life the trees should be thinned, which is best done while they are in leaf in September, as at that time they are not so prone to "gumming." If the branches sweep down so as to come within reach of live stock they must of course be shortened.

A certain amount of dead wood will appear in fully grown trees, and orchards must be gone over once a year in the autumn or winter for the purpose of removing this. All cuts made on cherry trees should be covered immediately with paint or tar to prevent the entrance of fungus spores. *See* also pp. 32-40.

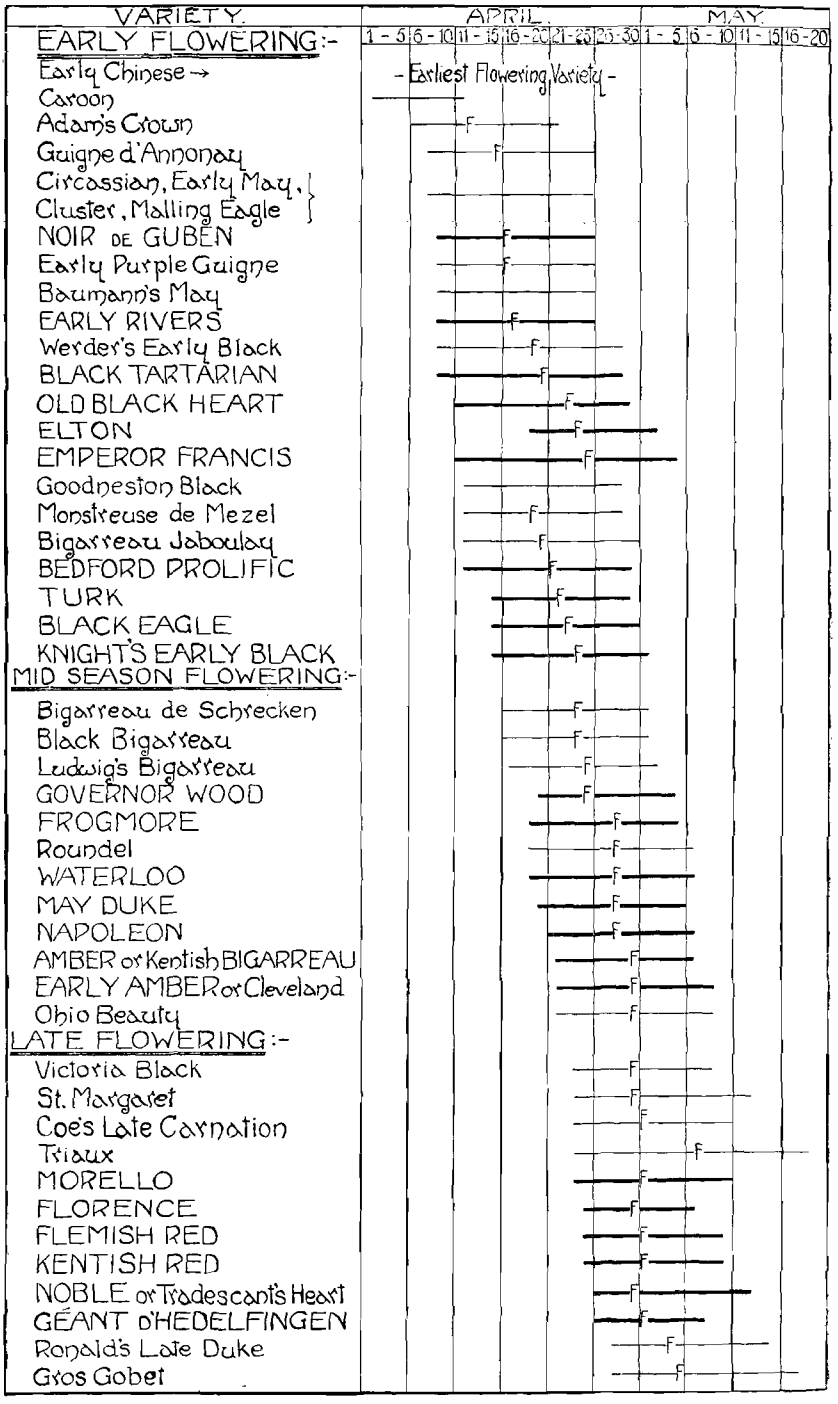
Management of the Orchard.—In laying down an orchard to grass especial care must be taken to obtain a fine turf. A good mixture of the finer grasses only should be sown; the coarser species such as cocksfoot, rye-grasses and oat-grasses are best excluded. Clover should not be sown, as the only desirable clover, the wild white, will develop of its own accord if the orchard is properly managed.

The orchards are best sown down in the autumn, during August or September, after the last fruit crop has been taken from the bush fruit, if such has been planted beneath the trees. The land must be carefully cleaned of all perennial weeds such as thistles, docks, nettles and couch grass and should be made firm before sowing.

Grass orchards should be grazed closely with sheep. In practice the grass cherry orchards are usually employed for fattening sheep, numbers of tegs being fed on mangolds, cake and the grass, and sold off as they become ready for market. As a rule 10 sheep are run to the acre. If small profit be made from the sheep it must be borne in mind that their main value in the orchard lies in the manure they supply to the trees and the service they render in keeping the grass short. On no account should cherry orchards be allowed to grow crops of hay, as the trees suffer greatly from this practice.

* HOOPER, C. H. The study of the order of flowering and pollination of fruit blossom applied to commercial fruit growing. *J. Roy. Soc. Arts*, 1929; **77**: 424—442.

TABLE II.—APPROXIMATE ORDER OF FLOWERING OF CHERRIES IN 1928



The horizontal lines indicate the approximate total flowering periods. F = date of full flower. (For a few varieties the date of full flower is not available.)

The varieties printed in block letters are described on pp. 66–70.

(*Adapted from chart published in Jour. R. Soc. Arts, Vol. LXXVII.*)

In addition to the organic manure supplied by the sheep, the trees demand an additional supply of phosphate and potash. The application of artificials is a question which must be tackled experimentally until the best results are obtained. Basic slag applied in the autumn is a valuable dressing on some soils as a source of lime and phosphates, and will also tend to encourage the growth of white clover. Many growers find that a dressing of 2-3 cwt. of superphosphate and $1\frac{1}{2}$ cwt. of chloride (muriate) of potash per acre, applied in the spring, gives satisfactory results.

The application of lime or chalk is also necessary for cherries in common with all stone fruits. Lime may be applied in the form of quick-lime but ground lime is preferable. From 15 to 20 cwt. per acre once every three years, or from 5 to 10 cwt. if basic slag is being given, would be a fair dressing. Chalk may be applied in the form of ground chalk and a fair dressing would be 25-30 cwt. per acre.

Failure to feed cherry trees adequately and regularly is a great mistake, for it will be found that the orchard will well repay the necessary expenditure.

The turf should be maintained in good condition by an annual chain harrowing and rolling in the early spring to break down mole and worm casts and to clear off the moss.

An ideal cherry orchard will possess a turf almost like that of a lawn, but kept short entirely by sheep. The latter should be kept off during the winter months, approximately between the middle of November and middle of February.

Gathering the Fruit.—Birds are a trouble to the cherry grower. As the fruit ripens more and more are attracted. It will be necessary, especially in isolated orchards, to provide a bird scarer from daylight to dark. If the bird scarer is provided with a gun he should be warned against firing charges of shot into the trees. Various scaring devices can also be rigged up in the trees themselves.

The worst bird enemies are blackbirds, thrushes, jays and starlings, the last invading the orchards in flocks and doing a vast amount of damage if left undisturbed. Sparrows also peck off the opening buds and blossoms in the spring, and bullfinches will do a great deal of damage to the buds in the winter. As it costs almost as much to keep the birds off 5 acres as off 50, small orchards are not recommended.

The gathering of fruit can be done by women working in gangs with a man to move the ladders and pack the cherries for market. Each tree is picked over once or twice before being

finally cleared. Cherries should not be picked when wet, as they will then not travel well. During wet seasons the fruit is apt to crack and rot; extra care is then required to ensure presentable fruit being sent to market.

Marketing.—A National Mark scheme for home-grown cherries was introduced early in 1930. Two grades are prescribed both for black and white varieties—*Extra Selected* and *Selected*—based mainly on size and colour. Each " Extra Selected " cherry must measure not less than $\frac{7}{8}$ in. in diameter, while the minimum for the other grade is $\frac{11}{16}$ in. The scheme requires the use of standard methods of packing and standard packages, together with a declaration of net weights. Authority to use the National Mark is granted to growers or packers with an anticipated output of cherries of not less than 5 tons, or to associations of growers as in the case of other schemes for tree fruits. Marketing Leaflet No. 59, dealing with the scheme for cherries, may be obtained free from the Ministry.

Varieties of Sweet Cherries.—The cherries described below are named as nearly as possible in order of ripening.

Early Rivers. (Middle to end of June).—Fruit fairly large, heart-shaped, shining black when fully ripe, with a small stone. Flesh rather tender, juicy, and flavour fairly rich and sweet. Travels fairly well. Tree is a strong grower with open, spreading habit. The branches have a distinctly drooping effect. A good orchard variety which crops regularly and well. Self-sterile.

Governor Wood. (End of June and early July).—Fruit large, heart-shaped, pale yellow flushed with light red. Flesh tender, juicy and very sweet. Stone small. Tree a strong free grower; habit upright to spreading and crops well. Self-sterile. This variety, which came from America, has established itself as a good market cherry. The fruit is rather on the soft side and is inclined to crack and rot in wet seasons. It travels only fairly well and requires careful handling.

Knight's Early Black. (Early July).—Usually follows Early Rivers very closely. Fruit large, obtuse, heart-shaped with irregular surface. Dark purple, black, or dead black when fully ripe. Flesh purplish red with a sweet rich flavour. Texture fairly firm and travels well. Tree is a free grower. This is one of the best black cherries, although a medium cropper. Self-sterile.

NOTE.—This variety is sometimes referred to locally as Circassian. It is quite distinct, however, from Black Circassian, correctly known as Black Tartarian.

Black Tartarian (or Black Circassian). (Early July).—Fruit very large, shining purplish black or quite black. Flesh purplish, rather tender, fine full flavour, stone small. Tree of upright, bushy habit, spreading more as it ages, and carrying a wealth of foliage. A first-class cherry and a good, regular cropper. Self-sterile.

Elton. (Early July).—Fruit large, heart-shaped, pale yellow, mottled with bright red. Flesh pale, tender, sweet and flavour fair.

Stone medium. Does not travel well. Tree a free grower of spreading pendulous habit. Rather a shy bearer and the fruit is inclined to crack in wet seasons. Self-sterile. This cherry is losing favour as a market variety but does exceptionally well in some localities.

Frogmore Early. (Early July).—The earliest of the Bigarreau Class and a little later than Governor Wood. Fruit large, obtuse heart-shaped, rather flattened on the side, pale yellow, flushed with red. Flesh tender, very sweet and of good flavour. It is firmer than Governor Wood but not quite so large and a better cherry in a wet season. Travels well. Tree is a free grower, upright to spreading, a good cropper. Self-sterile.

Black Heart. (Early to middle July).—Fruit fairly large, heart-shaped, uneven, dark blackish-purple. Flesh dark red, firm and sweet. Flavour fair. Stone large. Tree makes medium, spreading growth; is a regular, free cropper. A very old cherry, does well in grass orchards and sells well for cooking purposes. Self-sterile.

Waterloo. (Early July).—Fruit large, heart-shaped, deep shining black, uneven. Flesh fairly firm, sweet, flavour rich. Stone small. Tree is a moderate grower of compact, upright habit, a little shy in bearing but fairly regular. Self-sterile. A very old variety but a good market cherry, hanging well after ripening and good for wet seasons.

Black Eagle. (Middle to early July).—Fruit large, heart-shaped, deep purplish black. Flesh full, rich, sweet flavour. Stone small. The fruit and habit of tree closely resemble Waterloo but it is a little later. Rather inclined to run off in stoning. Self-sterile.

NOTE.—A local variety known as Malling Black Eagle is distinct from this cherry and is not recommended for general cultivation.

Kentish Bigarreau or Amber Heart. (End of July).—Fruit medium size; even, pale yellow, mottled with dull red. Flesh white, juicy and sweet. Quality good, stone medium. Tree grows well with upright, open habit, and is a prolific cropper. Self-sterile. This variety is very old and is very profitable in Kent.

Napoleon Bigarreau. (Early August).—Fruit very large, heart-shaped, flattened on one side, pale yellow, splashed with bright red. Flesh firm, juicy, full rich flavour. Travels well. Tree very vigorous, hardy, of spreading habit, a prolific cropper and self-sterile. Rather susceptible to Silver Leaf disease. This is a fine market cherry, one of the best of this class, and soon makes a tree.

Turkey Heart (or The Turk). (Early August).—Fruit medium, heart-shaped, black. Flesh firm and very full flavoured. Travels well. Stone small. Tree fairly free growth, upright to slightly spreading habit. Self-sterile. An old variety very popular in Kent. It is one of the first to blossom and therefore liable to frost damage. Fruit ripens up rather unevenly.

Emperor Francis. (August).—Fruit very large, dark red. Flesh firm, sweet and rich flavoured. Travels well. Stone small. Tree of medium, upright habit. Self-sterile. One of the best late cherries and does well in the North.

Tradescant's Heart (or Noble). (Early August).—Fruit very large, heart-shaped, uneven, dark red to blackish purple. Flesh dark purple, firm, slightly acid, rich flavour. Inclined to crack in wet

seasons. Tree of vigorous growth, upright habit. Self-sterile. This cherry is of recent introduction to Kentish orchards where it is known as Noble. It is an old variety.

Florence. (Early August).—Fruit very large, heart-shaped, pale yellow flushed with red, shining. Flesh very firm, sweet and of first-rate flavour. Travels well. Tree a vigorous grower, of rather spreading habit. One of the best late cherries and deserves to be grown more for market.

The following varieties, less known, but possessing valuable qualities for commercial orchards, are also well worth growing.

Bedford Prolific. (Early July).—Fruit large, purplish black, much resembling Black Tartarian. It is hardier, and freer in habit, but the fruit is inferior in quality. Self-sterile.

Cleveland Bigarreau (or Early Amber). (End of June or early July).—Fruit medium sized, pale yellow, flushed with red and of fair quality. Tree large and crops well, but is rather subject to brown-rot and leaf scorch.

Noir de Guben. (End of June).—Fruit very large, reddish-black, firm-fleshed, of good quality. It hangs well. Tree is vigorous and prolific.

Geant d'Hedelfingen. (Late July).—Fruit large black, firm-fleshed, resembling an improved Black Tartarian. Tree is free growing and of spreading, pendulous habit.

Windsor. (Late July).—Fruit large, dark red, firm-fleshed, good-flavoured. Travels well but cracks in wet seasons. Tree is robust, of upright, compact habit, and crops freely.

Early Purple (known in some districts as *Early Leicester*).—Fruit large, dark red, nearly black, of first-class quality. Tree has a strong upright habit of growth and flowers the earliest of all varieties. It is not a regular cropper but the fruit always commands a high price.

DUKE CHERRIES.—In addition to the varieties described above there is a small but distinct group known as the Duke cherries of which May Duke is the most noteworthy.

May Duke. (End of June).—Fruit large, roundish, very dark red when fully ripe. Flesh deep red, very tender, juicy, and of sweet rich flavour. Stone small. Tree has a distinctly upright habit of growth, is vigorous, hardy and a good regular cropper.

DEVONSHIRE MAZZARDS.—These varieties are peculiar to North Devon, and there is no evidence to show that they will thrive outside this district. They are also somewhat inferior to the better known commercial varieties described above.

The Dunn. (Second week in July).—The largest of the Mazzards. Colour very deep red, almost black; somewhat heart-shaped. In flavour inclined to be acid and is rather more suitable for culinary purposes.

The Large Black.—Slightly smaller than the Dunn; round; skin shiny; jet black. Flesh fairly firm, juicy and sweet. The best of the Mazzards for dessert. The stalks are slightly tinged with red.

The Small Black (or *Green Stem*).—Very small round; jet black; skin thin and shiny; stalk bright green. Used for dessert or cooking, but does not carry much flesh.

NOTE.—The above varieties of Mazzards must be picked with the stalks intact or the fruit will bleed and be spoiled.

Preserving Mazzard.—In size between the Dunn and the Large Black; round; black; flesh very firm. May be picked without the stalk and is a good variety for bottling.

SOUR CHERRIES

The sour or cooking cherries comprise the Flemish Red, Kentish Red and Morello varieties.

As a class they are more amenable to the ordinary plantation type of cultivation, and for this reason are often found interspersed with other fruit in permanent plantations.

Large blocks of these varieties are often planted alone, and on suitable soil the trees are prolific croppers.

Soil and Situation.—Sour cherries will succeed on any well-drained loose land, and thrive particularly well on sandy gravels, brick-earths and flinty lands or chalk.

They are not quite so particular as to situation as sweet cherries, and will even do well with a north aspect. Frost pockets and steep valleys should, however, be avoided.

Propagation.—Kentish and Flemish Red are usually grown as standards, in grass, but Morello should be grown as bushes on a low leg, so that short shoots affected with Brown Rot may easily be cut out. The Mahaleb stock has been a popular one in the past, but the common cherry known as *Cerasus austera* is often used. The Gean is also a suitable stock. There is no really dwarfing stock for cherries, and it hardly matters which is used.

Planting.—Whether planted triangularly or on the square, half standards are usually placed at least 15 ft. apart each way and bush trees 10 or 12 ft. each way. Bush trees should be planted on the square.

Cultivation.—Sour cherries fruit on the young wood, and, after the half standard trees are shaped, pruning is not a necessity. They are, however, not so intolerant of the knife as the sweet varieties and do not " gum " so freely. They may therefore be pruned, to keep them shapely or within bounds, if desired. Bush trees also need no pruning after planting. The trees respond to good feeding.

Picking.—Sour cherries hang better after ripening than do the sweet varieties, and birds do not take them so freely.

Sour cherries as a class are mostly sold for culinary purposes, a certain quantity of Morellos being taken for the manufacture of cherry brandy. In addition to the demand for the fruit on the market for retailing, there is a big demand from preserving firms for bottling purposes.

Varieties of Sour Cherries.—

Kentish Red. (Middle July).—Fruit medium size, round, dark red, transparent, with very tender, juicy, acid-flavoured flesh. A good cooking cherry and preserves well. Tree of medium growth and does well on half standards or bushes. Bears freely if planted with others, particularly Flemish Red. Self-sterile.

Flemish Red. (End of July).—This variety is the nearest approach to the wild cherry, *P. cerasus*. It resembles Kentish Red but the fruit is smaller and a little brighter red. Tree makes compact growth, is less drooping than the Kentish Red, and does well as a bush. Very free-bearing and self-fertile. Will succeed where the other varieties do not thrive so well.

Morello. (August—September).—Fruit large, inclined to heart-shaped, flattish, dark red or black when fully ripe. Flesh soft, juicy with briskly acid flavour. Tree is of a spreading, pendulous habit of growth, and succeeds as a standard, half standard or bush. It is remarkably prolific, self-fertile, and the fruit will hang a long time.

There are really two varieties of Morello in existence. The old-fashioned, smaller variety is most sought after for the manufacture of cherry brandy.

The Morello is the best of the sour cherries for all purposes.

Diseases and Pests of Cherries.—Cherries are subject to attack by a number of diseases and pests, the principal of which are described below.—

BROWN-ROT.—The blossom, shoots and fruit of cherry trees are attacked by the Brown-rot fungus, *Sclerotinia laxa*, which causes considerable damage in wet, cold seasons. The fruit may also be attacked by the allied species *Sclerotinia fructigena*. The disease varies in intensity with the season and is difficult to control in old cherry trees on account of their large size. It is especially important that no mummied cherries should be allowed to remain on the trees, as these constitute a sure means of carrying the disease over from year to year.

The Kentish and Flemish varieties are very susceptible to Brown-rot attacks, and some of the sweet varieties are more subject to them than others. Further information concerning this disease will be found in the Ministry's Bulletin No. 88.*

* Bulletin No. 88, *Brown Rot Diseases of Fruit Trees*. Price 1s. 6*d*. (by post 1s. 8*d*.).

CHERRY LEAF SCORCH.—This disease has the effect of withering up the leaves on the shoots. They remain hanging there throughout the winter and may be seen as late as May. It is caused by the fungus known as *Gnomonia erythrostoma*. The dead leaves of all trees in which they are readily accessible should be removed and burnt since they are the means by which this fungus is carried over from season to season. For larger trees two applications of Bordeaux mixture, one just before blossoming and the other directly afterwards, have been found to give effective control.

SILVER LEAF.—This disease has made heavy attacks on cherries during the past few years. Napoleons and Turkey Hearts are especially susceptible to attack, as also are all the sour cherries. Trees which have been headed back (pollarded), or headed back and grafted, are also very liable to attack. Care should be taken to see that no wounds are left uncovered, and grafting operations should be expedited as much as possible. Full particulars concerning this disease will be found in the Ministry's Leaflet No. 302.

WITCHES' BROOMS.—Another serious disease, caused by the fungus *Taphrina Cerasi,* results in the formation of the so-called "Witches' Brooms." The fungus mycelium is present in the branches and stimulates them to produce numerous twigs which together take on a form roughly comparable to a loose broom. The leaves borne by these abnormally branched twigs are also penetrated by the fungus which ultimately produces countless numbers of spores on their surfaces. Such leaves are usually wrinkled or crumpled and reddish in colour. These brooms are always barren, and since they serve as centres from which the disease is spread they should be cut out promptly and destroyed by fire.

An allied fungus, *Taphrina minor,* causes a blister or curl of cherry leaves somewhat similar to peach Leaf-Curl, but this trouble is not common.

GUMMING.—Gumming is a trouble that affects some varieties of sweet cherries more than others. Trees upon which the knife has been used tend to gum excessively. If the gumming is very bad and persistent it is generally taken as a sign of an unhealthy condition of the tree, but there seems to be no remedy. The cause of gumming in cherries is obscure, but it does not appear to be due to any fungus or other parasite.

WINTER MOTHS.—The chief insect pest of cherries is the Winter Moth. All standard and half standard trees should be grease-banded to prevent the ascent of the females. The bands should

be maintained in an effective condition throughout the year, and replaced annually in fresh positions on the trunks of the trees. When, however, this is neglected and caterpillars are found to be feeding in the spring, they may be destroyed by spraying.

LACKEY MOTHS.—Periodical attacks by the caterpillar of this moth become epidemic, and trees which cannot be sprayed early with lead arsenate may then suffer severely. Under these circumstances mechanical measures, such as tearing down the webs and the collection in winter of the egg bands, may have to be carried out at a cost which exceeds that of an efficient high-power spraying installation.

CHERRY BLACK FLY.—This black fly (*Myzus cerasi*) is another serious insect pest. In some seasons it swarms over the shoots and under the leaves, causing the latter to curl up. The honey-dew issuing from the pest gums up the leaves and if it gets on the fruit spoils it. The leaves and shoots are often killed outright if the attack is bad.

The best method of controlling the Cherry Black Fly is by spraying in winter with a tar-distillate wash. These washes also serve the purpose of generally cleansing the trees, and of reducing the number of winter and lackey moths. Tar-distillate washes are proprietary, and the Ministry is precluded from recommending any particular brand; whichever wash is chosen, care should be taken to use it in conformity with the maker's directions.

If winter spraying is not carried out, cherry aphis can be controlled by the use of a good contact spray, such as nicotine and soap. This should be applied as soon as the pest makes its appearance, before the foliage has been curled. A suitable formula is as follows:—

Nicotine (98 per cent.)	¾ oz.
Soft soap	½-1 lb.
Water	10 gal.

The successful spraying of cherry trees depends largely on the spraying plant employed. With an efficient power plant trees of any size may be sprayed thoroughly.

CIDER AND PERRY ORCHARDS

After almost a century's neglect of cider and perry fruit production there has arisen a growing demand for cider and, to a less extent, perry. This demand for cider has already outgrown the supply that can be produced in some seasons from home-grown fruit.

Selection of a Site.—The intending planter should first seek local expert advice as to the suitability of his land for cider apples or perry pears, since vintage fruits behave very differently on various soils. Present-day planters are fortunate in having, through the Research Stations and the County Horticultural Staffs, an accumulated fund of knowledge at their disposal as to the types of soil that are believed to be best adapted to various kinds of fruit trees. The proper distances of planting the trees must depend upon the varieties selected and the character of the soil, and on both points the Horticultural Superintendent would be able to give advice. *No amount of subsequent skill will remedy satisfactorily errors made at the start.* The best local advice should always be obtained at the outset.

Varieties.—INTERMIXING.—Special factors must be considered in connexion with the intermixing of varieties in orchards for cider purposes. When the crop is ripening on the trees, and during the gathering period, stock must be excluded from the orchard. To make the best use of the grass it is essential that this period should be as short as possible. The first special consideration, therefore, is *that intermixed varieties should be a mixture of sharps, sweets and bittersweets of the same gathering period.* In effect this means that it is necessary to consider varieties as being in one of three classes, viz:—those that should be gathered from the orchard by early autumn, in mid-autumn, and at a still later date respectively. (This gathering period should not be confused with maturity for grinding, which usually occurs some time after the fruit is off the trees.) By thus limiting orchards to varieties of the same gathering period the grass is kept grazed for as long as possible, and in addition the fruit is often gathered more readily from the resulting short turf. With the usual haphazard mixture of varieties in orchards the need for getting rank grass down before winter is so great that later varieties are gathered too soon. Cider makers do not want immature fruit, and price inducements have been given for fruit "in season."

The second consideration, consistent with securing cross fertilization, is that each sort should be in some group form that will enable varieties to be picked up separately. The simplest form *giving good cross fertilization is for the varieties to alternate in complete rows.* Ability to offer a named variety is often recompensed by a substantially higher price per ton. In addition to the above factors, fruits for cider or perry must be selected with due regard to their

characteristics from an analytical standpoint. The types can be roughly grouped into " sharps," " sweets " and " bitter-sweets," and apples of these types can be distinguished by taste. In planting an orchard it will be well to consider what proportion to allot to each of the above classes; this point is dealt with more fully below. The vigour and life of the chosen varieties should be similar.

CHARACTERISTICS OF CIDER APPLES AND PERRY PEARS.—While there are far too many varieties of cider apples and perry pears, including a large proportion of inferior quality, their number cannot be reduced to the same drastic extent as with market kinds, owing to the necessity for maintaining an adequate supply of each type over an extended season and for levelling out as far as possible the effects of uneven crops, so that as constant a supply as possible is forthcoming.

The chief characteristics in order of importance to the planter are: (1) heavy and regular cropping capacity, (2) vigour of growth, hardiness and resistance to serious pests and diseases, (3) vintage quality. As regards the last point, high sugar content and slow rate of fermentation are very desirable features that are definitely associated with specific varieties. Other points that should be considered are ability to carry a heavy crop without breakage of boughs, and to give fruit of at least medium size.

TYPES OF CIDER APPLES.—*Sharps.*—There are three main types of sharp apples, (a) varieties containing a sufficiency of tannin and other constituents to make a good cider without blending, e.g., Cherry Pearmain, Kingston Black; (b) varieties of the Foxwhelp and Cap of Liberty types, which are too acid to be used alone, but which possess valuable aromatic qualities and give a character to a blend when present even in relatively small proportions; (*c*) varieties that are unsuitable for use alone as they contain too much malic acid and little or no tannin, e.g., Tom Putt, Fair Maid of Devon and the market culinary varieties generally. There is a special demand for apples of the types (a) and (b) by cider manufacturers for the production of high-grade bottled ciders. Unfortunately, some of these varieties cannot be described as robust growers, neither are they heavy croppers except where grown on suitable land, but provision should be made for satisfying this demand because the demand for bottled ciders is increasing. Apples of type (c) provide practically only malic acid, and in view of the fact that the culls, graded out from the culinary and dessert sorts, are of this class and quite

suitable, it seems inadvisable to plant varieties of this class of cider apple.

Sweets.—This type consists of " mild " varieties high in sugar content but low in both astringency and acidity. They are valuable for blending with sharp and bittersweet varieties to tone down excessive sharpness and bitterness respectively and to give " softness " to the cider. Certain widely grown sorts like Improved Pound and Morgan Sweet are inferior in vintage quality. Some kinds, such as Sweet Alford, Woodbine and Eggleton Styre, are valuable for this purpose, but these should not be planted to a greater extent than is necessary to give the required degree of balance to blends of the other two main classes, particularly where a farmer makes his own cider.

Bittersweets.—These varieties may contain either a perceptible or a high amount of tannin. They possess valuable flavour characteristics, and, like varieties of the sweet class, are necessary in the production of high-grade bottled ciders of low acidity, which, on medical grounds, are preferred by many people. It may be noted that good class bittersweets not infrequently command higher prices in the market than other varieties, with the exception of Foxwhelp and Kingston Black types. The bittersweet apple has not been favoured by the cider-making farmer owing to difficulties in management that may arise in the course of the manufacture of the cider when bittersweets are used to a preponderating extent. The cider factories, however, make a good demand for apples of the bittersweet class for blending with ' cull ' apples.

Culls of Market Fruits.—The culls of all cooking and dessert varieties are high-acid apples, and will make a cider that is not properly balanced; it contains too much acid, has a too-rapid rate of fermentation, and lacks body. When this thin cider is blended with that made from apples of the bittersweet class the lack of balance is somewhat rectified.

The analysis figures given in the table below for ciders made (*a*) from blended cider varieties, (*b*) from Bramley's Seedling culls, and (*c*) from a mixture of Bramley's and the bittersweet Dabinett, show only too well the defect of cider made from Bramley's Seedling as compared with that made from the blends. The high acidity of the Bramley's Seedling cider has been reduced from 0.84 to 0.5 of malic acid by the mixture of Dabinett, the tannin having been increased from 0.1 to 0.15 and the rate of fermentation lowered from 9.4 to 7.0 The figures for

this blend show that the cider from the Dabinett and Bramley's Seedling is still inferior to that made from vintage cider fruits.

ANALYSIS OF CIDERS

(The National Fruit and Cider Institute, Long Ashton, Bristol, 1929)

Fruit used	*Final Sp. G.*	*Malic Acid*	*Tannin*	*Rate of fermentation*
(*a*) Mixed cider varieties	1·024	0·47	0·24	3·7
(*b*) Bramley's Seedling	1·020	0·84	0·10	9·4
(*c*) { ½ Bramley's Seedling, ½ Dabinett }	1·025	0·50	0·15	7·0

These culls, however, can be used in the cider industry provided sufficient quantities of the bittersweet and sweet classes can be secured for blending to make the cider balanced and palatable. The Dabinett and the Knotted Kernel in particular are well suited for blending purposes.

VARIETIES OF CIDER APPLES.—In the following lists the letters E.F., M.F., and L.F. before the variety of names refer to early flowering, mid-season flowering and late flowering respectively. The letters, E.G., M.G., and L.G. after the variety names refer to early gathering, mid-season gathering and late gathering respectively. Varieties marked with an asterisk are known to have a slow rate of fermentation. Where a variety may be expected to appeal to growers in one district more than to growers in another, the district for which it is specially recommended is indicated in brackets.

In addition to varieties mentioned in these lists there exist good local varieties that may ultimately come into more general cultivation.

VARIETIES OF LONG REPUTE.

(Recommended by the Joint Committee of representatives of the National Farmers' Union and of the Cider Makers' Association for general orchard cultivation.)

Sharps.	*Sweets.*	*Bittersweets.*
Crimson King		EF Knotted Kernel* EG.
MF Dymock Red E-MG.	MF Woodbine MG.	Ellis Bitter (Devon) MG.
Fair Maid of Devon MG.	MF Sweet Alford*† MG.	MF Dabinett* LG.
Reinette Obry LG.	MF Eggleton Styre* MG.	LF Royal Wilding* LG.
		E-MF Bulmers' Norman (White Muscadet)†

Under normal conditions all of these varieties can be relied upon to make good orchard trees, but some grow more rapidly than others. Those marked † are the best for producing a head 6 ft. 6 in. from the ground level in the nursery in the shortest space of time. The others require one year longer in the nursery.

HIGH-GRADE VINTAGE VARIETIES RECOMMENDED FOR PLANTING IN CONDITIONS KNOWN TO BE FAVOURABLE TO APPLE CULTURE.

Sharps.

EF	Cap of Liberty*	MG.
MF	Kingston Black*	MG.
E-MF	Fox Whelp	MG.

These varieties grow best when grafted on sorts that make good stems, e.g., King Alford.

BRIEF DESCRIPTIONS OF LEADING OR RECOMMENDED VARIETIES OF CIDER APPLES

Bulmer's Norman (*White Muscadet*).—A good bittersweet. Pale green, large. Exceptionally vigorous, spreading tree. Heavy cropper. Flowers early to mid-season. Fruit fit for gathering mid-season.

Cap of Liberty (*Red Soldier, Bloody Butcher*).—A good quality sharp. Crimson, streaked, middle size. Growth moderate rather sprawling, inclined to canker. Heavy cropper. Flowers early. Fruit fit for gathering mid-season. This variety seems to succeed best in heavy soils of the lias formation.

Crimson King.—A fair quality medium sharp. Crimson, russet markings, very open eye, large. Very vigorous, rather upright. Mid-season.

Cummy Norman.—A useful bittersweet. Greenish-yellow with a slight red cheek, small. Strong grower, spreading. Heavy cropper. Flowers mid-season to late. Fruit fit for gathering mid-season.

Dabinett.—A high quality bittersweet. Green with a dull crimson cheek. Moderate but healthy growth, flat headed. Heavy cropper. Flowers mid-season. Fruit fit for gathering late.

Dymock Red (*Long Ashton*).—A good quality sharp. Crimson, slightly angular, middle size to large. Very vigorous growth, straight spreading branches. Good cropper, flowers mid-season. Fruit fit for gathering early mid-season.

Fair Maid of Devon.—A good quality sharp. Bright red flush and striped, especially on sunny side. Ground colour creamy yellow when ripe. Medium size. Heavy cropper, strong growing, spreading habit. Mid-season.

Eggleton Styre.—A useful aromatic sweet. Pale orange yellow, middle size to large. Vigorous growth, upright. Moderate cropper. Flowers mid-season. Fruit fit for gathering mid-season.

Ellis Bitter.—A useful bittersweet. Red and yellow, large. Good grower. Fruit fit for gathering mid-season.

Foxwhelp (New).—ex Marsh Farm, Wellington, Herefordshire. An aromatic sharp. Yellow streaked with bright crimson, large. Vigorous growth, droops with age. Heavy cropper. Flowers early to mid-season. Fruit fit for gathering mid-season.

Kingston Black (Black Taunton).—A much prized aromatic sharp. Deep purplish crimson, streaked, medium size. Moderate growth, round headed. Usually only a moderate cropper. Flowers mid-season. Fruit fit for gathering mid-season.

Knotted Kernel.—A good quality bittersweet. Bright Crimson, rather small. Very vigorous growth, upright, spreads with age. Generally rather late coming into bearing. Heavy cropper. Flowers early. Fruit fit for gathering early.

Reinette Obry.—Fruit fit for gathering late.

Royal Jersey.—Red, large to medium size. Fruit fit for gathering late.

Royal Wilding (The Cadbury).—A high quality bittersweet. Yellow-green with a red-brown cheek, middle size. Strong grower, spreading. Moderate cropper. Flowers late. Fruit fit for gathering late.

Sweet Alford.—Pale primrose-yellow, red cheek, medium size. A very good sweet variety. Strong grower, roundish head with a few dominant straight shoots. Good cropper. Flowers mid-season. Fruit fit for gathering mid-season.

Woodbine.—Medium size grower. Flowers mid-season. Fruit fit for gathering mid-season. Aromatic sweet.

VARIETIES OF PERRY PEARS.—The perry pear is not grown in Somerset or Devon, but in the Midland cider counties it is valued and the demand is expected to increase. Some of the perry pears go sleepy (" blet ") so rapidly after they are fit for gathering that it is difficult to get them to the factories in good condition.

As with apples, variations in sharpness, astringency and sugar content are found in the analyses of pears. There is a mild class very low in both acidity and astringency, but as this class is usually mealy rather than juicy it is not of much value. A sharp class containing little tannin, represented by Pint, is almost valueless. An astringent-sharp class (e.g., Butt and Barland) is sometimes valuable, but the most useful pears are of an astringent-mild class; included in this group are Oldfield, Taynton Squash and Moorcroft.

The flowering period of perry pears is spread over a shorter season than that of apples, and is also earlier.

BRIEF DESCRIPTIONS OF SOME LEADING OR RECOMMENDED VARIETIES OF PERRY PEARS

Aylton Red.—A moderately astringent aromatic pear of some value. Pale green and crimson, conspicuous russet dots, middle size. Moderate growth, round headed. Heavy cropper. Flowers early. Fruit fit for gathering late. Matures for grinding late.

Blakeney Red.—A second quality pear. Yellow and bright red, above middle size. Moderate grower, very upright but spreading with age. Heavy cropper. Flowers mid-season. Fruit fit for gathering mid-season. Matures for grinding 2nd season.

Butt.—A second quality astringent-sharp pear. Pale green, below middle size, conical. Very strong grower, long upright arching branches. Heavy cropper. Flowers mid-season to late. Fruit fit for gathering mid-season. Matures for grinding 2nd season.

Gin.—A useful pear of a mild type. Yellow green, below middle size, round. Vigorous growth, upright, slightly arching branches. Good cropper. Fruit matures for grinding 2nd-3rd season.

Huffcap.—There are a number of "Huffcap" varieties, the best being moderately astringent with high sugar content. Small to middle size. Very vigorous, spreading trees. Flowers mid-season to late. Matures for grinding late 2nd season.

Red Longland (Red Longdon).—A moderate quality pear, useful for mixing with cider. Green yellow, red cheek with ashy dots, middle size. Strong grower, upright habit. Heavy cropper. Flowers late. Fruit matures for grinding 3rd season (Nov.).

Winnals Longland (Winnals Longdon).—A good quality stringent pear. Yellow with a red cheek, large. Tree very vigorous, upright to wide-spreading. Good cropper. Flowers late. Matures for grinding 3rd season (Dec.).

Moorcroft (Malvern Hills).—A good quality mild pear. Orange with a thin red cheek, russet dots, large. Vigorous growth, pyramidal in youth. Moderate cropper. Flowers early-mid-season. Fruit fit for gathering end of September and early October. Matures for grinding at once.

Oldfield.—One of the best pears. Greenish yellow with russet dots, small-middle size. Growth moderately vigorous, spreading. Good cropper. Flowers mid-season. Fruit matures for grinding 2nd or late 2nd season. Usually bears early.

Rock (Brown Huffcap).—A high quality very astringent pear that makes a perry rather difficult to manage. Dark green, reddish brown cheek, small. Moderate growth but long lived. Good cropper. Flowers late. Matures for grinding late 3rd season (Jan.).

Taynton Squash.—A high quality pear, dull yellow, thin red cheek and russet, small. Vigorous, spreading growth. Heavy cropper. Flowers early. Fruit fit for gathering very early (Sept.). Matures for grinding at once.

White Bache.—A good quality pear. Pale yellow, small-medium size. Growth vigorous, spreading. Matures for grinding 2nd season.

National Mark Scheme for Cider.—To assist the cider maker and to improve the reputation of English cider the Ministry introduced in 1931 a National Mark scheme that established, for the first time, definite standards of quality for cider produced from home-grown fruit.

There are two grades, viz., *Select Cider and Select Cider (Champagne Process)*, the second of which must be matured in bottle. Authority to apply the Mark is granted to manufacturers and farm makers of cider with an annual output of not less than 3,000 gal. and involving the use of not less than 20 tons of apples and pears grown in England and Wales, and also to associations of farm cider makers. Full details are given in Marketing Leaflet No. 22, obtainable free from the Ministry.

Preparation and Planting of New Cider and Perry Orchards.*—TYPE OF TREE AND STOCK.—The only recommended type of tree for vintage orchards is the standard; the head of which should be formed at not less than 6 ft. above ground. Trees of drooping habit may usefully be as high as 7 ft. from ground level to the commencement of the head. The trees for planting should be at least 3 but not more than 5 years old, and have a reasonable amount of root if they are to make good, early progress.

The tree may be worked at ground level for strong varieties, but weaker growers are best head worked on an intermediate strong variety like Morgan Sweet, Bramley's Seedling or Bulmer's Norman (White Muscadet). Head working can be carried out in the nursery or after the tree has been established in the orchard. In the past in some districts seedling stocks have been grown to standard height and have been head worked without an intermediate working. There is evidence that this method is at least as efficient as the general current methods, and provided that strong growing, uniform seedlings are available there is little objection to it.

The stocks should be selected seedling stocks, either of " free " (" kernel ") or crab origin. At a later date it may be possible to recommend certain strong vegetative stocks, or more desirable seedlings may become available. It is important that trees in grass should be well supplied with " anchor " roots so that the trees are able to withstand wind pressure. It is also important that the trees should have been well " feathered " in the nursery since this ensures a satisfactory strength in the stem.

* See also " Planning and Planting Orchards," pp. 1-10.

Perry pears should be worked on selected seedling stocks. Most of the old established perry pears now in the country have been worked at from three to six feet above ground level.

ESTABLISHMENT OF ORCHARDS ON GRASS LAND.—Cider orchards are usually planted directly into turf, but it is desirable that a high stock-carrying condition of the grass should be attained before the trees are planted. Particulars of a good pasture seed mixture are given on p. 6.

ESTABLISHMENT OF ORCHARDS ON ARABLE LAND OR OLD HOP YARDS.—Cider orchards may be established on arable land, when the young trees usually make greater headway than when planted in grass. If this method is adopted the land may be grassed down about ten years later. Naturally this method is more expensive than the common practice, but the adverse margin could be reduced or eliminated by intercropping with other crops. This method was common many years ago when more land was under the plough, and may be advised in some instances to-day.

Manuring, Renovating, Pruning, Top-grafting and Replanting Old or Neglected Orchards.—For information on these subjects reference should be made to the relevant paragraphs in the following section dealing with general orchards.

THE RENOVATION OF NEGLECTED ORCHARDS

The causes of the unprofitableness of orchards are many. Some are beyond remedy, but others are preventable. It is of the first importance, therefore, to make sure what the trouble is, before embarking upon heavy expenditure.

Speaking generally, it is not commercially profitable to restore plantations and orchards that have become unproductive owing to extreme old age, stunted growth from their youth, or to severe damage to the trees caused by stock, careless staking, etc. It is, however, possible to restore to fruitfulness plantations and orchards that have become unfruitful through overcrowding, lack of pruning and proper cultivation, or neglect to control insect and fungus pests, such as caterpillars, Woolly Aphis, Canker and Brown-rot.

Even when orchards are unremunerative because they consist of varieties that are unsuited to the locality or are of poor market quality, much may be done to bring the trees into a profitable condition by top grafting.

It will be understood that, although some results of renovation may become apparent in the following season, careful treatment will be required for several years before badly neglected trees are brought into full bearing.

The renovation of a neglected plantation or orchard may be divided into two sets of operations:—(1) thinning overcrowded plantations by grubbing out trees, judicious pruning, top-grafting, manuring and general cultivation: (2) cleaning the trees and controlling insect pests and fungus diseases by winter washing and summer spraying.

Overcrowding.—Close planting is often the cause of a considerable reduction in the quality and yield of the fruit crop. The trees grow into each other and fruit is produced only on the top branches, with the result that the fruiting area is reduced by at least one-half. At the same time, normal lateral extension is prevented and the head of the tree is forced up to a great height in search of light and air, while much of the tree's food supply is used up in maintaining barren limbs. Picking the fruit then becomes a matter of great difficulty and thorough spraying and horse cultivation impossible.

Plantations and orchards that have become badly overcrowded should receive very drastic treatment, and nothing less than the grubbing out of alternate trees, or even alternate rows, will be sufficient to permit the proper cultivation of the ground. When this has been done, the next treatment will consist of pruning, or top-grafting.

Pruning.—If the trees are of suitable varieties and have not lost too large a proportion of their lower branches, they will probably be very thick and require thinning out. The first stage will consist of sawing out large limbs, including those that are exceptionally tall, badly placed, or too close together, in order that the trees may be thoroughly sprayed. Judgment is required in deciding which limbs to remove and if unskilled labour is used, these should be marked. The final saw-cuts should be made close home, smoothed with a knife or chisel, and painted to exclude disease. This operation may require the removal of half the growth of the tree, and may be sufficient for the first year.

Either in the same, or the following season, according to the severity of the removal of large limbs, the smaller crossing, badly placed branches and diseased wood must be removed. Most of this work will also be done with the saw, and all wounds should be carefully finished off and painted. Any further

pruning required will be of an ordinary nature and is discussed elsewhere.

Top-grafting—Apple trees that have lost many of their lower branches, or are varieties of poor market quality and are not too old, should be top-grafted with a suitable strong-growing variety.

Pears may be top-grafted in the same manner as apples, provided the tree is not too old. Clapp's Favourite, Conference, Souvenir du Congrès, and sometimes Doyenné du Comice, will crop well when top-grafted on to another variety.

Top-grafting plums and cherries is not recommended, as trees rarely stand the process. Trees that have grown to a great height as the result of close planting, so that the fruit cannot be picked satisfactorily, should have the central upward-growing main branches cut back to a side branch at a reasonable height. A new head will then form below this height.

Winter Washing of Fruit Trees.—This operation was formerly employed chiefly to destroy moss and lichens, and also to reduce the numbers of such pests as Mussel Scale, Codling Moth, and Blossom Weevil, which spend the winter on the trunks or branches, under loose scales of bark or among moss and lichens. Owing, however, to the introduction of "tar-distillate" washes, winter washing of fruit trees has assumed a much greater importance and it has now become a routine treatment in all orchards, and not merely one for occasional use only.

Tar-distillate Washes are made from products obtained in the distillation of coal, and are sold under various proprietary names by the firms engaged in their manufacture. Besides generally cleansing the trees, they have the very great advantage of destroying the eggs of aphides and suckers, and a considerable proportion of the eggs of Winter and other moths. Certain forms of these washes, which have recently been developed, have also given successful results experimentally against the eggs of the Apple Capsid, and commercial control of this pest has been obtained in a number of trials.

The Ministry is unable to recommend any particular brand of tar-distillate wash, and when selecting a wash, growers are advised to consult the Horticultural Superintendent of the district in which they reside, or to refer to the results of trials, which are published in the Ministry's *Journal* from time to time. The instructions given by the maker of the wash selected should be strictly followed, and in diluting the concentrated fluid a reasonably soft water should be used.

since, if the water is very hard, the oil may not mix properly, resulting in possible damage to the trees and loss of efficiency. If very hard water must be used, expert assistance should be obtained as to the best method of overcoming the difficulty.

Tar-distillate washes should be applied only when the trees are fully dormant and care should be taken to cover every part of the tree, including the smaller branches and twigs, otherwise aphis and sucker eggs will not be killed. The washes are destructive to foliage, and if used in a grass orchard will cause considerable burning of the grass; they may even cause the death of such plants as kale or spring cabbage planted between fruit trees.

Other Cleansing Washes.—Those who for one reason or another do not desire to use a tar-distillate wash may use either a caustic soda wash, a lime-sulphur wash, or a lime wash. The cleansing effects of these washes are in the order stated, but none of them is nearly so effective against insect pests as a tar-distillate wash. Further information respecting these other washes and formulae for preparing them will be supplied on application to the Ministry.

Manuring.—One of the common causes of unfruitfulness is insufficient manuring. This is much more common in grass orchards than in cultivated plantations, especially if the trees in the latter have been intercropped with soft fruits or vegetables that have been manured.

Poverty-stricken trees present a well marked appearance; the leaves are of a light yellow colour, very little annual growth is made, and the bark of the trunk and branches has an "unkind," hide-bound appearance. The quickest response is obtained by thorough cultivation in addition to manuring.

Grass Orchards.—If the orchard presents the characteristic appearance of starvation and the pasture is poor, either pigs should be turned in to root up the turf, the grass then being harrowed and rolled; or, better still, the grass should be ploughed up and cultivated for two or three years, dressings of dung being given whenever intercropping is practised.

A dressing of 5 cwt. or more of sulphate of ammonia, 2-4 cwt. of sulphate of potash and 2-4 cwt. of basic slag per acre gives good results. Ground lime in dressings of 4 to 5 cwt., also has a good effect. Apart from the benefit to the trees, the improved condition of the pasture alone will more than cover the cost of the manure.

At the same time, brush or chain harrowing and rolling must be carried out annually, in the early spring, to break down worm and mole casts and to tear out moss.

As soon as the trees commence to crop heavily, they should receive a good dressing of dung spread round in a circle corresponding to the spread of the branches. The greater part of the dressing should be applied towards the circumference of the circle where most of the vigorous young feeding roots are to be found. In many districts this dressing is given as a mulch in late spring as soon as the flowers have set. It then helps the tree to carry a heavy crop to maturity; in other districts a similar dressing is given in the autumn. If the trees are healthy and growing strongly, but are not fruiting, these dressings of dung should be withheld.

Cultivated Plantations.—Trees grown on cultivated land that show signs of starvation usually have a yellow leaf-colour and make poor growth. The scorching or browning of the edges of the leaves, so general on apples on paradise stocks growing on poor soils, is often due to lack of humus or potash, or both.

As soon as circumstances permit, the ground should be cleaned, ploughed and manured with 2-4 cwt. of sulphate of potash and 2-4 cwt. of superphosphate per acre. In February, a dressing of 4-6 cwt. per acre of sulphate of ammonia or nitro-chalk should be given in the first year. Subsequent manuring will be governed by the appearance of the trees.

Re-planting.*—Although the planting of young trees in old orchards is not a practice to be recommended if fresh land can be obtained, growers are frequently obliged to fill up gaps owing to the requirements of a clause in their lease or agreement.

If the orchard is composed almost entirely of old trees likely to die in the course of a few years, young trees planted as the vacancies arise should be placed so that they are between the positions which were occupied by the old trees.

Where the gaps are to be filled in, the roots of the old tree should be removed as completely as possible, in order that no decaying wood may be left in the soil, and a circular hole, at least six feet in diameter and from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet in depth, should be dug and left open to atmospheric influences as long as possible before the tree is planted. The soil may also be sweetened by a dressing of quicklime. If fresh soil

* See p. 97 as to loans for planting land.

can be obtained to substitute for that dug out, the newly-planted tree will have a better chance of flourishing. On grass land the grass should not be allowed to grow within 5 feet of the tree for 6-8 years after planting.

THE CONTROL OF PESTS AND DISEASES

Introductory Remarks.—The object of this section is to describe some of the best and simplest methods of preventing the more common pests and diseases from causing widespread damage to trees and fruit. Growers who find the outlines of treatment given here insufficient for their purpose should obtain the Ministry's leaflets* dealing with the pests or diseases causing trouble, and if still in difficulty should seek the aid of the County Horticultural Staff.

In special cases, where detailed investigation is required, the Advisory Entomologist or Mycologist in the Province should be consulted and specimens forwarded, whenever possible. Such specimens should consist of a portion of the plant showing the nature of the damage or disease, together with samples of the pests, if any. The material should be packed carefully, preferably in a tin box, so that the contents may arrive in a fresh and undamaged condition. No holes should be made in the box.

General Hygiene.—Trees or bushes that are overcrowded, starved, unpruned, or are growing in unsuitable situations cannot be rendered fruitful by any system of pest control, and anything wrong in these respects should receive attention before other measures are attempted. Overcrowding prevents efficient spraying, and emphasis may be placed upon the need for dealing drastically with this evil. If necessary, every alternate tree should be grubbed, and the remainder pruned so as to thin out the centre of the tree and space the branches evenly. Tree trunks, branches and prunings may also prove a source of pests, and should either be burned or at least removed from the orchard.

INSECT PESTS

Apples, pears, and plums are the fruits most often grown in a mixed orchard, and the chief pests by which they may be attacked comprise caterpillars, sawflies, aphides, apple suckers, red spiders, and perhaps certain beetles or weevils.

* Methods of controlling fruit pests and diseases are subject to frequent modification and improvement; growers are strongly advised to read the advice given here in respect of any particular pest in conjunction with the latest Advisory Leaflet on the subject.

The first principle in insect control is to destroy as many of the pests as possible in the winter, which may be achieved by burning prunings, by grease-banding, and notably by spraying with an egg-killing wash, a measure which is strongly to be recommended wherever it can be carried out. (See p. 83.) With the arrival of spring and the bursting of the buds, pests that have escaped winter treatment become active, and they must be destroyed when young and before they have had time to do damage. Caterpillars are best dealt with by spraying their food with such a poison as lead arsenate. Sucking insects (e.g., aphides), red spiders and other mites feed chiefly on sap, which cannot be rendered poisonous, and to destroy them it is necessary to use a contact insecticide, such as nicotine, which is fatal to any insect that it touches. By one or other method, most of the pests mentioned should have been destroyed before the trees blossom, or, with plums and pears, shortly afterwards. During the remainder of the season, operations directed against certain special pests take the place of the more general routine spraying carried out in early spring, and they include when necessary spraying with lead arsenate against Codling Moth, and with nicotine against Apple Sawfly. Trees may also be banded with old sacking or corrugated cardboard to trap Codling Moth larvae and Apple Blossom Weevils. In plantations in which the Apple Capsid is present, the control of this pest is of paramount importance; it requires, however, a special programme, and reference should be made to Advisory Leaflet No. 154.

Programmes of Work.—The year may be divided as follows:—October-February, the Dormant Season; and March-September, the Active Season.

DORMANT SEASON.—In early October all standard trees should be grease-banded to catch Winter Moths (Adv. Leaflet 11); bands should be scraped or freshened up with new "grease" at the end of February. Immediately after Christmas and after pruning, all trees and bushes should be thoroughly sprayed with a tar-distillate wash. The work must cease before the buds have begun to swell, and therefore plums, which start early, should be dealt with first. Tar washes are destructive to plants in leaf (e.g., spring cabbage) and no spray must be allowed to fall upon them.

ACTIVE SEASON.—The following programmes assume the presence of many common pests, which, however, do not necessarily occur everywhere or in every year: in an average clean orchard less spraying may be permissible. Apples present the most serious problem, notably because the Apple Scab fungus

(Leaflet 131) has to be controlled in addition to insects. The inclusion of lime sulphur in the three alternative programmes will assist in controlling Scab.

Apples.—(i) If tar distillate has been used, spray, just before the blossom buds turn pink, with lime sulphur and lead arsenate mixed. As soon as the petals have fallen, give a further spray of the same chemicals, but using the lime sulphur at weaker strength. This programme will deal with Red Spiders, caterpillars in general, and Codling Moth.

(ii) If the trees have not been winter sprayed, apply lime sulphur and lead arsenate when the blossom buds can be seen, but are still quite green; follow with nicotine and soap when the buds show pink, and make a further application of lime sulphur and lead arsenate immediately after blossoming. This programme deals with aphides, Red Spiders, caterpillars and Codling Moth.

(iii) Pre-blossom sprays as in (i) and (ii), but after blossoming apply two sprays of nicotine and soap, one five days after the petals have dropped and the second a week later. These later sprays are directed against Apple Sawfly.

It should be emphasized that lead arsenate is very poisonous and should not be allowed to reach salads or other foodstuffs. If the trees have been grease-banded, the chemical may ordinarily be omitted from pre-blossom sprays, and if its use in post-blossom spraying is objectionable, some control of Codling Moth may be obtained by banding (see Adv. Leaflet 42). Where a non-poisonous caterpillar spray is required, a Derris wash is recommended, but it will not entirely replace lead arsenate.

Pears.—A pre-blossom spray of lime sulphur to control Pear Leaf Blister Mite, and a post-blossom spray of lead arsenate if caterpillars are troublesome (lime sulphur may be added to this second spray to prevent Scab). Nicotine and soap whenever necessary for aphides; if applied when the blossom is fully open, it will assist in controlling Pear Midge.

Plums.—If winter sprayed, use lime sulphur immediately after blossoming to control Red Spider. Lead arsenate can be added if necessary to control caterpillars. Plums which have not been winter sprayed are likely to suffer from aphides, and a nicotine and soap wash immediately after blossoming should be substituted for the lime sulphur.

Formulae:—

1.	Tar distillate	1 gal.
	Water, either according to maker's directions, or ...	14 ,,
2.	Lead arsenate paste (20 per cent. As_2O_5)	1 lb.
	or lead arsenate powder (30 per cent. As_2O_5) ...	½ ,,
	Water (or *dilute* lime-sulphur wash)	25 gal.
3.	Nicotine, 95-98 per cent	1 fluid oz.
	Soft Soap	1 lb.
	Water	10 gal.
4.	Lime Sulphur	1 gal.
	Water (*a*) for black currants	11 ,,
	(*b*) pre-blossom applications to apples and pears ...	29 ,,
	(*c*) for plums; also for apples and pears after blossoming	99 ,,
5.	Derris wash ... It is generally advisable to buy ready-made preparations and dilute to maker's instructions.	

NOTE 1.—Lead arsenate and nicotine are highly poisonous.

NOTE 2.—Some varieties of apples (e.g., " Lanes " and Stirling Castle) and gooseberries (e.g., Crown Bob) are easily damaged by lime sulphur (see Leaflets 131 and 195). Lime sulphur should not be used on Stirling Castle at all.

NOTE 3.—Tar-distillate washes are sold in proprietary form and are obtainable from horticultural sundriesmen.

FUNGUS DISEASES

The two most effective measures in preventing fungus attacks on fruit trees are (1) the pruning out of dead or diseased twigs and branches, and (2) spraying with a suitable *fungicide*. The importance of pruning lies in the fact that many of the fungi which attack fruit trees make their way into the tissues of the twigs and branches. When they have penetrated into these tissues they cannot be reached and destroyed by spraying, hence the only remedy is to cut out and burn the diseased portions, taking care to cut back to healthy wood. If this is not done the fungus continues to live and extend the damage; further, by producing spores, it may spread to other parts of the same tree or to other trees near by. These spores or fungus " seeds " are produced at certain times of the year on the surface of the diseased twigs, branches, fruits or leaves. They are also produced in great quantities on mummied fruits of apple, pear and plum, and for this reason such fruits should always be collected and destroyed as soon as possible.

If a fungicide is applied at the right time, many spores will be killed outright; moreover, certain spray fluids on drying form a thin film of poison on the plant which thus becomes protected from any fungus spores that may fall upon it

subsequently and would otherwise begin to grow. The essence of this treatment, therefore, is to apply the fungicide before the fungus has had time to reach or begin to grow into the plant.

In addition to this preventive spraying, it is possible, in certain cases when the fungus lives on or near the surface of the plant, as, for instance, with powdery mildews, to check the disease by spraying after the fungus has begun to develop.

Outline of Treatment for Various Crops.—APPLE.—The general *winter* treatment of pruning out dead wood, etc., has already been indicated. During pruning all dead fruit and wood, as well as the prunings, must be collected and burnt. Parts of apple and pear trees affected by *Canker* (Advisory Leaflet No. 100) should be cut out or pared away and the wounds dressed with soft grafting wax or white lead paint; these substances are also useful for applying to large wounds made in pruning. Wood bearing pustules of *Scab, Brown-rot,* or *Blossom Wilt* (Leaflet No. 131, Advisory Leaflets Nos. 155 and 63) must also be cut away and burnt, and the same treatment applies to twigs of apple trees attacked by *Mildew* (Advisory Leaflet No. 205). All dead or mummied fruit still hanging on the trees must be gathered and burnt.

For *Scab,* the trees should be sprayed with Bordeaux mixture or lime sulphur solution. Of the two, the former is the more powerful fungicide, but it sometimes causes a certain amount of scorching of the foliage and russeting of the fruit, especially in certain varieties. Lime sulphur may also cause some scorching and leaf and fruit drop, but it has the advantage that it also controls *Red Spider* and, to some extent, apple *Mildew.*

Preparation of Bordeaux Mixture.—Bordeaux Mixture is prepared from copper sulphate (bluestone), lime and water. Hydrate of lime is perhaps the most convenient form of lime to use but quicklime is quite suitable. The mixture can be made up according to various formulae, but, for use against Apple and Pear Scab, it is generally prepared at the rate of, copper sulphate 4 lb., hydrate of lime 6 lb. (or quicklime 4 lb.) and water 50 gal. This is sometimes known as " equal lime " Bordeaux. A mixture containing 19 lb. hydrate of lime (or 12½ lb. quicklime) is known as " excess lime " Bordeaux.

To make 50 gallons of the mixture, place 4 gallons of clean water in a *wooden* vessel. Take 4 lb. of copper sulphate, preferably in the form of granular crystals, tie up in a clean piece of sacking or other cloth and suspend from a stick, placed across the top of the vessel, so as to hang just below the

surface of the water. This should be done overnight, or at least some hours beforehand, since the bluestone takes some time to dissolve.

When hydrate of lime is used, 6 lb. of it should be thoroughly stirred into 46 gal. of water in a 50-gal. barrel. If quicklime is used 4 lb. of good lump or " fat " lime should first be slaked by adding small quantities of water at a time, when a fine powder should result. More water added to the powder will produce first a creamy paste, and then milk of lime. This must be poured through a fine strainer into a 50-gal. barrel and made up to 46 gal.

Having made sure that the whole of the 4 lb. of copper sulphate has dissolved, the four gallons of solution containing it should be poured steadily into the barrel, vigorous stirring being carried on just before and during mixing.

Lime-Sulphur Solution.—This is best purchased in concentrated form from a reliable dealer. There are various brands on the market, but the one selected should be guaranteed to have been prepared from lime, sulphur and water only. It should contain not less than 24 per cent. weight/volume (i.e. 24 lb. per 10 gal.) of dissolved sulphur in the form of polysulphides. It should be reasonably free from all suspended matter and should remain practically clear when diluted with water. For use against Scab one gallon of the concentrated solution, as purchased, should be poured slowly into 29 gallons of water, stirring all the time. For post blossom spraying the dilution should be one gallon to 99 gal. of water, but in some cases it is possible to use a stronger solution, viz., 1 to 59. Spraying machines for use with lime-sulphur solution, if made of copper, should be tinned, otherwise the copper will become corroded.

Addition of Lead Arsenate.—It has been found in practice that lead arsenate may advantageously be added to Bordeaux mixture or to lime-sulphur solution, since it is valuable against caterpillars and other biting insects and also tends to increase the fungicidal value of lime-sulphur solution. Lead arsenate is obtainable either as a paste or a powder, the former being used at the rate of 1-1$\frac{1}{4}$ lb. and the latter at $\frac{1}{2}$ lb. per 20 gal. of water.

Application of Sprays.—To control Scab really effectively, three applications are necessary for many varieties. The first should be made just before flowering (with apples, the buds are then showing pink), the second as soon as the petals have fallen and the third about three weeks later. Recent trials

have demonstrated the supreme importance of the pink-bud application and, indeed, have shown that in some districts and in certain seasons an earlier first spraying, viz., in the green-flower stage, is practically essential for successful control, particularly with varieties liable to wood infection.

Spraying should be done if possible on a fine, calm day but not in strong sunshine. The spray fluid should be applied with considerable pressure through a suitable nozzle, in such a way that all parts receive a uniform wetting. Since the fungus may occur on both sides of the leaves, it is important to spray the under as well as the upper surfaces as far as possible. The quantity of fluid required per tree will naturally vary with its size and seasonal development. For medium sized trees it may be reckoned that at least a gallon per tree will be necessary for the first application.

Recommendations for Spraying.—The following suggestions for spraying apples are based upon actual experience in this country. They are, however, to be regarded rather as a guide to the grower than as rigid rules to be followed blindly. Modifications will naturally be made where experience dictates and special circumstances demand.

1. Preliminary, " green flower," application.

For varieties liable to wood infection and for all varieties when cold, wet, sunless conditions prolong the normal green flower condition:—

Spray with Bordeaux mixture—OR—with lime-sulphur solution, 1 to 29 (except Stirling Castle).

2. " Pink Bud " application.

Of paramount importance for all varieties:—

Spray with Bordeaux mixture (except Cox's Orange Pippin and Lord Derby)—OR—with lime-sulphur solution, 1 to 29 (except Stirling Castle).

With Beauty of Bath, Charles Ross, Lane's Prince Albert, Lord Derby, Gladstone, Grenadier, Early Victoria, Stirling Castle, Belle de Boskoop, Rival and a few other varieties, pre-blossom spraying against Scab is often considered sufficient, except in seasons particularly favourable to the development of this disease.

3. First post-blossom application; immediately after the petals have fallen.

(*a*) All varieties except Stirling Castle, Lane's Prince Albert, Beauty of Bath and, in some localities, Newton Wonder and Rival, may be sprayed with lime-sulphur solution 1 to 99. In the Eastern Counties and in the West

of England it has been found that a stronger solution (1 to 59) may safely be applied to the varieties Allington Pippin, Worcester Pearmain, Early Victoria, Blenheim, Annie Elizabeth, Lord Derby, Grenadier, Bismarck and Bramley's Seedling.

(*b*) If preferred, " excess-lime " Bordeaux may be used except for the varieties Lord Derby, Cox's Orange Pippin, James Grieve, Rival, Beauty of Bath, Gladstone, Early Victoria, Lane's Prince Albert, King Edward, Stirling Castle and Lady Sudely.

4. Second post-blossom application; about three weeks after the previous one.

Repeat the corresponding first post-blossom application. Lead arsenate may advantageously be added to spray fluids for the green flower, pink bud and the first post-blossom applications.

Dusting.—Both sulphur and copper-lime dusts have from time to time been advocated for use against Scab, but it has been found on the whole that dusting does not compare favourably with spraying for the control of this disease. Dusting is perhaps more easily and more cheaply carried out than spraying, but it must be borne in mind that to secure reasonable control a greater number of applications of dust are required than of spray. It would appear from the limited number of experimental trials so far carried out in this country that sulphur dusting can be expected to be reasonably satisfactory only when repeated applications are made, post-blossom, to trees that have been sprayed pre-blossom with lime-sulphur solution.

During the summer, dead trusses of bloom killed by *Blossom Wilt* should, as far as possible, be removed together with the diseased spurs.

PEAR.—Scab is the most important disease. To control this Bordeaux Mixture (4-6-50) or lime sulphur solution (1 to 29 for pre-blossom, 1 to 99 for post-blossom applications) may be used with safety on practically all varieties, and three, or even four, applications may be necessary, starting early, as with apples. Care should be exercised in spraying Doyenné du Comice, however, for this variety is liable to injury by post-blossom applications of both copper and sulphur sprays.

PLUM.—With *Wither-Tip* and *Brown-rot* (Leaflet 367), diseased shoots and dead, mummied fruits must be removed and burnt by the end of March. If the attack has been very bad, a 1 per cent. caustic wash may be applied immediately previous to flowering, usually about the end of February.

For *Silver Leaf* (Leaflet No. 302) the essence of control consists in the immediate destruction of all fructifications of the fungus *Stereum purpureum* whenever and wherever seen, and the removal and burning of all dead wood on which alone such fructifications can develop. This must be done before the 15th July in each year. Wounds should be avoided, but those which are inevitable should be protected with white lead paint.

Spraying Machines.*—There are two main types of spraying machines suitable for use in allotments or small holdings. They are:—

(*a*) Knapsack Machines.
(*b*) Small Wheel Manual Machines.

The Knapsack.—These machines are the most widely used for this purpose. They are the cheapest kind of machine obtainable and are suitable for spraying all kinds of fruit trees, potatoes and other vegetables. For large standard trees a long lance attachment can be fitted, but it is found that the pump is not sufficiently powerful to maintain the high pressure necessary to carry out this work thoroughly.

Knapsack machines, as their name implies, are carried on the back by means of shoulder straps. The container, which holds about $3\frac{1}{2}$ gallons of spray-fluid, is usually made of plain or tinned copper. The former is less expensive, but cannot be used for a lime-sulphur wash for which either a tinned copper machine, or one with a container made of some chemically resistant alloy must be used.

Fitted to the container is a short length of hose, and attached to this is a brass lance about three feet long. The nozzle is fitted at the end of the lance. For spraying large trees, as previously mentioned, a bamboo lance five to six feet long can if necessary be fitted to replace the metal one. All spraying machines are fitted with strainers.

The power for spraying is obtained by one of the following means:—

(*a*) *An Internal Pump* which is fitted to the base of the container. Its action is similar to that of a pair of bellows. The valves are of rubber, and when perished can easily be replaced.

(*b*) *An External Pump* which is fitted on one side of the container and is of the ordinary plunger type. The valves are of metal, and are in such a position that they can easily be inspected.

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* For further information in this connexion see Bulletin No. 5, *Commercial Fruit Tree Spraying and What it Costs*, obtainable from H.M. Stationery Office, price 9d. (10d. post free).

(*c*) *Pneumatic Pressure* which is obtained from an air pump fitted inside the container. These machines are fitted with a pressure gauge and safety valve.

Small Wheel Manual Machine.—Where it is desired to spray even a small orchard of standard trees, some type of small wheel manual machine is recommended. These machines are suitable for all work for which a knapsack is used, and have powerful pumps fitted to them, so that the tops of fairly large trees can be reached. This type of machine is very much more expensive than the knapsack type, but is much more durable and useful if a considerable amount of spraying has to be done each year.

The small wheel manual machine consists of a galvanized metal container holding 12 or 18 gallons, mounted on one or more wheels. The pump is of the plunger type, fitted with an air chamber and metal valves. A pressure of 60 to 70 lb. per square inch can easily be maintained. There is a single or double lead of rubber hose 20 ft. long. A metal or bamboo lance can be fitted to the hose to suit requirements.

Nozzles.—These are fitted to the lance to split up the jet obtained by means of the pump into either a coarse or very fine spray as may be required. There are many types on the market, and in making a choice the purchaser should ascertain that the nozzle can easily and rapidly be cleared if blocked.

Care of Spraying Machinery.—Most of the fluids used for the control of insects or fungi have either a corrosive effect on the metal or rubber parts of the machine, or have small particles in suspension which wear away the valves and plungers.

The spray-fluid should be carefully strained at least twice before being poured into the container, and all working parts of the machine must be kept well oiled. The container and pump should be thoroughly washed out with clean water after use.

THE PURCHASE OF INSECTICIDES AND FUNGICIDES

The insecticides and fungicides on the market may conveniently be divided into two distinct groups:—

A. Ordinary chemicals or mixtures thereof, the nature of which is commonly known to the public and which are usually sold under recognized descriptive names or under their chemical names, e.g., lime-sulphur solution, lead arsenate.

B. Materials which are sold under proprietary names, and concerning which no detailed information as to composition or contents is given by the manufacturer, although he may indicate the general class to which a particular material belongs, e.g., "X.Y.", a tar-distillate wash.

The increasing employment of insecticides and fungicides in the agricultural and horticultural industries in recent years has brought into special prominence the importance of purchasing only high-grade products in order to ensure efficiency and safety in use, and it is the object of this section to draw attention to certain safeguards of which the purchaser may avail himself when buying articles in Group A above.

GROUP A

In former years the Ministry issued a leaflet entitled "Standards recommended for certain Insecticides and Fungicides," detailed specifications were given for some of the more important materials in Group A. Further discussions on the subject have recently taken place between representatives of the National Farmers' Union, manufacturers of insecticides and fungicides, and the Ministry, and as a result, the Association of British Insecticide Manufacturers undertook to revise these specifications and to add specifications for certain materials not previously dealt with: the latter include certain copper-containing fungicides sold for potato spraying. These revised specifications, which have been accepted by the Government Chemist, the National Farmers' Union, and the Ministry, have been published in detail in the Ministry's Bulletin No. 82, "Specifications and Methods of Analysis for certain Insecticides and Fungicides". This Bulletin can be obtained, price 3d. net, from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, or through any bookseller, and should be consulted for the technical details of the various agreed specifications.

The insecticides and fungicides dealt with in this manner are as follows:—

Lead arsenate (powder and paste).
Lime-sulphur solution.
Nicotine and nicotine sulphate.
Copper sulphate.
"Bordeaux" powder (copper sulphate and lime).
"Burgundy" powder (copper sulphate and soda).
"Cheshunt" Compound (copper sulphate and ammonium carbonate).
Soft soaps for spraying purposes.
Sodium and potassium cyanides.
Calcium cyanide.
Formaldehyde.

Purchasers of any of these chemicals are strongly recommended to require a guarantee that the materials supplied are strictly in accordance with the specifications prescribed in Bulletin 82 (1934). By so doing they will be certain of obtaining products

of high quality. It is necessary to note, however, that a declaration of chemical composition does not always indicate fully the efficiency of a product in practice, since such factors as the physical condition of the components are also of great importance and there are at present in many instances no accepted standards by which these can be defined. Specifications that will afford a complete guide to the efficiency of insecticides and fungicides cannot, therefore, be prepared in all cases at present, but the grower may feel satisfied that by stipulating that his purchases of the materials in the above list shall comply with the specifications in Bulletin No. 82, he will get the best obtainable in the present state of knowledge.

GROUP B

The Ministry is unable to express any opinion as to the merits or demerits of any particular brand of insecticide or fungicide, but in its leaflets and elsewhere certain classes of products, largely or wholly sold as branded articles (e.g., tar-distillate washes, miscible oils, etc.) are frequently recommended. In such cases, the grower's chief safeguard lies in buying from a reputable British manufacturer or merchant. Advisory officers and members of County educational staffs do not as a general rule carry out trials with proprietary articles of secret composition, but exceptions are made occasionally in the case of such proprietary materials as winter washes, and valuable information may often be obtained either from the published reports of such trials or by consulting the appropriate Adviser or Horticultural Officer.

LOANS TO DEFRAY COST OF PLANTING

With the sanction of the Ministry of Agriculture and Fisheries, landowners* can obtain loans under the Improvement of Lands Acts to defray the cost of planting their land. Such loans are repayable over a term of years varying according to the character of the planting, the maximum period in the case of standard fruit trees being 25 years. The loans are secured by an Order issued by the Ministry charging the land with the annual repayments. In each case an inspection has to be made by an officer of the Ministry before the improvement is commenced.

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* These facilities are not available to tenants, except that the expression " landowner " includes a tenant holding under a lease, or an agreement for a lease, for a term whereof not less than 25 years is unexpired at the time of making an application.

Further information concerning the facilities afforded can be obtained from (i) The Lands Improvement Company, 58, Victoria Street, Westminster, London, S.W.1, or (ii) The Agricultural Mortgage Corporation, Stone House, Bishopsgate, London, E.C.2, these being the two bodies set up under Act of Parliament by whom improvement loans are usually made.

A pamphlet (Form A. 749/L.I.) giving general information on the subject can be obtained on application to the Ministry.

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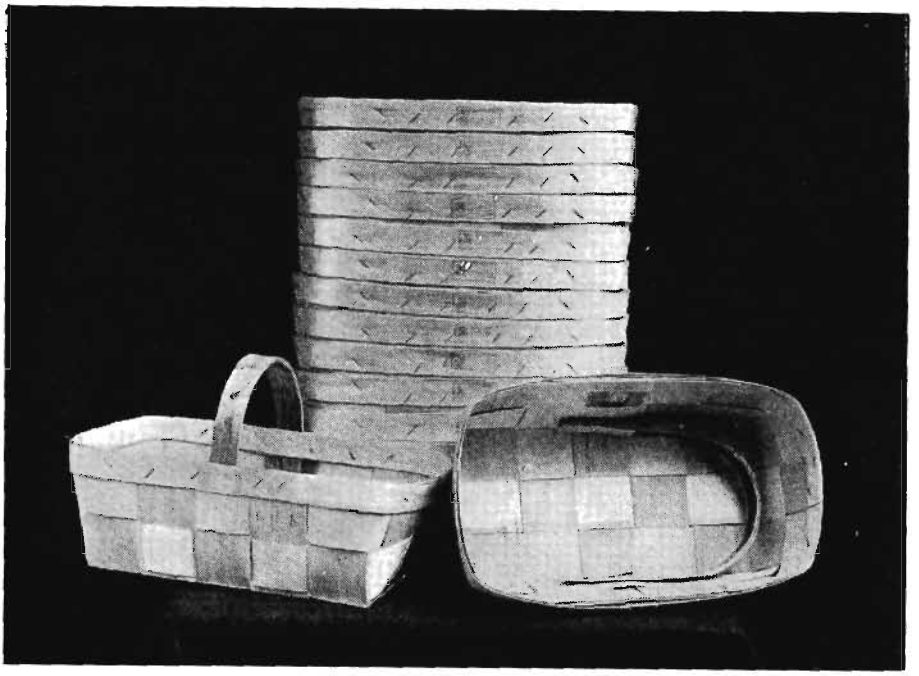

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