SCHOOL GARDENING

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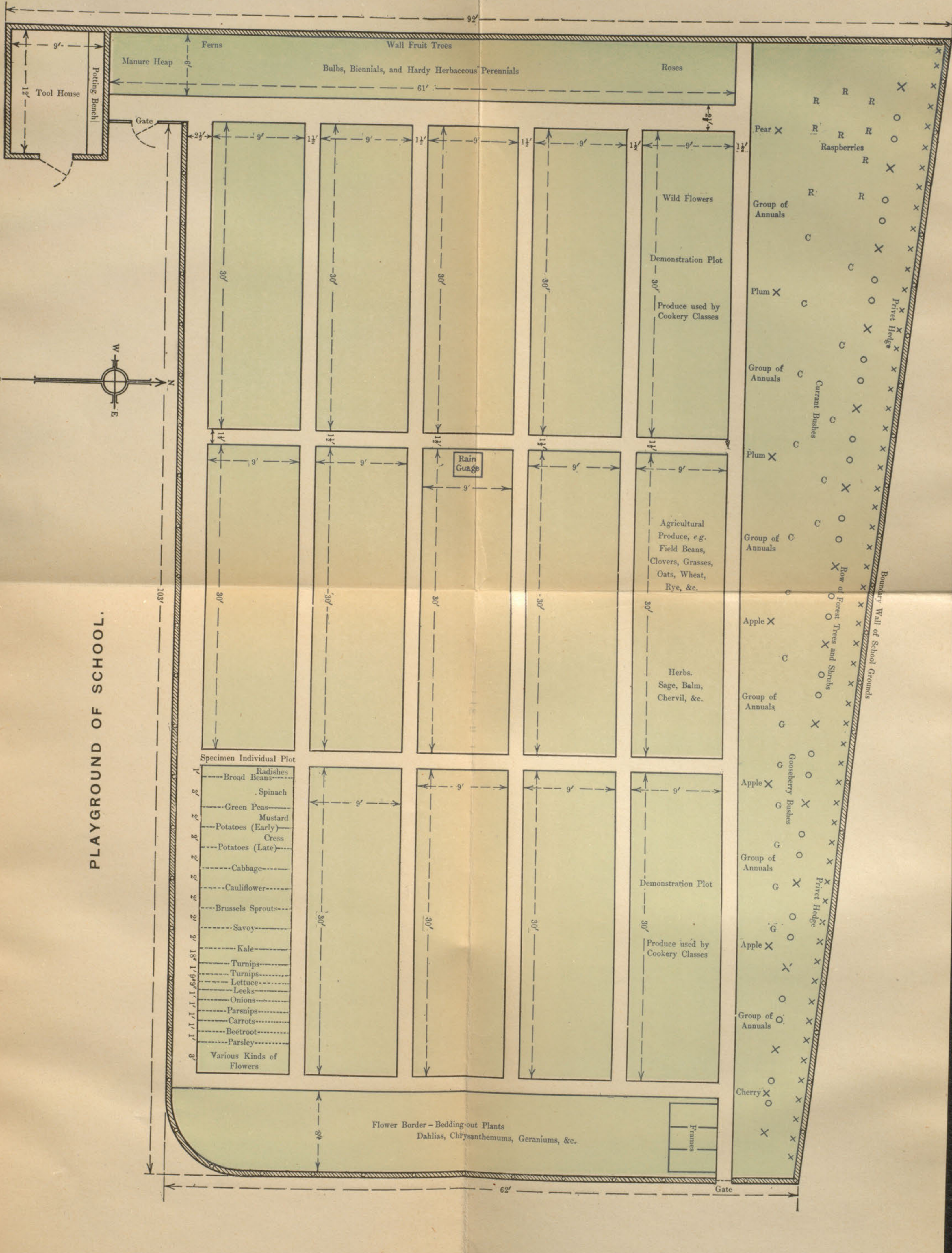
WITH A GUIDE TO HORTICULTURE

COLSTON PUBLIC SCHOOL, GLASGOW.

PLAN OF SCHOOL GARDEN.

Scale, 1 in. = 11 ft.



SCHOOL GARDENING

WITH A GUIDE TO HORTICULTURE

BY

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PREFACE.

During my connection with the technical side of gardening—lecturing, teaching, and supervising school gardens—I have frequently been appealed to, by teachers and others, for a book dealing with school gardens, giving brief cultural details, plans of cropping, lists of different groups of plants, etc., together with the notes of my lectures to teachers attending the courses in School Gardening and Rural Knowledge at the West of Scotland Agricultural College Farm, Kilmarnock, and other centres.

This book is the result of these appeals, and, in attempting to meet the requirements of those seeking information on the subject, I have experienced considerable difficulty, not in obtaining material, but in condensing the matter sufficiently to bring it within reasonable limits.

I have endeavoured to treat the subject on very broad lines, bringing together much valuable information useful to all engaged in gardening and not found previously within the covers of any one book, and I have aimed at supplying sufficient information to meet ordinary requirements on the various subjects treated. It must, however, be clearly understood that full details of the cultivation of the numerous crops referred to in this work, with exhaustive treatment of such subjects as soils, manures, insects, plant diseases, etc., could not be given in a book of this size. Furthermore, there are several phases of gardening, such as Fruit, Flower, and Vegetable culture for market, Intensive Cultivation, Marketing of Garden Produce, etc., not touched upon, as they do not come within the scope of this work.

I trust that, notwithstanding any shortcomings and imperfections, this volume will be found of use to those for whom it has been specially prepared, and that the matter supplied in such a concise form will create a desire for further information, either from the various books mentioned at the end of this work, or from that greatest of all books, the Book of Nature.

My thanks are due to Mr. D. G. Nicolson, Headmaster of Neilston Public School, near Glasgow, for much valuable assistance during the preparation of this work for the press; and to Mr. B. P. Perry, my assistant in the Horticultural Department at the Experimental Farm, Kilmarnock, for his transcription of some of my notes and lists of plants.

I am also greatly indebted to Messrs. the Agricultural and Horticultural Association, 92 Long Acre, London; Messrs. Sutton and Sons, Reading; Messrs. Kelway and Son, Langport, Somerset; Messrs. Boulton and Paul, Horticultural Builders, Norwich; and Messrs. Walter Voss and Co., Carlton Works, Millwall, London, E., for the loan of blocks used in illustrating this work.

A. H.

Agricultural College, Glasgow.

August 1912.

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INTRODUCTION.

The teaching of gardening in Public Elementary Schools is by no means new. It has been taught for over forty years in the public schools on the continent. It is stated that no fewer than 12,000 school gardens have been established in Austria-Hungary since 1870. In the United States of America, Canada, New Zealand, Ceylon, and the West Indies it is also being taught and becoming increasingly popular. In England, at the end of 1911, there were over 2,000 school gardens, at which about 38,000 pupils were receiving instruction.

In Scotland the subject is of more recent introduction, but during the last four years about 350 schools have taken it up. As in other parts of the world, it promises to become very popular and useful, as most valuable and lasting results are obtained from knowledge gained by the pupil through his own observation and activity. For the pupils are dealing not with abstract ideas, but with real things; not with descriptions and illustrations, but with actualities and occurrences.

The older forms of education led the more intelligent pupils away from their native callings into the professions, and gave little to the pupil who was to remain a worker at home, in the way either of fitting him for such work, or of giving him the means for a rational enjoyment of his leisure time.

The rural population must depend largely on themselves for relaxation and enjoyment, and school gardening and Nature Study are intended to enable them to enjoy their leisure hours. The formation of village libraries, natural history societies, village museums, recreation rooms, and the holding of flower shows should have a tendency to keep the people on the land, by providing the means of recreation, amusement, and food for the mind.

The purposes for which school gardens are formed are primarily educational. They are not intended to train the pupils to be skilled gardeners, but to stimulate and cultivate their powers of observation, and to give them a taste for rural life and rural occupations.

It has been found from actual experience that pupils, to whom the ordinary school subjects make no appeal, are often deeply interested in something which calls for the use of their hands and eyes, and that during a course of such manual and mental training as is provided by a scheme of gardening their minds are awakened; so that subsequently they enter into the more abstract and intellectual studies of the school with greater zest.

In country districts it should frequently be possible for pupils to have, at their own homes, little plots in which they could carry on gardening operations. Children who have taken a course of gardening at the school usually pay more attention to the home garden, if there is one, and when they grow up they are more likely to become allotment-holders, or market-gardeners, or to follow other pursuits connected with the land.

Like Nature Study, the study and practice of gardening cultivate the powers of observation and reasoning, while supplying an excellent form of manual training, and tending to make pupils methodical. Furthermore, it imparts a knowledge of rural pursuits such as the tilling and manuring of the soil, and furnishes practical acquaintance with the various crops grown in garden and field, as well as with their habits of growth and their uses. Methods of propagation, the time and manner of sowing and planting, and the principles of grafting, budding, and pruning can only be learned by practical experience.

Under skilful teaching the children become acquainted with the various weeds, their names, their habits of growth, and the best methods of exterminating them; also with common insects, useful and harmful; and with plant diseases. These are matters of the utmost importance to those destined to earn their livelihood in rural districts, and such instruction fits them for their special work.

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PART I.

THE SCHOOL GARDEN.

CHAPTER I.

THE FORMATION OF THE SCHOOL GARDEN.

The Site for a School Garden.—In forming a school garden, the authorities may have very little choice in the selection of the land, but may have to take whatever land is available, and, by suitable methods of cultivation according to its character, make the best possible use of it.

Sometimes the only land available is the schoolhouse garden. When that is so, a portion of it large enough for the needs of the class should be set apart. A special plot, however, is always desirable whenever it can be obtained.

The land, if possible, should adjoin the school premises, and be sheltered from the cold north and north-east winds, as well as from the prevailing winds of the district. A warm, well drained soil, having a southern aspect, will give the best results. This is especially desirable in cold and wet districts.

Low lying ground with a cold, damp, sour subsoil should if possible be avoided, as it is usually subject to mists and early and late frosts. Steep slopes, especially in dry districts or on sandy soil, should also be avoided. A good medium loam, about two feet in depth, is preferable to one of an extreme character, such as a very light sand or a very heavy clay, or a soil largely composed of peat. Light sandy soil is improved by adding clay, marl, or well rotted farmyard manure. Heavy, low lying ground will be improved by draining, deep cultivation, manuring, or by the addition of sand, grit, "breeze," or any vegetable refuse. Exposed land should be sheltered by means of walls, wooden fences, or living hedges of privet, yew, thorn, cypress, hornbeam, or beech. Some gardens are, however, already sufficiently sheltered by means of buildings, clumps of trees, or hills.

Fencing.—When fencing is necessary a choice will have to be made between living hedges as mentioned above, and permanent fencing of some description.

The following figures show the cost per yard of different kinds of fencing, but it is always advisable to obtain estimates for the types considered desirable under the circumstances, in order that the prices may be compared:—

Unclimbable iron railings, 4s. to 6s. 6d. per yard.
Galvanised strained wire fencing, about 1s. per yard.
Solid wire fencing, about 10d. per yard.
Barbed-wire fencing, about 1s. 2d. per yard.
Wooden rails with barbed wire, about 1s. 2d. per yard.
Split chestnut paling, according to height and distance apart of the pales, 1s. 7d. to 2s. per yard (Fig. 1).

Where rabbits, poultry, or dogs are troublesome, wire netting should be placed around the garden to prevent their entrance. It is important that the garden should be properly fenced off.

The land should be brought into a good state of cultivation either by digging or trenching, the grass (except couch) or weeds (except bindweed and similar perennial weeds) being placed at the bottom of the trench. At the same time there should be added, if possible, manure, leaf mould, or material from a compost heap.

The first digging or trenching of a garden is generally too laborious for children; in such cases it is usual to employ a labourer to break up the soil and bring it into a fit state for cropping, the pupils having an opportunity of observing how the work is performed.

The whole of the proposed garden should be measured, and a plan made, showing the manner in which it is to be laid out.

Laying out the Garden.—The planning of school gardens is carried out under two different methods.

(*a*) A *common plot* about the size of a cottage garden—10 to 40 poles—or an allotment on which all the pupils work. This is more conducive to economy as regards area of land and garden tools. It also allows space for a reasonable quantity of vegetables and flowers to be grown. The method of cropping and culture is similar to that prevailing in an ordinary small garden.

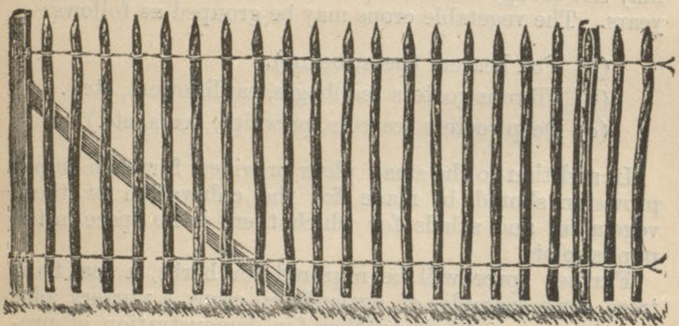


Fig. 1.—Split Chestnut Paling suitable for Fencing Gardens.

But since the school garden exists not so much for the teaching of gardening as for educational purposes, this common plot system cannot be recommended. Besides, the pupils are not so easily controlled, nor so usefully employed, as when they have a plot each. They are often in the way of each other, and only four or five can be doing useful work at one time.

(*b*) *Individual plots*, or one plot for each pupil (in some cases two pupils, a senior and a junior, work a plot between them), as shown on the three plans of school gardens.

This method of "one pupil one plot" is the more common, and is undoubtedly the better of the two. The pupils experience the full effect of undivided responsibility, and consequently take more interest in their plots when entirely managed by themselves. As will be seen from the plans, the individual plots are about 1 square pole in area (about 30 feet by 9 feet), with paths 1 to 2 feet wide between the plots; the main paths are from 3 to 4 feet wide. The plots are generally arranged to run east and west so that the rows of vegetables run north and south. A row of each of the common vegetables and salad plants is grown, and in some cases a few flowers. The cropping is arranged in a regular rotation, so that the same crop may not occupy the same piece of land in two consecutive years. The vegetable crops may be grouped as follows:—

(*a*) Pod bearers (peas, beans).
(*b*) Fibrous rooters (cabbages, cauliflowers, etc.).
(*c*) Deep rooters (carrots, parsnips, beets, etc.).

In addition to the small plots provided for each pupil, provision should be made for the cultivation of those vegetables and salads for which there is no space in the pupils' plots.

Further space will be required for herbs, a few fruit trees, some examples of agricultural crops, a nursery plot to serve as a seed bed, another for demonstration of propagation by cuttings, budding, grafting, etc., and lastly a plot where simple experiments of various kinds enumerated and explained elsewhere can be carried out.

Wooden pegs eighteen inches long by $1\frac{1}{2}$ inches square, pointed at one end, and painted, tarred, or treated with creosote, may be used to mark off each plot. Where there is a school joinery class these might be made by the pupils.

If ashes, gravel, clinkers, stones, or other material are available for the paths, then the soil where the paths are to be made may be removed, otherwise it should be left; the constant treading will soon consolidate it. The edges of the paths may be kept in order by using 4-inch deal boards (treated with some preservative such as creosote or tar), or bricks, stones, slates, or tiles; or living edges may be formed with suitable dwarf plants—for which see Chapter XV.

PLAN OF SCHOOL GARDEN, BANNOCKBURN, STIRLINGSHIRE. Scale, 1 in. = 20 ft.

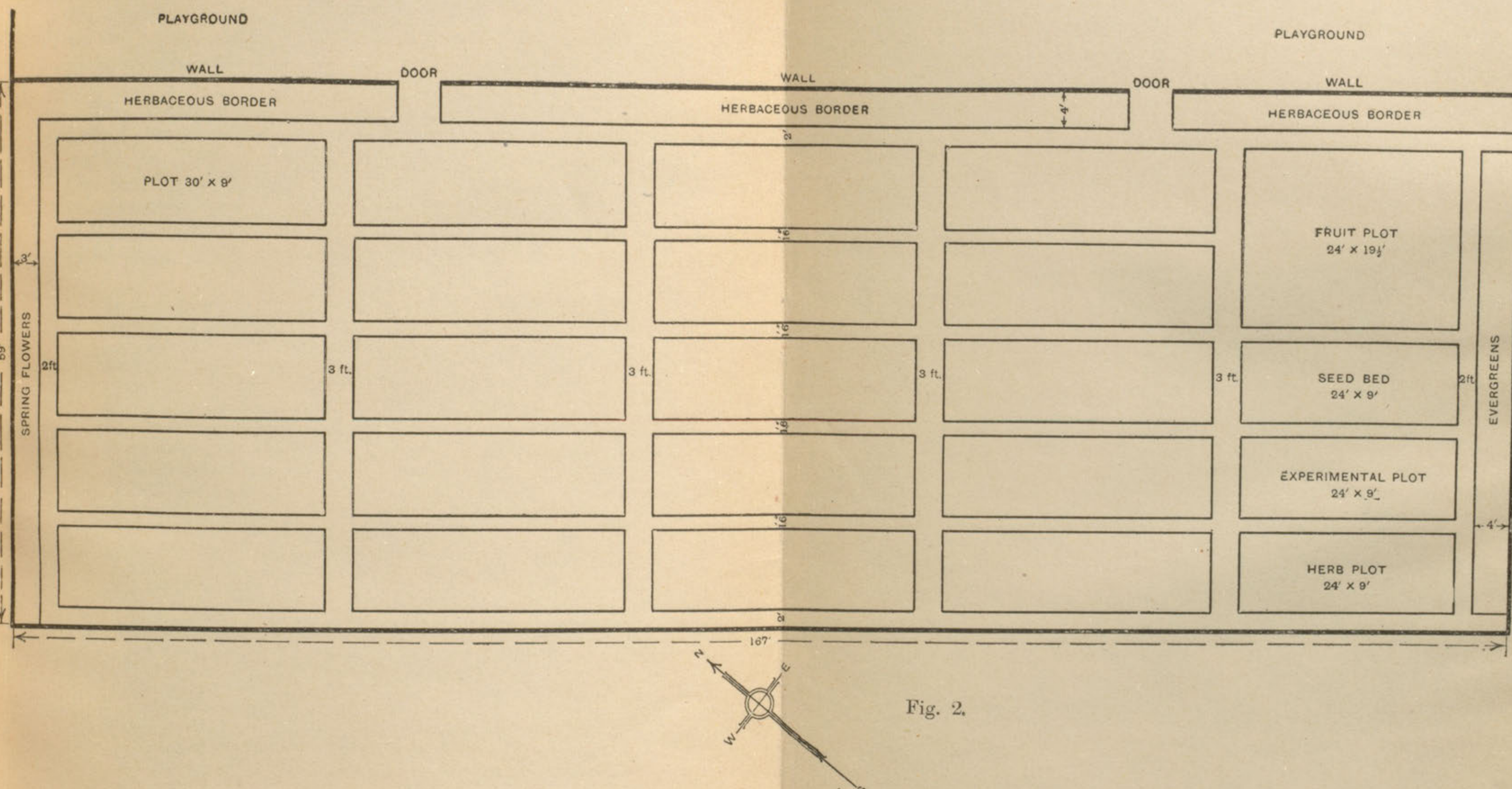


Fig. 2.

In laying out the garden, however, much will depend upon the configuration of the land, so that no hard and fast rule can be laid down as to the number, size, and direction of the plots. The number of plots will depend upon the number of pupils and the area of land at disposal. When the plots are formed, the pupils should measure the garden, and each make a plan drawn to scale, showing all the plots. Detailed plans showing the cropping of the plots should also be made.

The Cost of Establishing a School Garden.—The initial cost of establishing a school garden will vary according to the system of laying out, the condition of the land, the number of pupils available for gardening, and the requirements of the Local Education Authority. Below will be found details of the cost of tools, etc., for a garden of 10 plots, sufficient for ten to twenty pupils:—

	£	*s.*	*d.*
10 Spades, No. 1, 2s. each	1	0	0
10 Digging Forks, 4 pronged, 2s. each	1	0	0
10 Draw Hoes, 6 inch, handled, 1s. each ...		10	0
10 Dutch Hoes, 5½ inch, handled, 1s. each ...		10	0
10 Rakes, handled, 1s. each		10	0
10 Trowels, 6d. each		5	0
10 Hand Forks, 6d. each		5	0
10 Small Dibbers, 2d. each...		1	8
2 Birch Brooms, handled		1	0
1 Billhook		2	0
1 Watering Pot		2	4
1 Garden Line with reel complete		2	0
3 Measuring Rods, 4 feet long		1	0
1 Wheelbarrow	1	0	0
1 Large Rake, about		2	6
Pea sticks, or wire netting for peas, say ...		5	0
Manure, say		14	0
Seeds, Tubers, Wood labels, etc., about ...		13	6
Sussex or Trug Basket, about		1	6
Spray Syringe		8	6
Fruit Trees, say	1	1	6
24 Hardy Plants or Herbs, say		6	0
Tool and Potting Shed, £3 to £10, according to size, say	5	0	0
Total	£14	2	6

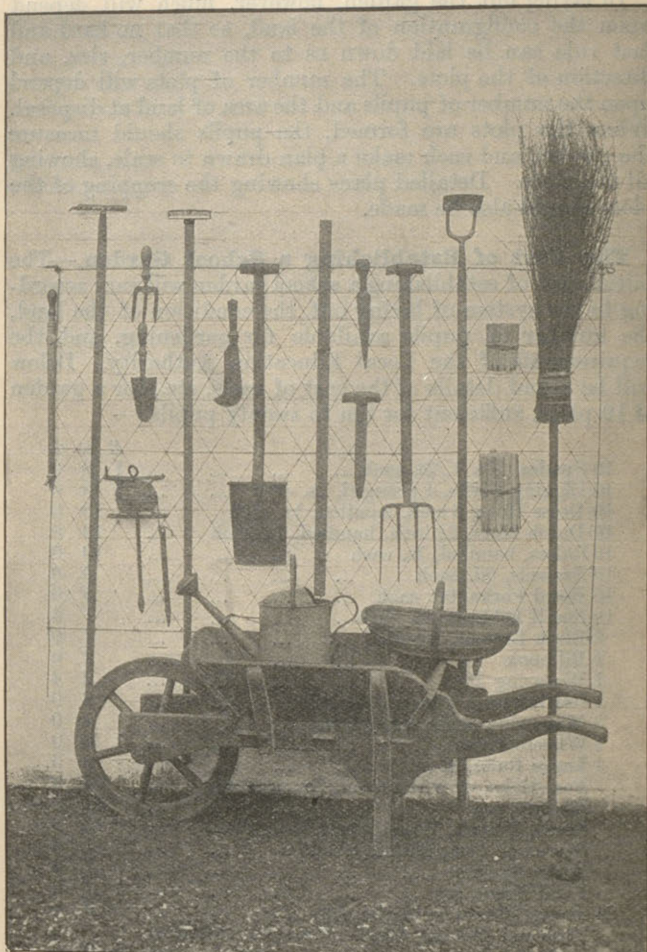


Fig. 3.—A Set of Tools suitable for a School Garden.

It will be seen from the foregoing statement that a sum of about £14 represents the initial cost of equipment for a school garden, and of carrying it on for the first year. In many cases, however, a much smaller sum will suffice.

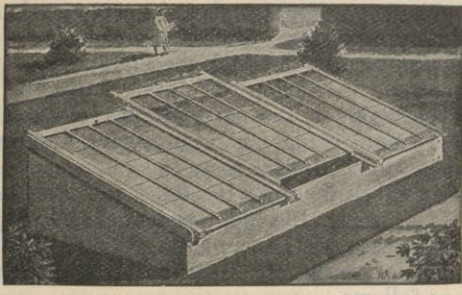


Fig. 4.—Garden Frame.

But, on the other hand, where draining, levelling or trenching are necessary, and also a charge is made for rent of the land, then the cost will be slightly increased.

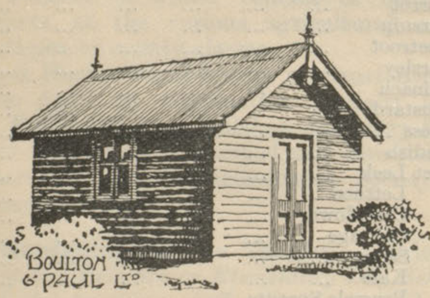


Fig. 5.—Toolhouse and Potting Shed.

Where there are two classes in school gardening, then, for the sake of economy, one set of tools will suffice for both, but a double set of plots should be provided.

A garden frame will prove useful in the spring for rearing seedlings of leeks, celery, onions, cauliflowers, tender annuals, etc.; for growing tomatoes or cucumbers in summer, and for preserving tender plants through the winter.

A ready-made frame (Fig. 4) will cost 20s. to 60s. according to size and quality. But when there is a joinery class a suitable frame may easily be made by the pupils. A small greenhouse finds a place in some gardens, but is not absolutely necessary. See Fig. 7, page 15.

It is desirable that the tool shed (Fig. 5) be provided with a bench for use during wet days. A similar bench or shelf on the outside of the shed will be found convenient for label writing, sorting, etc., even during fine weather.

In addition to the initial cost, the annual outlay after the first year will be about £2 10s. 0d., made up as follows:—Manure, 14s.; seeds, 13s. 6d.; pea sticks, 5s.; painting, repairs, and breakages, 14s.; plants, 3s. 6d.

Particulars of seeds, etc., required per annum for ten plots are as follows:—

	s.	*d.*
1½ pints Peas	1	6
1 pint Broad Beans (9d.) and ½ pint French Beans (5d.)	1	2
1 oz. Turnip		3
½ oz. Onion		4
½ ,, Carrot		3
½ ,, Parsnip		3
½ ,, Beetroot		3
½ ,, Parsley		2
1 ,, Spinach		2
2 ,, Mustard		4
2 ,, Cress		6
2 ,, Radish		6
1 packet Leek		3
1 ,, Lettuce...		2
1 ,, Cauliflower		3
1 ,, Cabbage		2
1 ,, Savoy		2
1 ,, Kale		2
1 ,, Brussels Sprouts		2
6 ,, Culinary Herbs		6
30 ,, Flower Seeds	2	6
14 lb. Potatoes (for one row) say	1	0
300 Wood Labels, 6 inch...	2	0
Extra seeds if required		6
	13	6

The cauliflower, cabbage, and allied plants may either be raised from seed, or plants purchased locally. The latter cost 1s. per hundred or more, according to kind. Collections of seeds, tubers, wood labels, etc., to meet the requirements of school gardens may be obtained at a slightly cheaper rate through some County Education or Agricultural College Committees, who contract with seedsmen for large quantities at reduced rates.

Qualifications of Teachers.—It is desirable that teachers of a class in gardening should possess a certificate or diploma in horticulture, or rural science. This, however, need not be insisted upon if the teacher has a practical acquaintance with the subject, and is enthusiastic in such work, especially in view of the fact that gardening is intended to be educational, and to be correlated with other subjects taught. At the same time good culture of the crops, neatness, cleanliness, and method should, as far as possible, go hand in hand with the educational side of gardening. Such certificates and diplomas as those referred to above are obtainable by attending summer or winter courses of instruction in rural subjects at the various agricultural and horticultural colleges or county classes.

The Royal Horticultural Society of Great Britain holds annually in April an examination specially for school teachers. Full particulars, syllabus, and entry forms may be obtained by sending a stamped and directed envelope to the Secretary, Royal Horticultural Society, Vincent Square, London, S.W.

Where Gardening may be Taught.—Gardening may be taught at (1) *Primary or Elementary Day Schools* by a member of the teaching staff, who must work with his pupils and set them a good example. If the teacher has not sufficient knowledge nor any natural liking for the subject, it would be better to engage the services of a fully qualified gardener.

(2) The subject may also be taught at *Evening Schools* as an ordinary continuation class subject. This is done

by practical work in the garden during the spring and summer months (a plot being allotted to each student). In the winter a course of lectures or lessons on the principles of horticulture may be given in the schoolroom. (See chapter on Evening School Gardens.)

(3) *Secondary Schools.* Gardening may also be taught at these schools, in which case a special teacher—generally a highly qualified gardener—is employed for the purpose. The work done is both practical and theoretical, and includes land surveying, laying out and forming gardens for flowers, fruit and vegetables.

The question is sometimes asked why local gardeners are not also employed for elementary schools. The best answer to this is that it is not intended to make skilled or professional gardeners of the pupils, but to arouse in them an interest in nature and rural life generally, and to correlate, as far as possible, other school subjects with that of gardening. This can best be done at an elementary school by a member of the regular teaching staff.

Giving the Instruction.—Experience has shown that the teacher can attend to the pupils in the garden, even in small country schools, without the rest of the school work being detrimentally affected. It is generally found to be most convenient to arrange that gardening should be taken as the last lesson on one or two afternoons in each week, although the class may in some cases be held at other times. As a rule, three hours in all per week should be allocated to this subject, and the lessons may be given when the other pupils are drawing, or in the time otherwise devoted to nature study, of which it is but a practical form.

The teacher should encourage his pupils to ask questions and to point out to him any peculiarity in the growth, etc., of the crops.

He should make quite clear to the class what is proposed to be done at each lesson, and, as far as possible, explain the why and wherefore of the various operations as they are performed.

One or two lessons, each of one to three hours' duration, may be given weekly during the spring or summer months or throughout the school year.

During wet or unsuitable weather the lesson may be postponed, a note being made in the "log book" to that effect, or a lesson may be given in the schoolroom or potting shed on some subject such as seed sowing, thinning seedlings, "pricking off" seedlings in boxes, making cuttings, making labels and seed packets, mixing composts, potting, budding, grafting, and cleaning and storing seeds in packets for future use.

For this purpose the various roots, stems, leaves, tubers, bulbs, etc., from the garden should be employed to illustrate the lesson. After the removal of the crops in autumn, the pupils may be instructed, when the condition of the soil and the state of the weather are favourable, in the digging, trenching, or manuring of the soil for the crops of the succeeding year.

It is advisable to interest the whole school in the work, and the scholars should accordingly be encouraged to visit the garden periodically, but they should, during the visit, be under the supervision of one of the teachers.

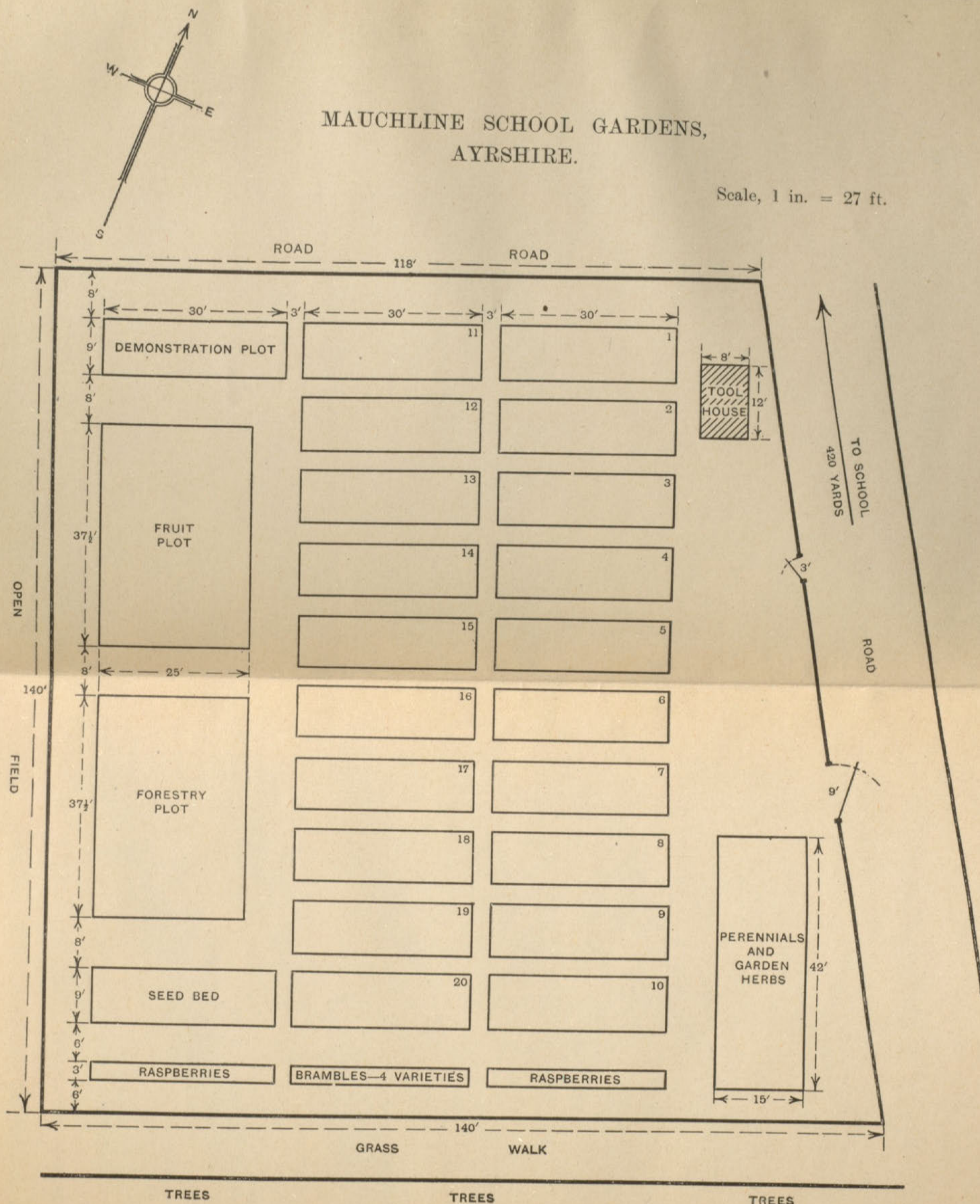
Girls in the Gardening Class.—When gardening was introduced into elementary schools, it was with the intention of giving the pupil a working knowledge of the subject; and it was thought, therefore, to be a subject fitted only for boys. Since those days, and with the introduction of nature study into schools, educational authorities have advocated school gardening not so much as a special subject but rather as a living adjunct to the school, and one which may be correlated with the three R's and other subjects. If gardening, therefore, is educational for boys, it is just as educational for girls. If boys require a change from the desk to the open air, so also do girls; if boys are intended for outdoor life in after years, so are many girls, and work in the open air is perhaps more suitable for girls than work in mills, factories, or workshops.

Many women find employment on the farm at harvest time and during the fruit or potato season, and in the bunching of flowers for market. Moreover, women often undertake the care of the garden or orchard, and the management of poultry in connection with the farm or cottage. Many also enter training colleges, or other institutions, where they can obtain a knowledge of agriculture or horticulture—practical and scientific—with a view to taking up these subjects seriously as a means of livelihood.

On these grounds it is surely reasonable to include girls in a gardening class, as is already done in various parts of the world. At schools where provision is made for laundry, cookery, and sewing, girls would naturally take part in such work, but where no such provision is made, it is sometimes found difficult to provide for them whilst boys are at gardening. In such cases the girls may take a plot each the same as boys, or they may have flower plots of about ten square yards, or small beds for useful herbs, or the flower borders around the school buildings may be looked after by the girls, a section each, and window boxes or tubs for flowers outside the school may also be cared for by them. Such borders might be planted with annuals and perennials, including a few bedding plants and climbers on the walls.

Care of the School Garden during the Summer Holidays.—Experience has shown that where gardens have been kept in a clean state of cultivation for several years little harm will accrue to the crops, and weeds will not become very troublesome during the holidays, especially if, prior to breaking up, the garden receives a thorough cleaning in order that no weeds are left to grow and choke the crops, or to produce seed. Immediately on resuming after the holidays, all large weeds should be removed by hand, and the ground thoroughly hoed and raked.

Some gardens, however, that have not received the same attention in the matter of careful cultivation may require to be seen to during the vacation. The pupils,



N
W
E
S
MAUCHLINE SCHOOL GARDENS,
AYRSHIRE.
Scale, 1 in. = 27 ft.
ROAD
118′
ROAD
8′
30′
3′
30′
3′
30′
9′
DEMONSTRATION PLOT
11
1
8′
TOOL HOUSE
12′
12
2
13
3
TO SCHOOL
420 YARDS
FRUIT PLOT
37½′
14
4
3′
OPEN
15
5
ROAD
8′
25′
140′
16
6
FIELD
FORESTRY PLOT
37½′
17
7
9′
18
8
19
9
8′
PERENNIALS AND GARDEN HERBS
42′
SEED BED
9′
20
10
6′
3′
RASPBERRIES
BRAMBLES—4 VARIETIES
RASPBERRIES
6′
15′
140′
GRASS
WALK
TREES
TREES
TREES

Fig. 6.

where convenient, sometimes visit the garden once a week, in order to attend to any pressing work. In certain instances arrangements may be made with the janitor or caretaker to keep the plots and garden tidy during the holiday period, or the services of a local gardener, or handy man, may be requisitioned one day per week for a like purpose. It is questionable, however, whether any of the different modes of procedure alluded to are desirable, except in extreme cases, as a valuable object-lesson for the pupils may be obtained by observing the various effects entailed on their plots owing to their enforced absence.

Disposal of the Produce.—In some cases the produce may be sold and a strict account kept of moneys received and expenditure for seeds, pea sticks, manures, etc., but it is frequently found that, owing to the large number of kinds grown, and the small quantity of each, the returns are scarcely worth the trouble; besides in many places there is considerable difficulty in disposing of produce in this way, as many cottagers have their own gardens.

It seems best, therefore, not to attempt the selling of the produce, but the teacher should allow the pupils to take the crops they have grown—only, however, when fit to gather. In this way the children are encouraged in their work by being able to exhibit to their parents what they have grown.

Prizes.—The giving of prizes, by the head teacher or some public-spirited person, for the neatest and best cultivated plot in a school garden creates much interest among the pupils, not only those taking gardening, but of the whole school.

It does not, however, seem desirable to offer prizes for the best kept garden, as a whole, in a county or group of counties, as the character of the soil and climate varies so much in different localities, and accordingly no fair comparison can be made.

Classes at which the pupils may compete are sometimes provided in connection with the local flower show. It should be possible to organise in connection with large schools either an annual flower show or some form of competition for the produce grown. For rules and regulations some schedule issued by a horticultural society should be consulted, or a copy obtained of the Rules for Judging, issued by the Royal Horticultural Society, 1s. 6d. post free.

CHAPTER II.

THE MANAGEMENT OF THE SCHOOL GARDEN.

Commencing Work.

In order to facilitate the work of planting and sowing when the time comes, it is advisable to have everything in readiness, such as tools, pegs, tallies, seeds, manures, etc.

The wooden labels or tallies may have the names of the crops written on them, and be placed in position beforehand in accordance with the scheme of cropping shown on the

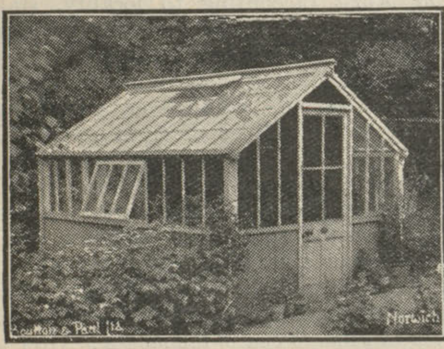


Fig. 7.—A Small Greenhouse.

plans. They should be thinly painted on one side, and if possible, whilst the paint is still wet, have the name and date of sowing neatly written upon them, using a soft pencil (not ink).

In the spring, as soon as the weather is suitable, outdoor work may be begun and the ground prepared for broad beans, peas, potatoes, celery, leeks, onions, and shallots.

If a greenhouse (Fig. 7), hotbed, or garden frame is available, seeds may be sown in March or April, in order to have early plants for planting out, of the following: Onions, leeks, celery, sprouts, cauliflower, savoy, and lettuce.

In April, savoy, kale, sprouts, cabbage, colewort, broccoli, cauliflower, leeks, and lettuce may be sown outside on a special seed bed, in a warm, sunny, sheltered position. These will be ready for transplanting in from four to six weeks. The cabbage tribe do better when transplanted to other beds before being planted in their permanent quarters.

Half hardy annuals may be sown in pots or boxes and placed in frames. When large enough to handle, they should be pricked off in boxes, eventually being hardened off, and planted out early in June.

The following is the order in which the various crops may be planted or sown on each plot:—

March or April (according to locality, state of the weather, kind of soil, etc.): Broad beans, green peas, early cabbage, kale, onions, shallots, parsnips.

April or May: Radish, spinach, mustard, cress, potatoes, turnips, carrots, sprouts, cauliflower, parsley and other herbs, grasses and examples of farm crops; also hardy annuals.

Middle of May to first week in June: Scarlet runner beans and French beans, which are very susceptible to frost, should now be sown, also beetroot, colewort, and lettuce, the latter on a seed bed for succession. A second sowing of radishes, mustard, cress, and spinach may be made, for succession, if space can be found for them.

First week in June to end of the month: After the spring frosts are safely past, runner beans, French beans, celery, and tender annuals and bedding plants may be planted out from the greenhouse or frames.

The ground at all times should be kept clean and free from weeds by hand weeding and hoeing. The edges of the plots may be preserved by means of a spade and the garden line.

Fig. 8.—The School Garden, Bannockburn, Stirlingshire. (Early Summer.)

Crops which may be Grown on each Pupil's Plot and Time of Sowing (see Plans of Cropping).

(*a*) *Vegetables:—*

(A selection will have to be made, as it is scarcely possible to represent so many kinds on an average sized plot.)

Potato, early variety.—Plant March to April.
Potato, main crop variety.—Plant March to April.
Turnip: white, yellow, and purple top varieties.—Sow seed for succession, April to July.
Carrot.—April to May, and again in July.
Parsnip.—March to April.
Beet.—April to May.
Onion.—Under glass January to March, or outdoor March to April, and again in August.
Leek.—February to March under glass, or outdoor April to May.
Celery.—Sow under glass March to April.
Peas.—March to June.
Broad Beans.—February to April.
Dwarf, French, or kidney bean.—Sow in May, or under glass in April.
Scarlet runner bean.—Sow in May, or under glass in April.
Cabbage, summer and autumn varieties.—April.
Cabbage, for spring and early summer use.—July to August.
Red cabbage for pickling.—April and July.
Savoy.—April.
Cauliflower.—March to April.
Broccoli.—April to June.
Brussels sprouts.—April.
Scotch kale or curly green.—April and July.
Spinach.—March to July.
Colewort.—April and July.

(*b*) *Salads:—*

Lettuce, radish, mustard and cress.—Sow in succession March to July.

(c) *Flowers*:—

Sow or plant a few kinds at one end of each individual plot or on a special flower border.

Plants for the Demonstration Plots, etc.

(a) *Herbs and Miscellaneous Plants*:—

Parsley, sage, mint, thyme, balm, chervil, marjoram, savory, rosemary, rue, wormwood, lavender, artichoke, asparagus, seakale, rhubarb, horseradish, shallot, chives, garlic, etc.—Sow or plant March, April, or May.

(b) *Fruits*:—

Apple, pear, plum, damson, black currant, red currant, white currant, gooseberry, raspberry, strawberry, brambles, such as parsley-leaved, loganberry and Japanese wineberry.—These may be planted in autumn or spring (see plans of fruit plots).

(c) *Flowers*:—

Annuals, biennials, perennials, bulbs, bedding plants, shrubs and climbing plants.

(d) *Agricultural Plants*:—

Wheat, barley, oats, mangel, swede, clovers, beans, grasses, etc.

(e) *Trees and Shrubs* for a Forestry Plot (Fig. 14):—

A few typical kinds if space can be found for them.

Plans of Cropping.

Notes on Cropping the Plots.—Crops enclosed in brackets ( ) are intercrops coming into use before the main crops are ready. When it is thought desirable to provide a succession of crops either for summer or winter use, the following examples may be found of use. It should be borne in mind, however, that winter crops—greens, leeks, etc.—will probably occupy the land when the necessary digging operations should be performed, thus rendering this task more difficult of accomplishment.

Radishes may be succeeded by another sowing of parsley, or by planting leeks, lettuce, etc.

Lettuce may be succeeded by radishes, turnips, or carrots.

Early turnips may be followed by lettuce or leeks.

Early potatoes by winter greens or leeks.

It is not essential that all the pupils' plots should be planted in exactly the same order. Some may be sown as shown on the first plan and others as per second and third years plans, thus illustrating a three years' system of rotation.

Number of fruit trees, etc., on fruit plot (Fig. 12), with their approximate cost:—

	s.	d.
3 Apples	4	6
1 Plum	1	6
1 Pear	1	6
5 Gooseberries at 3d.	1	3
5 Black Currants at 3d.	1	3
2 Red Currants at 3d.		6
2 White Currants at 3d.		6
5 Brambles	2	6
10 Raspberries	1	3
40 Strawberries	2	0
	16	9

Cost of fruit trees for plot 40 feet by 40 feet (Fig. 13) :—

		s.	d.
4 Apples on Crab stock...		6	0
3 Apples on Paradise stock		4	6
1 Pear		1	6
1 Plum		1	6
12 Gooseberries		3	0
9 Black Currants		2	3
3 Red Currants			9
3 White Currants			9
20 Raspberries		2	6
20 Strawberries		2	0
2 Loganberries		1	6
3 Parsley-leaved Brambles		1	6
3 Common Brambles		1	6
2 American Brambles		1	0
	£1	10	3

Plans of Cropping. *Individual Plot showing Method of Cropping.*

(N.B.—The crops are to be sown or planted on the lines, not in the spaces between them.)

← **9 Feet.** →

30 Feet.

18″	(Radishes on Edge of Plot.)		Sow in Drill 3″ to 4″ wide.
	Broad Beans.	18 Seeds.	Sow seed 3″ to 4″ deep.
18″	(Spinach.)		Sow in Drill 3″ to 4″ wide.
18″	Green Peas (Tall or Medium).		Sow thinly 2″ to 4″ deep in a wide Drill.
1′	(Mustard and Cress.)		Half a Row of each; sow similar to Radish.
18″	Green Peas (Dwarf) or French Beans.		Sow thinly 2″ to 4″ deep in a wide Drill.
1′	(Lettuce.)	9-12 Plants.	Plants from Seed-bed or Frame.
18″	Cabbage.	6 Plants.	
2′	Cauliflower or Broccoli.	6 Plants.	
2′	Kale.	6 Plants.	
18″	Savoy or Brussels Sprouts.	6 Plants.	
18″	Turnips.	Thinned to 9-18 Plants.	Sow in Shallow Drill 1″ deep.
2′	Potatoes.	6-7 Sets.	Plant Sets 4″ to 6″ deep.
2′	Leeks.	12-18 Plants.	Plants from Seed-bed or Frame.
15″	Onions.	18 Plants.	Sow in very Shallow Drill and thin out, or Plant Onion Sets or Seedlings.
18″	Parsnips.	Thinned to 12-18 Plants.	Sow thinly, or 4 Seeds every 6″ to 9″.
15″	Carrots.	Thinned to 15-18 Plants.	Sow thinly 1″ deep.
18″	Beetroot.	Thinned to 12-18 Plants.	Sow in a similar manner to Parsnips.
1′	Parsley.	12-18 Plants.	Sow thinly, or Transplant from Boxes.
3′	Several Kinds of Flowers in Lines, Circles, or Semicircles.		

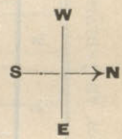


Fig. 9.—First Year's Cropping.

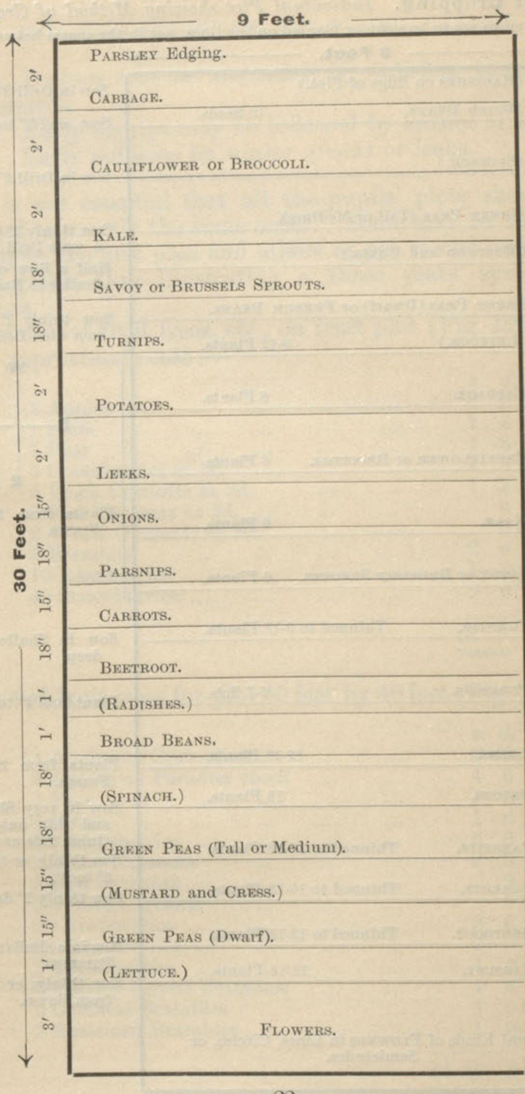


Fig. 10.—Second Year's Cropping of an Individual Plot.

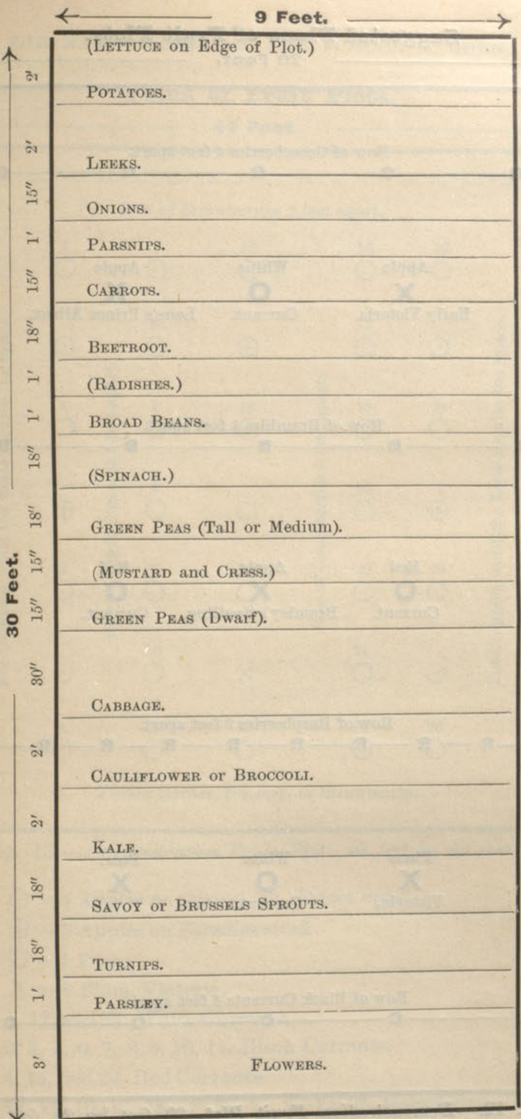


Fig. 11.—Third Year's Cropping of an Individual Plot.

Suggested Plans of Fruit Plots.

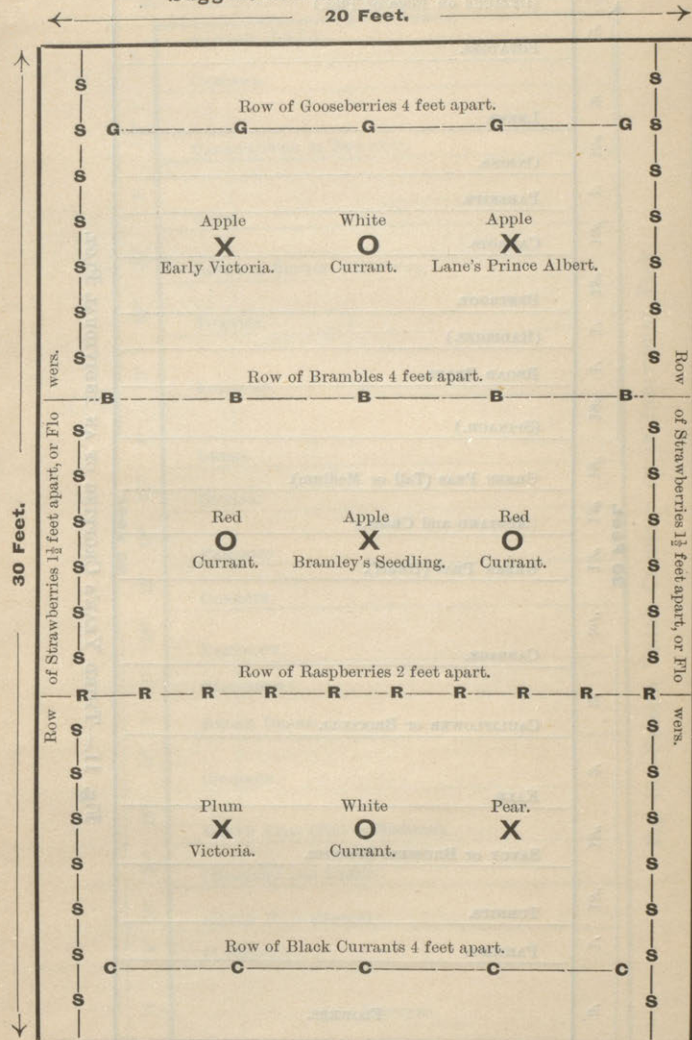


Fig. 12.—*Demonstration Fruit Plot,* 30 *feet by* 20 *feet.*

Plans of Fruit Plots.

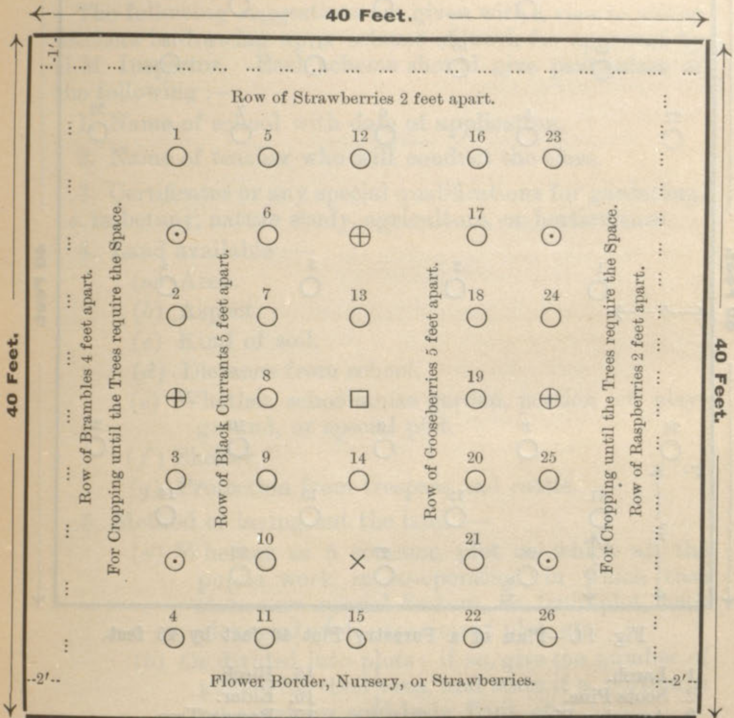


Fig. 13.—*Demonstration Fruit Plot*, 40 *feet by* 40 *feet.*

⊙ = 4 Apples on Crab stock, 20 feet apart.

⊕ = 3 Apples on Paradise stock.

□ = 1 Pear.

× = 1 Plum, Victoria.

1, 12, and 23, White Currants.

2, 3, 5, 6, 7, 8, 9, 10, 11, Black Currants.

4, 15, and 26, Red Currants.

13, 14, 16, 17, 18, 19, 20, 21, 22, 24, 25, Gooseberries.

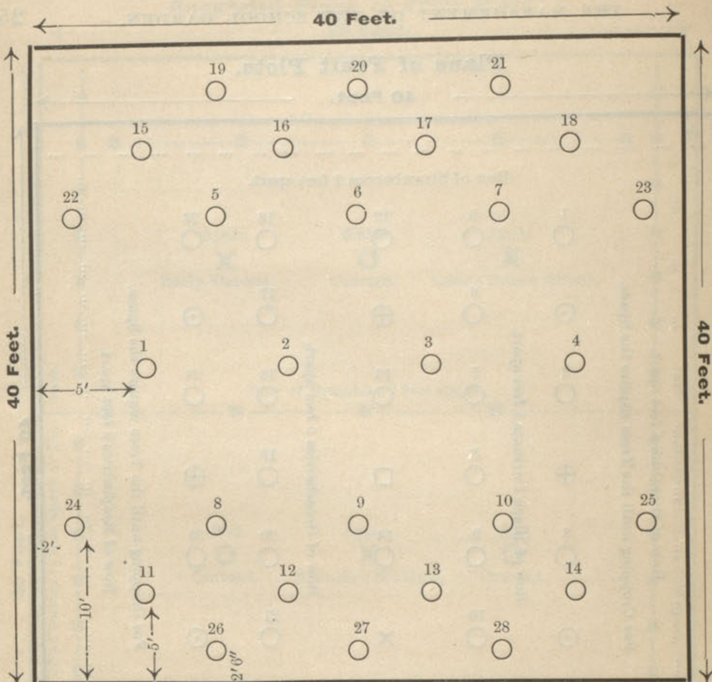


Fig. 14.—**Plan of a Forestry Plot 40 feet by 40 feet.**

1. Larch.
2. Scots Pine.
3. Austrian Pine.
4. Sycamore.
5. Ash.
6. Silver Fir.
7. Oak.
8. Beech.
9. Common Spruce.
10. Elm.
11. Willow.
12. Lime.
13. Poplar.
14. Yew.
15. Birch.
16. Elder.
17. Rowan Tree.
18. Holly.
19. Buckthorn.
20. Barberry.
21. Cherry Laurel.
22. Hazel Nut.
23. Broom.
24. Juniper.
25. Lawson's Cypress.
26. Butchers' Broom.
27. Lilac.
28. Guelder Rose.

The cost will be from 4d. to 1s. each, according to size and kind.

Schemes of Work.

The following suggestions are given with a view to aiding teachers in drawing up a scheme of work for approval by H.M. Inspector. Each scheme should give particulars of the following :—

1. Name of school with date of application.

2. Name of teacher who will conduct the class.

3. Certificates or any special qualifications for gardening, *i.e.* in botany, nature study, agriculture, or horticulture.

4. Land available :—

(*a*) Area.
(*b*) Aspect.
(*c*) Kind of soil.
(*d*) Distance from school.
(*e*) Whether schoolhouse garden, portion of play-ground, or special plot.
(*f*) Shelter.
(*g*) Protection from trespass and cattle.

5. Method of laying out the land :—

(*a*) Whether as a common plot on which all the pupils work in co-operation, in which case state any special feature, *i.e.* fruit plot, herb plot, seed plot, experiment plot, etc.
(*b*) Or divided into plots; if so, give the number of plots with their area, and state if a portion is set apart for seed-beds, fruit, etc.
(*c*) Or whether as a combination of common plot and individual plot.

6. Nature of the crops to be grown, giving a list of the vegetables, herbs and fruits, and stating whether, in addition, flowers are cultivated.

7. Number of pupils available for gardening (not to exceed 20 for one teacher at any lesson in Scotland; 14 pupils is the limit for one teacher in England); whether they work singly, in pairs or in co-operation, and how the attendance is to be kept.

8. Number of hours and lessons per week devoted to this subject.

9. General equipment of the garden, viz. a list of tools, giving number of spades, forks, rakes, hoes, etc., and stating whether there is a wheelbarrow, tool shed, or a garden frame.

10. Who provides the seeds, plants, trees, manures, and tools?

11. How is the produce disposed of, *i.e.* given to the pupils, sold, or used in connection with the cookery classes?

12. Describe how the pupils are to record their work and observations.

13. State how it is proposed to provide for those pupils taking gardening a second or a third year.

> *Example:* In the first year they may work their own plots; in the second or third year they may work on the demonstration plot or fruit plot, and take part in propagation, manuring, and any experiments conducted, or additional practice may be given on the individual plots.

14. A sketch or plan of the proposed garden should be submitted with the scheme.

15. The practical work to be performed, *i.e.* trenching, digging, hoeing, mulching, manuring, seed sowing, transplanting, pruning, propagation, etc., and also the proper care and use of the various garden tools provided.

16. Correlation with other subjects, *i.e.* showing how it is proposed to correlate school gardening with such subjects as—

> Composition, arithmetic, mensuration, drawing, nature study, cookery or woodwork. (See next chapter.)

17. Winter work, *i.e.* what is proposed to be done during the winter months. (See notes on winter work, page 48.)

> NOTE.—In drafting a scheme of work it is important that the Code Regulations of the Board of Education (England and Wales) or of the Scotch Education Department (Scotland) be consulted in conjunction with the requirements of the Local Education Authority.

CHAPTER III.

CORRELATION WITH OTHER SUBJECTS. PUPILS' NOTE-BOOKS.

At many points school gardening comes into close touch with other subjects of the school curriculum such as nature study, drawing, dictation, composition, arithmetic, mensuration, wood-work, etc., and should therefore, as far as it is practicable, be correlated with these subjects.

Correlation with Drawing.

Brush or pencil drawings of flowers, vegetables, fruits, seeds, weeds, insects, garden implements, etc., or of some of the more important operations performed in the garden, such as budding, grafting, layering, making cuttings, or methods of planting and pruning trees or shrubs. The pupils should make rough sketches in their note-books of these or anything else that comes under their notice.

Correlation with Nature Study and Botany.

The garden will supply many interesting subjects for more detailed study in the class-room, *e.g.* the germination of different kinds of seeds, such as peas, beans, onions, mustard, etc., the keeping of exact data as to time of sowing, period before germination takes place, and the conditions found necessary, *i.e.* air, heat, moisture, etc. Life histories of a few typical insects, or of some common plant disease. Careful comparison of a few typical plants, of the common natural orders or groups of plants, such as the pea and bean family, cabbage family, parsley family, etc., showing the reasons for placing them in their respective groups.

Comparison of local soils, also of weeds found in or near the garden (see special list); reason why some weeds spread so quickly, *e.g.* groundsel, chickweed, couch grass, etc. Note which birds are of common occurrence.

Observations of habits and date of first appearance of bees and other insects in the garden. Bee-keeping is a very interesting and profitable adjunct to the school garden; bees are of great importance in conveying pollen from flower to flower, thus giving a greater yield of fruit. Note the kinds most commonly visited (see Chap. XV.). Weather observations may also be taken note of, *i.e.* rain gauge, barometer, maximum and minimum thermometers, direction of wind, etc. The teacher should encourage the pupils to look beyond the precincts of the school garden and to note the best and most suitable varieties of farm and garden crops and fruit trees suited to the district, while an interesting study could be made of the common grasses—useful and useless kinds—(see Chapter XXIII.) found in fields or highways. Local methods of cultivation should be discussed; also the date when certain operations are performed locally.

The pupils should be encouraged to notice for themselves the appearance of the onion fly maggot, carrot fly maggot, cabbage root maggot, bean aphis, cabbage caterpillars, etc.

Pupils should be asked to bring to school specimens of flowers, fruits, leaves, grasses, or anything of interest. These may form the subject of a lesson for discussion or drawing. Some of the specimens may be kept for future reference.

A collection of the weeds found in the garden or in the district could be made when well in flower, and carefully pressed by laying them between sheets of blotting-paper, old newspapers, or any kind of absorbent paper, and placing a board with weights, bricks, stones, or something very heavy on the top. They should be examined and changed frequently until they are quite dry, after which they may be mounted on sheets of hard white paper of demy size. Fish glue or gummed strips of paper may be used to fasten them to the sheets. Due regard must be paid to the length and breadth of the specimens before pressing.

Dried specimens of plants should be kept in a dust-proof cabinet and stored in a dry place: as a further precaution against attacks of insects they should be brushed over with a solution of 1 oz. corrosive sublimate, 1 oz. carbolic acid, and 1 quart of methylated spirits.

Correlation with Arithmetic and Mensuration.

Careful measurements of the whole garden and of the various plots should be made by the pupils, and afterwards drawn to scale. Produce from any given area may be weighed and calculations made as to the quantity an acre or a rood would be expected to yield. "Profit and Loss" accounts might be kept of the produce from the plots, and expenditure in purchasing seeds, manures or plants.

Numerous problems should be set, the following being a few examples:—

1. A cubic yard of ordinary garden soil weighs 1 ton. Find the weight of soil moved in trenching to a depth of 2 feet a plot 30 feet by 9 feet.

2. Find the quantity of artificial manure required for 10 plots each 30 feet by 9 feet if the manure is applied at the rate of 1 lb. per 5 square yards.

3. To find the quantity of artificial manure required for a plot (or all the plots of the garden) when applied at the rate of

1 oz. per square yard
2 oz. "
3 oz. "

4. Find unit values of manure, *e.g.* compare value of nitrogen in nitrate of soda (containing 15 per cent. of nitrogen) selling at £12 per ton and the value of nitrogen in sulphate of ammonia (containing 20 per cent. of nitrogen) at £14.

5. Mixture of manures.

A mixture of 5 lb. superphosphate
2 lb. sulphate of ammonia
3 lb. kainit

is applied to 40 square yards of a potato crop. Find quantities of each manure required for $\frac{3}{4}$ acre, for 5 acres, etc.

6. Calculate rates per square yard when manure is applied at the rate of

1 cwt. per acre
$1\frac{1}{2}$ cwt. ,,
$2\frac{1}{4}$ cwt. ,,

7. What fraction of the whole area of the school garden is taken up by the walks?

8. Find the area of any given piece of ground.

9. Find the cost of cartage at 1s. per cubic yard of sufficient gravel to cover the paths in the garden to an average depth of $1\frac{1}{2}$ in. (For area of paths see No. 7.)

10. Given a quantity of seed the pupil

1. Weighs same and makes note of weight (some fraction of oz.).
2. Takes note of length of drill sown with this weight of seed.

From these data the pupil may calculate

1. Quantity of seed required to sow down half an acre after distance apart of rows had been decided upon.
2. What length of drill given quantity of seed will sow, and thence what convenient area could be sown.

11. Comparison of local weights and measures with Imperial or Standard weights and measures.

Note.—These are not meant to be *set* examples, but may convey some hints as to how questions may be made up—the best time for propounding a sum being after a pupil has carried out some piece of work and made careful note of result, though to find cost of manures for large area, and crop from large area, might be the problem suggested first, and the pupil be asked to experiment on a small scale.

Correlation with Reading and Composition.

Pupils should keep note-books in which they enter in their own words what they have done or observed in the garden from day to day, detailing depth, distance apart, when crop was sown, when mature, etc.

Such notes might form an exercise in composition at some future time, the pupil writing out a complete account of the life-history of some common pest, insect or weed, or the cultivation of some common garden crop grown by the pupils.

The pupils could read in some gardening book or periodical full particulars of any crop or of any particular operations on which they are engaged.

Correlation with Wood-work.

During the winter months wood-work might very well take the place of gardening. Lessons on trees and timber could be given, and for this purpose a few typical trees might be grown on the school premises, so as to familiarise the pupils with the habit, kind of bark, shape of the leaf, etc.

The course of wood-work models could be designed with special reference to the garden, without losing any of the educational value. The boy would know that the results of his work would be useful in the garden. The following are examples of work that may be done:—

Mending broken tool handles, making labels (tallies), stakes for dahlias and other plants, stakes for corners of the plots, window boxes, garden frames, propagating frames, dibbers, wooden palings, footscrapers, trellis work, and cabinets for storing seeds, fruits, botanical specimens, etc. Boxes for seed sowing, for transplanting seedlings, or for sprouting potatoes. Deep boxes, with sliding glass fronts for observation of germination, etc.

The making of such articles has a distinct utilitarian value, and is, perhaps, of greater educational importance than many of the pipe racks, paper knives, and rulers so often seen.

Correlation with Cookery.

Generally speaking, vegetables form a very small part of our food, especially amongst the working classes. The reason is, perhaps, that very few people know how to cook them, or, if they do, they will not take the trouble to do so.

Several instances have come under my notice of children refusing to take home from the school garden scarlet runners, French beans, Brussels sprouts and salads, because their parents did not want them. But with the introduction of cookery lessons into the school curriculum this state of things would probably vanish, especially if teachers would concentrate more attention on vegetable dishes and emphasise their importance and usefulness in household economy.

There is ample opportunity for the combination of school cookery centres with school gardens. The girls could, with the help of the boys, gather vegetables direct from the garden, and thereby gain a knowledge and appreciation of the appearance and quality of fresh produce. At many schools the garden produce is used in the cookery lessons and for the use of soup kitchens, which are a great boon to children living at a distance from the school.

Note-books Kept by the Pupils.

Educational authorities attach considerable importance to the correct keeping of garden notes by the scholars attending the classes, and the following suggestions have been drawn up with a view to providing guidance where a note-book on similar lines is not already in use. The notes should be made in a good exercise-book from the working notes entered by the scholars on the spot in a small penny note-book. The writing up of the permanent notes might be regarded as a composition lesson. Care should be taken that only notes on work which the pupil has actually done should be recorded.

The note-book should be prepared on the following broad lines, and the entries should, as far as possible, be made whilst the work is still fresh in the minds of the pupils.

(*a*) Particulars of the school garden.

(1) Name of School....................................

(2) Parish.....................(3) County..............

(4) Name of pupil..

(5) Age last birthday.............(6) Class..........

(7) Situation of garden................................

(8) Aspect..

(9) Nature of gradient (if any).......................

(10) Nature of the soil to a depth of one foot ....

Nature of the subsoil...........................

(11) Area of the garden.................................
length..................width....................

(12) Area of pupil's own plot..........................
length...................width..................

(*b*) Plan of the garden, drawn to scale, showing all the plots.

(*c*) Plan of the pupil's plot, showing manner of cropping.

(*d*) Plans of fruit plot, herb plot, or any other feature of the garden may also be made, and the names of the plants grown may be filled in, showing the position of the several kinds. This will be found useful for reference in case the labels get lost.

(*e*) Particulars of crops grown.

A double page of the note-book may be set apart for this purpose, and columns ruled to contain particulars of all the crops grown. The following examples indicate the necessary information which should be furnished:—

Name of Crop.	Variety.	Date of sowing or planting.	Date when seedlings appeared.	Depth of sowing.	Date of transplanting or thinning.	Length of row.	Distance apart.	Date when crops matured.	Number of weeks taken to mature.	Yield of crop.	Estimated value of the produce.	Remarks.
											s. *d.*	
Cauliflower	Early London	April 8	May 1	1 in.	June 3	9 ft.	18 in.	Aug. 4	17 wks.	4 heads	0 6	Two plants destroyed by cabbage root maggot.
Carrot ...	Long Red Surrey	,, 29	,, 20	1 ,,	,, 19	,,	6 ,,	,, 15	15 ,,	18 good roots = 5 lb.	0 5	The seedlings were dusted with soot at intervals.
Potato ...	The Factor	March 29	,, 2	5 ,,	...	,,	18 ,,	Sept. 19	25 ,,	18 lb.	0 9	The tops slightly damaged by frost on May 6th.

(*f*) In a similar manner notes of the following may be kept:—

(1) Manuring.—Kind of manure used, quantity used, cost of manure, date of application, crops manured, crops not manured; comparisons of manured crops may be made with those unmanured.

(2) Insect pests and diseases occurring in the garden may also be tabulated—name of the pest, name of plant attacked, part of plant attacked, date when first seen, remedies or preventives used; when used, results.

(3) Weeds found growing in the garden may be grouped, giving local names, botanical names if known, duration, *i.e.* annual, biennial or perennial, habit of stem growth, how they propagate themselves, how best destroyed, remarks.

(4) Weather observations and records.—Provision should also be made in the note-book for recording temperature, rainfall, etc.

(*g*) A diary of all work performed by the pupils should be kept, such as digging, levelling, sowing, thinning, lifting the crops, etc. The state of weather and condition of the soil should also be noted. If such work is to have its full educational value the records should be entered by the pupils in their own words, as this causes them to think for themselves. Notes or records of work in the pupils' note-books dictated by the teacher are all too common, and should, as far as possible, be discouraged.

Examples of Entries in Note-books.

Actual notes extracted from pupils' note-books. The following extracts are given with a view to aiding teachers as to the lines on which note-books may be kept. They are not intended to be models, but merely suggestions of what might be done.

Diary or Record of Work.

18th Feb.	I helped to remove two cart-loads of manure into the garden and I then spread it over some of the plots.
25th ,,	I filled in my weather report and helped to spread the manure over the spare plots.
4th March.	I helped to remove the manure into the garden and continued spreading it.
11th ,,	I helped to mark off the plots and get the flower plot delved.
18th ,,	I helped to delve the plots round about the trees and raked my own plot.
25th ,,	I put into the ground the following seeds: Broad beans, spinach, green peas, radish, turnips, carrots.
1st April.	Easter holidays.
8th ,,	This week I planted one row of early potatoes. I also sowed cabbage, kale, and other seeds.
15th ,,	I put into the ground the following seeds: Parsnips, onions, beetroot, parsley, mustard, cress, and leeks.
22nd ,,	This week I helped to sow peas, beans, and lettuce in the cookery plot. In the herb plot I helped to sow such herbs as thyme, savory, sage, chervil, balm, and marjoram.
29th ,,	This week I helped to sow some lettuce, raked the ground among the trees and filled some notes in my note-book.
6th May.	This week I planted some plants in my plot such as cabbage, cauliflower, Brussels sprouts, savoy, and kale.
13th ,,	I filled in my weather report for the past week, made some drawings, and helped sow some anemone seeds.

20th May. This week I thinned the turnips and continued weeding. I also planted some scarlet runner beans at the top of my plot.

27th „ This week I sowed seeds of eight different kinds of flowers, and also continued weeding and hoeing.

3rd June. This week I helped to plant the following plants: Chrysanthemums, begonias, asters, scabious, lobelia, violas, dahlias, and marguerites.

10th „ This week I removed the mustard because it was ready for use, and also re-sowed mustard and peas. I also continued weeding.

17th „ This week I gathered the radishes, spinach, and cress, which were ready for use. I then re-sowed spinach and staked up the peas.

24th „ This week I transplanted two rows of lettuce. I also sowed a row of radish and turnip and thinned out the beetroot.

2nd Sept. This week I have not been in the garden because of the rain we had during August.

9th „ This week I helped to weed the tree plot, and then gathered some of the produce of my plot.

16th „ This week I revised my notes on soils, and then went outside and gathered the radishes, potatoes, beans, and peas.

23rd „ This week I revised my notes on soils, filled in my weather report, and helped to paint the garden frame.

30th „ This week I continued revising my notes on soils, filled in my weather report, and went outside and began to clean my tools.

7th Oct. I finished revising notes on soils. I then went outside and started to trim the hedge. I also got a lesson on how to take cuttings of plants and how to place them in the cold frame.

14th Oct. I revised my notes on operations connected with the soil. I also made drawings of cuttings, and then went outside and weeded my plot.

21st „ This week I helped to put in glasses the following hyacinth bulbs:—

1. Gertrude (red),
2. Robert Steiger (red),
3. Gigantea (white),
4. Grandeur à Merveille (white),
5. Charles Dickens (blue),
6. Lord Balfour (blue),

and I then went outside and continued to trim the hedge.

Composition.

30/3/09. Last Friday I was out at the gardens. I first dug the garden, and my companion David Young, who works the garden with me, took out the stones and the weeds.

We next got a line about one foot and a half from the edge of the plot and took a round piece of stick and made two rows of holes about two inches deep and six inches apart. We next put a bean in each hole and turned the earth over on the top of them and firmed it.

We next took our line about a foot from the beans, and with our spade we turned the earth over about six inches broad and an inch and a half deep for our peas. We next scattered the peas pretty thickly and took our rake and turned the earth back again, and with our spade we firmed the earth on the top. When we had finished we took a tally for our peas and wrote "Fillbasket Pea" and put it in the ground opposite our peas, and put a tally opposite our beans, which were the "Nettleship" beans.

8/4/09. We set radish two feet from the onions in the same way as the spinach. We then dug about a foot broad and one and a half feet deep. Then we turned the earth in again, and with a big dibble we made the holes as deep as we could. Then we filled them up to one inch from the top and put in two or three parsnip seeds and covered them with fine earth.

21/4/09. I was out at my garden on Tuesday. I prepared the piece of ground which was left vacant between the spinach and the onions, which was four feet wide. I set my line a foot from our spinach and with my finger made a drill for our beetroot about $1\frac{1}{2}$ inches deep. We then got our seeds, which were like little pieces of cork, and sowed them thinly along the drill. When this was done we pressed the seeds in the ground and covered them over with earth.

We next set our carrots a foot further along and with my fingers prepared the little furrow. I then set the seed and covered them over with earth and slightly firmed the soil with the back of my hand.

11/8/09. I was out at my garden to-day and I saw a great number of weeds had grown up during the holidays. The soil was dry and I took a hand fork and took out as many weeds as possible without loosening the vegetables. I saw my peas were ready and my beans were about ready for pulling. My runner beans were flowering and my French beans also, but my cabbages were greatly damaged by caterpillars.

7/9/09. We were out measuring the size of the whole garden and we found it was 184 feet by 40 feet and its area was 902 square yards. We also measured the vegetable plots and found them to be 27 feet by 9 feet. This measuring was done by a chain which measured 66 feet—100 links—so we came inside and found the area in square yards.

22/9/09. I drew a plan of my plot and also made up an account of what I had spent on my garden, and I found that after allowing 1s. for manure I had spent 1s. 8d. for seeds. In order to do this I put the dates when I got the seeds, the name of the seed, and then the price (as stated below).

Income and Expenditure of Pupil's Plot.

1909.		Expenditure.	*Income.
		s. d.	*s. d.*
March 23	Manure	1 0	
,, 30	¼ lb. Peas	2½	10
,, 30	Beans	1	2
April 5	Golden Ball Turnips ...	½	3½
	Cauliflowers	5	3½
	Potatoes	1½	5
	Lettuces	½	
,, 8	Radishes	½	
	Spinach and Cress ...	½	
	Parsnips	½	2½
	Onions	1½	2½
	Beets	½	
	Parsley	½	
	Carrots	½	5
May 4	Brussels Sprouts ...	1	
	Greens (Kale)	½	
	Cabbages	1	2
	Savoys	1	6
,, 19	French Beans	½	
	Swede Turnips ...	½	4
		2 8	3 10

* It was found impracticable to sell some of the crops grown, and some was therefore given to the pupils: consequently no value was placed upon it.

School Garden Income and Expenditure.

Account for 10 Plots, 1911.[1]

Income.

	s.	d.
Peas	8	2
Beans	2	6
Turnips	9	0½
Carrots	13	6
Beets	8	9½
Parsley	3	8½
Cabbages	3	8½
Brussels Sprouts ...	7	6
Cauliflowers ...	4	0
Red Cabbages ...	1	6
Savoys	1	6½
Potatoes	6	3½
Celery	6	5½
Lettuces		6½
Leeks		7½
Parsnips		4
Cress		2
Apples	1	8
Rhubarb	1	6
Flowers	5	0
	£4 6	6½

Expenditure.

	£	s.	d.
Farmyard manure ...	1	6	9
Artificial manures ...		13	6
Seeds: Peas ...		3	6
Beans ...		2	3
Potatoes ...		1	0
Beets ...			3
Carrots ...			3
Celery ...			3
Parsnips ...			3
Turnips ...			6
Parsley ...			3
Radishes ...			2
Lettuces ...			3
Leeks ...			6
Br. Sprouts ...			3
Cabbages ...			2
Cauliflowers			5
Grasses of sorts		1	0
Herbs ...		1	0
Cabbage plants of sorts		1	8
1½ doz. Geraniums ...		3	9
5 ,, Blue Lobelia		2	6
2 ,, Asters ...			8
2 ,, Stocks ...			8
6 Gladioli		1	3
Matting, 1s. 2d.; nails, 1s.; tags, 6d.		2	8
Leaf mould		2	6
Soil (4 carts) ...		4	0
Balance (profit) ...		14	4½
	£4	6	6½

[1] I am indebted to Mr. J. Loudon, M.A., Redding Public School, Polmont, Stirlingshire, for this balance-sheet. At this school all the garden produce is sold, and the money received spent in the upkeep of the garden.

Planting and Sowing Table.

Plant.	When sown.	When above ground.	When thinned or transplanted.	When ready for use.
Radish	25th March	11th April	6th May	17th June
Beans	,, ,,	2nd May		Sept.
Spinach	,, ,,	15th May		17th June
Peas	,, ,,	2nd May		August
Potatoes (early)	8th April	27th May		Sept.
Potatoes (late)	15th April	27th May		October.
Turnips	25th March	11th April		Failed
	24th June	Middle of July	5th Aug.	Sept.
Carrots	25th March	29th April	10th June	,,
Parsnips	15th April	29th April	17th June	,,
Beetroot	,, ,,	13th May	24th June	,,
Parsley	,, ,,	27th May		19th Aug.
Onions	,, ,,	27th May	10th June	Sept.
Mustard	,, ,,	28th April		10th June
Cress	,, ,,	2nd May		17th June
Lettuce	29th April	13th May	24th June	5th Aug.

Observation Lessons.

(*a*) *Horse Chestnut Twig* (Fig. 15).

5/3/09. The twig was examined and I noticed there was no change since the last date, which was 26th February. Since then it has been in water and I am going to observe it.

12/3/09. To-day I looked at the twig and there is no change.

19/3/09. When I examined the twig to-day I noticed that the bud is beginning to burst and that some parts have become green.

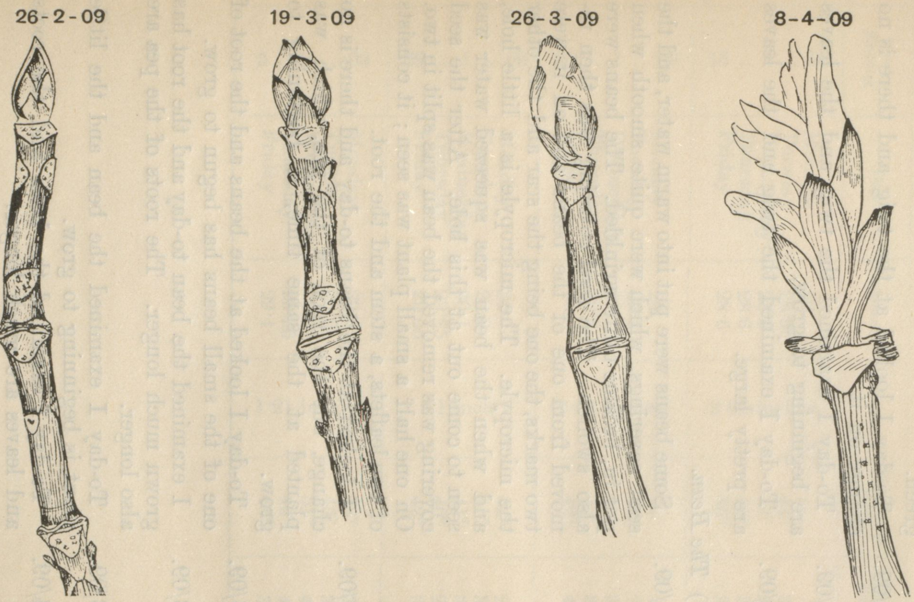


Fig. 15.—Horse Chestnut twig showing the various stages in the unfolding of the bud.

26/3/09. To-day I examined the twig, and the bud is much longer and other parts have become green.

31/3/09. To-day I looked at the twig and there is no change on it.

8/4/09. To-day I examined the twig and the leaves are beginning to grow.

21/4/09. To-day I examined the twig and the leaves are pretty large.

(*b*) *The Bean.*

26/2/09. Some beans were put into warm water, and the seed coverings, which were quite smooth when put in, became quite wrinkled. The beans were also swollen. The seed covering was then removed from one of the beans and on it were two marks, the one being the scar and the other the micropyle. The micropyle is a little hole, and when the bean was squeezed water was seen to come out at this hole. After the seed covering was removed the bean was split in two. On one half a small plant was seen; it consists of two leaflets, a stem and the root.

5/3/09. I looked at the beans to-day and there is no change, but the root of the pea, which was planted at the same time, is beginning to grow.

12/3/09. To-day I looked at the beans and the root of one of the small beans has begun to grow.

19/3/09. I examined the bean to-day and the root has grown much longer. The roots of the pea are also longer.

26/3/09. To-day I examined the bean and the little plant is beginning to grow.

7/4/09. To-day I examined the bean and the roots and leaves are much longer.

21/4/09. To-day I examined the bean and the leaves are much larger.

WEATHER REPORT.

Week Ending	Day.	Barometer.	Rainfall.	Maximum Temp.	Minimum Temp.
15 . 1 . 09	Monday	29	2·05 inches	—	—
	Tuesday	28·9		44°	31°
	Wednesday	28·9		38°	32°
	Thursday	28·6		40°	34°
	Friday	28·6		39°	31°
22 . 1 . 09	Monday	29	2·04 inches	—	—
	Tuesday	29·5		48°	28°
	Wednesday	30		50°	30°
	Thursday	30·6		40°	38°
	Friday	30		42°	40°
29 . 1 . 09	Monday	30	·21 inch	42°	26°
	Tuesday	29·9		41°	32°
	Wednesday	30·1		41°	30°
	Thursday	29·85		40°	25°
	Friday	29·65		42°	32°
5 . 2 . 09	Monday	29·6	1·21 inches	48°	30°
	Tuesday	29·5		45°	32°
	Wednesday	29·07		51°	42°
	Thursday	29·25		46°	42°
	Friday	29·4		48°	36°

CHAPTER IV.

SOME SPECIAL SUGGESTIONS.

Special Difficulties.

Teachers taking up gardening are sometimes at a loss to know what to do in the garden during the winter months when ordinary garden operations are at a standstill, the nature of the experiments which may be conducted during the summer, and also what observation lessons may be given the pupils. In view of this the following suggestions are made: they are obviously not intended to be a complete list of what is possible or what might be done, but merely afford an indication of the lines on which to work. Where the necessary equipment is available, more important and elaborate work or experiments can be undertaken, in which case the reader is advised to study some of the books of reference of which a list appears at the end of this book.

Suggestions for Autumn and Winter Work.

Propagation of Bedding Plants.—Cuttings of bedding plants such as marguerites, calceolarias, pentstemons, geraniums (pelargonium), pansies, and violas may be taken and inserted in sandy soil in a frame which will require to be covered with mats in severe weather.

Preservation of Tender Plants during Winter.—Dahlia tubers, begonia tubers, and gladioli corms may be lifted, dried, and stored in a frost-proof place. Geraniums, fuchsias, chrysanthemums, and other tender plants may be lifted, potted, and placed in a greenhouse during winter.

Roots for Winter Use.—Carrots, beetroot, and turnips may be lifted and stored in a cellar or shed, the roots being covered with sand, dry ashes, or soil. Parsnips and Jerusalem artichokes are best left in the ground all the winter and lifted as required for use.

Potatoes for Planting.—The potato crop may be lifted and medium-sized tubers selected for planting the following year; these may be placed in a frost-proof shed where light can reach them to encourage strong sturdy sprouts. The large tubers not required for immediate consumption may be placed in a cellar or clamp (see Fig. 25, p. 136).

Earthing Celery and Leeks.—The earthing up of celery and leeks may be completed when the weather is dry, care being taken to keep the soil from getting between the leaves.

Cleaning Operations.—All dead and decaying stems, leaves, flowers, etc., may be removed and the general cleaning up of the garden attended to.

Soil Preparation and Manuring.—The digging, double digging, trenching, or ridging of all vacant ground may be proceeded with, and manure or soil from a compost heap added at the same time.

Planting Biennials.—Wallflowers, forget-me-nots, double daisies, foxgloves, Canterbury bells, and other hardy biennial plants may be planted for spring and early summer flowering.

Purchase and Planting of Bulbs.—Bulbs, corms, and tubers may be purchased, some planted in borders or beds and others in pots or boxes for early flowering.

Increasing Gooseberry and Currant Bushes.—Cuttings of gooseberry and currant bushes may now be taken, prepared and inserted in the open ground for increasing the stock. Strong one-year-old shoots should be selected.

Stocks for Budding and Grafting.—Wild briars may be collected from the hedgerows or thickets (coppice) and planted in the garden for budding garden roses the following summer. Stocks for budding or grafting apples, pears, plums, or roses may be purchased from the nursery for practice in budding and grafting. These are sold at a cheap rate—8s. to 12s. per 100, according to variety and size; or seeds may be sown for raising a supply of these stocks.

Planting Roses, Fruit Trees, etc.—Trees and shrubs, including roses and fruit trees, may be purchased and planted during autumn or spring, but not as a rule in mid-winter unless the weather is very mild.

Pruning.—Fruit trees may be pruned and thinned; vigorous growing specimens may also require root pruning to check rank growth and to induce fruitfulness.

Raspberry Canes and Strawberry Runners.—The old fruiting canes of raspberries and the surplus runners of strawberries may be removed from the plants and the ground hoed or otherwise cleaned.

Staking Trees.—The staking of standard and half-standard trees may require attention to prevent damage by gales. Newly planted trees of this description require support to facilitate rooting.

Making Leaf-mould.—Fallen leaves of trees may be collected, placed in a heap, and turned once or twice to hasten decomposition and prevent rapid heating. When well decayed these make good leaf-mould, either for pot plants or for improving garden soils. Oak, beech, elm, or Spanish chestnut, being of a hard texture, make the best leaf-mould.

Preparation of Potting Loam.—Grass sods or turves may be procured from an old pasture or from the road side and stacked in a heap, grass side downwards. These, when well rotted, form good potting loam. The more fibrous the loam the more valuable it becomes. Sometimes it is possible to obtain good turfy loam where new buildings are about to be erected.

Lessons on Soils.—(*a*) Tillage operations such as digging, trenching, ridging, draining, etc., may be practised and thoroughly explained.

(*b*) Tests for the presence or absence of lime in soils if properly worked will be found interesting and instructive.

Take several small samples of moist soil from a field or garden, mix thoroughly, place a small quantity in a tumbler, add water and stir to remove air bubbles, and then pour over it a wine-glassful of spirits of salt (muriatic acid or hydrochloric acid). If effervescence takes place the soil contains sufficient carbonate of lime, but if no reaction takes place lime should be added to the soil.

(*c*) To test for acid in a sample of soil, lay a strip of blue litmus paper on a watch-glass (or small saucer), cover about three-fourths of it with the soil and moisten with water. After standing about an hour, if the paper in contact with the soil has reddened, the soil is acid and requires liming.

The test may also be applied by sticking the litmus paper into the soil in the garden, moistening with water, and examining as before.

(*d*) A mechanical analysis of soil may be made, and also the proportion of organic and inorganic matter in a sample of soil ascertained as follows:—

Weigh 10 grammes of the sample of soil, and leave in a warm place to dry. When the soil is perfectly dry ascertain the weight, and the difference will be the amount of water in the soil. Now heat the dry soil strongly, in a crucible of known weight, until it has ceased to smoke and has become red throughout. Allow to cool and then reweigh. The loss in weight will represent the organic matter.

Take a further 10 grammes of the dry soil, powder it finely, add a little water—rain water for preference—and stir well. Carefully pour the muddy liquid off into a large glass jar. Then add more water to the remainder of the soil, shake well, and again decant the liquid into the jar. Continue this operation, using further jars if necessary, until the liquid is no longer muddy but nearly clear. The part of the soil which remains behind and will not float over into the jars is composed of small stones, grit, and sand, while the jars contain clay and silt. The sand, etc., can be dried and weighed, and the weight subtracted from the original weight (10 grammes) to find in addition the weight of the clay. If the jars are left for a time the clay will gradually settle to the bottom.

The above simple experiment affords a rough indication of the contents of the soil as follows:—

Amount of water,
Amount of organic matter,
Amount of sand, } inorganic matter.
Amount of clay, }

The subsoil may be analysed in a similar manner for comparison.

Soil Capacity for Water.—A flower bed or grass plot of small but known area, say three yards by two yards, is watered until there is evidence of water lying on the surface. The quantity of water used is taken note of, and from these data the water capacity of the soil in gallons per square yard discovered.

Seed Collecting and Study of Germination.—Fruits and seeds of trees and shrubs—acorns, beech nuts, lime fruits, ash fruits, sycamore fruits, haws, and rose-hips may be collected and examined. Some may be sown in boxes, pots, or in the open for the study of germination.

An experiment to prove that air, warmth, and moisture are essential for germination may be made with some quick-growing seed such as wheat, mustard, maize, peas or beans as follows: Take two pots and fill with soil, sow some kind of seed in each and keep the soil moist; place one pot indoors in a warm place and the other outside (if this experiment is carried out during the winter the results are more obvious). Fill a third pot and sow the same kind of seed and keep in a warm dry place; do not give any water. Fill a glass cylinder or tumbler with water, drop some seed to the bottom and keep in a warm place. After a few days examine all the sowings and compare results. This experiment might be extended by sowing other pots, keeping one in the dark, one in semi-darkness, and one in full light near a glass roof or window. Another pot filled with washed sand may also be sown. Seeds of any choice annuals or other flowering plants may be collected, when ripe, for future sowing.

Making and Writing Labels.—The making and writing of wooden labels or tallies, in accordance with the cropping plan, may be done during the winter, or when the weather is unsuitable for outdoor work.

Care of Tools.—All garden tools should be examined periodically, and it should be a rule that each boy cleans the tools he has been working with, oiling them if necessary. If iron or steel garden tools are laid for a few minutes in a solution of soda they will be protected from rusting for a long time, even if exposed continuously to a moist atmosphere.

Wheeling Manure, Soil, etc.—Advantage should be taken of hard frosty weather to do all the necessary wheeling of manure, soil, leaves, etc., required in the garden.

Observation Lessons.

Plants from Damp versus Dry Soil.—A comparison may be made of plants found on heavy or damp soil with those on light or dry soil.

Comparison of Rushes, Sedges, and Grasses.—The distinction between rushes, sedges, and grasses may be noted as follows:—

In grasses the stems are usually hollow except at the joints; the leaves sheath the stem at their base, the sheath being usually split open on the side opposite to the leaf blade and terminating within the base of the blade in a small scarious appendage called a ligule or tongue. Leaves are arranged in two rows.

Sedges are stiffer than grasses. The stems are solid, generally three-angled, and with the sheaths of the leaves closed all round. Leaves are arranged in three rows.

Rushes are stiff and have cylindrical leaves; creeping underground stems (rhizomes). The structure of the flowers more closely resemble lilies than sedges or grasses.

Various Kinds of Stems.—The various modes of growth of stems (*i.e.* erect, creeping, prostrate, climbing, etc.) of plants may be illustrated. Specimens of each, if possible, should be procured to illustrate the lesson.

Study of Different Trees.—Specimens may be obtained of the shoots of British trees and shrubs, both in the summer and winter stage, and the points of difference described.

Observations on the Growth of Buds in the School-room.—Twigs of trees and shrubs may be obtained in winter, and placed in vases or jars containing water. Carefully note the period and method of growth (unfolding of leaves, opening of flowers, etc.); compare with those growing in the open. Sketches and notes of what is observed should be made from time to time.

Underground Stems.—The difference between a runner, offset, stolon, rhizome, sucker, tuber, corm, and bulb may be explained, a specimen of each being used in illustration.

Various Kinds of Roots.—The various kinds of roots, such as tap root, fibrous root, etc., may also be described and the actual specimens of each shown.

Nodules on the Roots of Leguminous Plants.—The roots of clovers, peas, beans, vetches, tares, lupins, etc., may be collected, examined, and compared with roots of other plants not belonging to the same natural order.

Study of Weeds.—Specimens of weeds found in or near the school garden may be collected and examined; point out those, if any, of a poisonous nature.

Study of Insects.—Insects, especially those known to be harmful to garden crops, may be searched for and their life-histories described. (See Board of Agriculture Leaflets.)

Drawing Lessons.—Drawings may be made of any specimens from the garden, such as flowers, fruits, vegetables, weeds, insects, or garden implements. Different shapes of leaves—their margins and arrangement of veins (venation)—may also be sketched.

Ordnance Maps.—From the 25-inch Ordnance map find the reference numbers of the fields near the school. A list of the fields may be made; show for what crops or purpose each field is being used.

Drawing to Scale.—Plans may be made of the garden and school premises showing the various features, *i.e.* plots, paths, buildings, etc. Plans on a large scale may be made of an individual plot, showing the method of cropping for the ensuing year; plans of the fruit plot, herb plot, etc., may be made.

Experiments.

Eight-plot Test.—To obtain some practical information on the requirements of a soil, the so-called eight-plot test may be resorted to. This, however, unless carefully carried out, may yield very misleading results. The test is as follows:—A piece of land typical of the field under consideration is measured into an oblong, 40 yards by 20 yards, and then divided up into eight separate plots, each 10 yards by 10, as seen in the following diagram:—

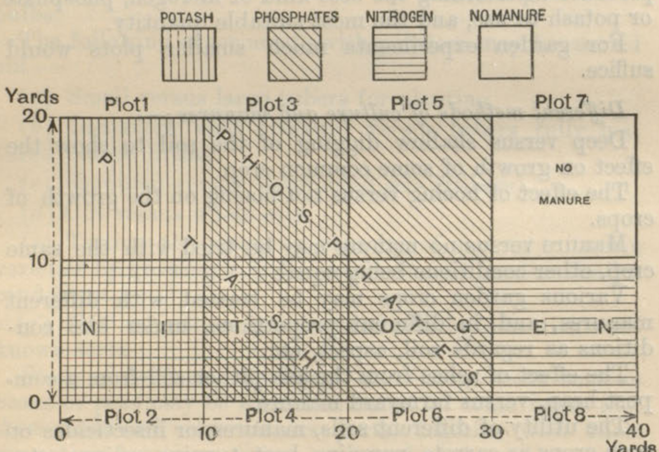


Fig. 16.

A quantity of potash manure is uniformly sown on plots 1, 2, 3, and 4.

A quantity of phosphate is uniformly sown on plots 3, 4, 5, and 6.

A quantity of nitrogen is uniformly sown on plots 2, 4, 6, and 8.

In this way the manuring of the plots will be as follows:—

Plot 1. Potash only.
Plot 2. Nitrogen and potash.

Plot 3. Potash and phosphate.
Plot 4. Nitrogen, phosphate, and potash.
Plot 5. Phosphate only.
Plot 6. Nitrogen and phosphate.
Plot 7. Unmanured.
Plot 8. Nitrogen only.

By weighing the produce of the respective plots any striking deficiencies in the soil will be indicated.

Further information may be obtained by adding extra plots for determining the best kind of nitrogen, phosphate or potash to use, and the most suitable quantity.

For garden experiments much smaller plots would suffice.

Different methods of culture and manures:—

Deep versus shallow digging of the soil to show the effect on growth of some common crop.

The effect of hoeing versus not hoeing on the growth of crops.

Manure versus no manure may be tried with the same crop, other conditions being equal.

Various garden crops may be treated with different manures, and in different proportions, under like conditions as regards soil, aspect, etc.

The effect of ashes from the ash pit, or soil from a compost heap, versus farmyard manure.

The utility of different soils, manures, or insecticides on such crops as carrots, parsnips, beet, turnips, onions, etc., in preventing the attacks of the various insect pests, etc., to which they are liable.

Carrots, parsnips, or beetroot may be grown under different conditions for comparison of results, in heavy soil, light loam, sand, and manured ground, or deep holes may be made and filled with finely sifted sandy soil. In the last mentioned three or four seeds may be sown and the resulting plants thinned to one plant in each hole. In the case of the other sowings the usual plan of thinning will be resorted to.

The effect of thinning versus non-thinning on some crop, such as carrots, beet, turnips, or parsnips.

Close planting of cabbages, leeks, or potatoes compared with the customary distance apart at which these plants are grown.

Sow small and large seeds of beans, peas, oats, or barley of the same variety and compare the resulting plants.

New seeds versus seeds three or four years old of turnips, carrots, marrows, or other crops may be sown and results compared.

The effect of deep versus shallow planting of potatoes or bulbs.

The following experiments with potatoes may be carried out:—

(*a*) Small versus large tubers for planting.

(*b*) Immature seed (tubers) versus tubers fully matured before lifting.

(*c*) Sprouted versus unsprouted sets (tubers).

(*d*) Cut versus whole sets.

(*e*) Testing the cropping capacity of say six to twelve varieties by growing a row of each variety under similar conditions.

(*f*) New varieties might be tried side by side with well-known sorts.

Study of Seeds and Seedlings, etc.—Large seeds such as beans or peas may be soaked in water for some hours and then examined, the various parts, together with their respective functions, being explained.

Similar seeds can be placed in eosin solution to show that the water enters the seed through the small hole known as the micropyle. Or broad bean seeds can be set in pots in various positions on the surface of the soil so that each seed is half buried. Some can be placed with the opening up, some with it downwards, and some on their sides. After about a week indoors in a fairly warm place, the growth in each case should be measured and the results compared.

Show the effect of light on the growth of plants by sowing two pots of peas, keeping one in the light and the other continuously in the dark. Give each a sufficient quantity of water and eventually note the difference in the growth of each.

A similar result will be shown by sprouting two potato tubers indoors, one in the light and the other in the dark.

Fill a pot with soil taken from the top nine inches of an untrenched part of the school garden, another with subsoil taken from the lower depth, 9 to 18 inches, and a third with clean builders' sand or washed sea sand. Sow with rye or mustard, and thin out when the seeds are up. Keep the pots together and equally well supplied with water; the plants then have as good a chance of growth in one pot as in any other. Compare results and explain the reasons for same.

Fill a pot with surface soil and another with the same weight of surface soil well mixed up with a small quantity (30 grammes) of plant remains—pieces of grass, or stems and leaves of other plants, cut up into fragments about half an inch long. At the same time put up two pots of subsoil, one of which, as before, is mixed with a small quantity of plant remains, and also put up two pots of sand, one containing a small quantity of plant remains and the other none. Sow all six pots with mustard, and keep watered and well tended. Compare results as before.

Put some fresh moist garden soil into a bottle and cork it tightly so that it keeps moist. Write the date on the bottle and then leave it in the light where you can easily see it. After a time—sometimes a long, sometimes a shorter time—the soil becomes covered with a slimy growth, greenish in colour, mingled here and there with reddish brown. The longer the soil is left the better. Often after several months something further happens, little ferns begin to grow and they live a very long time indeed. (Spores of ferns, mosses, fungi, etc., are always present in the air, and when they alight on a suitable medium they commence growth.)

The solubility of substances in water can be tested as follows:—

Take five small flasks and place in one some sugar, in the second some salt, in the third some blue crystals of sulphate of copper (poisonous), in the fourth some sand, and in the fifth some whiting, and then add some water to each and warm them gently over a spirit lamp. The salt, the sugar, and the sulphate of copper disappear from sight; the sand lies at the bottom unchanged, and the whiting mixes with the water, but the water does not become clear. Now taste the sugar water and the salt water. Evidently from the taste the sugar and salt are still there, and the blue colour of the sulphate of copper shows that the sulphate of copper also is still there. These three substances have dissolved in the water. The sand and whiting have not done so.

Now place five glass funnels in a row, and fit a piece of filter-paper into each, and empty the flasks each into a separate funnel. The water comes through clear in each case, but on tasting the sugar water and salt water we find that the sugar and salt have passed through the paper with the water. The sulphate of copper water is still blue in colour, showing that the sulphate of copper has passed through. But the sand and whiting have been left behind on the paper. This will show clearly what is meant when we say a substance dissolves or is soluble in water.—(Laurie.)

The Absorption of Nutritive Substances by Roots.—One or two very simple water cultures will show that plants can be nourished by dissolved salts taken up by the roots. Show that seeds supplied with a suitable nutritive solution[1] grow faster and stronger than similar seedlings supplied only with plain water. The plants thrive better if the bottles or jars in which the roots are growing be placed in cardboard cylinders to shut out the light.

It will be seen from the foregoing that many things

[1] For example :—

Potassium nitrate,	1	gramme.
Sodium chloride,	½	,,
Calcium sulphate,	½	,,
Magnesium sulphate,	½	,,
Calcium phosphate,	½	,,
Water,	1	litre.

A few drops of dilute solution of iron chloride should be added.

may be done during that period of the year when it is impracticable to carry on ordinary outside garden operations, but as a rule nature study, botany, or theoretical lessons in horticulture must not be registered as practical work in gardening. In this connection it will be advisable to consult the Code of Regulations. Those desirous of giving theoretical lessons on the principles of horticulture (plant life), or on the operations and practice of horticulture, will find a suitable syllabus in the next chapter.

CHAPTER V.

EVENING SCHOOL GARDENS.

Continuation Classes.

Organisation.

The teaching of gardening as an evening school subject has been introduced with much success in many districts, school teachers in a number of cases acting as instructors, and the County Education Committees financing the scheme.

The classes, as a rule, are carried on in the evenings during the spring and summer months, and are a continuation of the winter classes formed for young gardeners.

The pupils are usually between the ages of fourteen and twenty years, and twelve to twenty are found to be a suitable number to form one class.

A larger area of land is required for an evening school garden than for the ordinary school garden. The land may be either divided into plots of from two to three poles in area—each plot being worked by one pupil—or the whole garden worked in co-operation by the pupils.

In the latter case the garden should possess several distinctive features such as flower plots, vegetable plots (including salads and herbs), a fruit plot, and in addition experimental plots.

Plans of the entire garden, and separate plans of the various plots and the method of cropping, should be made.

Exact records of sowing, planting, thinning, etc., together with observations on the growth and general appearance of the crops, must be entered from time to time by the students in their note-books.

Lessons on digging, trenching, planting, hoeing, sowing, earthing up, etc., will be given from time to time, and any insects or plant diseases occurring in the garden may be commented upon.

The equipment required for an evening school garden will be much the same as advised for day classes, the School

Fig. 17.—Continuation School Gardens at Charlton Kings, Cheltenham.

Board or County Education Committee bearing the expense of tools, seeds, manures, fruit bushes, etc., and a tool shed or potting shed if required.

In some districts the education authorities now favour the plan of taking over and working on approved methods —under the direction of the horticultural instructor—an allotment garden, a typical cottage garden, or a model fruit plot, instead of evening school gardens. The occupier in each case gives his labour, and in return becomes entitled to all the produce. Public meetings are held at intervals to demonstrate various methods of cultivation, etc.

The management of evening school gardens is generally undertaken by a local committee including some members of the School Board (School Managers).

Experiments.

Where there are experimental plots some particular crop such as onion, leek, potato, carrot, beet, or parsnip might be grown under varying treatment as regards manuring, etc. The following examples will afford a broad indication of the lines on which to work :—

1. *Onions.*

(*a*) With manure (farmyard or stable dung).
Without manure.

(*b*) With chemical manures.
Without manures.

(*c*) With half chemical and half natural manures.

(*d*) Sown with carrots to test the effect on the onion fly maggot.

(*e*) Sown outside and then thinned.
Sown under glass and afterwards transplanted.

(*f*) Sown outside and thinned.
Sown outside and not thinned.

2. *Parsnips, Carrots, and Beet.*

(*a*) With fresh natural manure.
Without natural manure.

(*b*) With chemical manures only.
With chemical and natural manures.

(*c*) Thinned lightly.
Thinned to 8 or 9 inches apart.
Not thinned.

(*d*) Treated with lime at intervals.
Treated with soot at intervals.
Untreated.

3. *Potatoes.*

(*a*) Large sets
(*b*) Medium sets
(*c*) Small sets
(*d*) Cut sets
(*e*) Ripe sets
(*f*) Immature sets
say 50 sets of each.

(*g*) Different varieties may be tested side by side.

All land used for experiments should be carefully measured by the students, and the measurements, together with all particulars of the proposed test, entered in their note-books.

All experiments must be carefully performed—the nature of the soil, quantity of manure, hoeing, watering, etc., should be as uniform as possible.

When the crops are mature the produce may be carefully weighed, or otherwise calculated, in order to demonstrate the difference under the varying conditions. These results should be worked out showing the quantity and value of the produce per pole, rood, and acre. Thus the pupils will be receiving valuable instruction in writing, composition, land measurement, arithmetic, and hand and eye training, in a most interesting manner.

The exact time-table and syllabus may be left to the teacher in each case, and many useful lessons will occur to him during the course.

Syllabus of Instruction.

For those teaching horticulture as an evening continuation school subject during the winter, the following Syllabuses of Instruction may be found useful. They are intended to cover a two or a three years' course. The Second Year Syllabus is specially suitable for adults who require technical knowledge of the details of culture, etc., but are indifferent to the underlying principles of Plant Life as detailed in the First Year Syllabus.

Suggested Syllabus of Instruction in the Elementary Principles of Horticulture.

Winter Session, First Year.

I. *Plants.*—Examination of typical plants common in the garden.

(*a*) *Roots.*—Their forms, their functions, how the root branches and absorbs material from the soil, root hairs and how they work.

(*b*) *Shoots.*—(1) *Stem:* Its functions and growth, branching and hardening with age, adaptations of stems for special purposes, *e.g.* creeping and twining.

(2) *Leaves:* Their functions, veins and pores, adaptation of leaves for special purposes, *e.g.* climbing.

(*c*) *Vegetative Parts of the Plant as a Whole.*—Roots absorb water and minerals from the soil, passage of materials from root through stem into leaf, escape of water vapour from leaf, entrance of air from the atmosphere through the leaf pores, distribution of air throughout the plant, action of sunlight upon the contents of the green parts, food formation.

(*d*) *Reproductive Parts.*—Flower, fruit, seed, the part of the plant which becomes the seed and how the embryo is formed in its interior, common seeds of garden and farm, *e.g.* bean, mustard, grain of wheat; vitality of seeds, natural methods of seed distribution and special adaptations for same, *e.g.* thistledown, etc.

(*e*) *Germination of the Seed on Soil and on Blotting-paper.*—Part played by moisture, air, and heat; construction of the seedling.

(*f*) *Duration of Plants.*—Annuals, biennials, perennials.

(*g*) *Parts of the Plant used as Food Stores, e.g.* in turnips, mangels, potatoes, onions, cabbages, etc.

II. *Water* in its three forms; its presence in air; formation and deposition of rain, dew, and fog; rainfall and its measurement; its solvent action illustrated by total solids in water; different kinds of water; chemical composition of water shown by electrolysis or burning of hydrogen gas; elements and compounds.

III. *Air.*—A mixture of colourless gases, its weight measured by barometer, the action of heat, air currents, ventilation, measurement of temperature.

Chemical Properties.—Illustrate by a burning candle that it supports combustion, producing a change shown by drawing products of combustion through lime water.

Constituents.—Nitrogen and oxygen chiefly, also some carbon dioxide, water vapour, and very small amounts of other gases.

Oxygen supports combustion better than air, heat evolved, chemical changes, products of combustion, oxides, its relation to the living organism.

Nitrogen does not support combustion, its relation to plant life.

Carbon Dioxide.—A compound formed in combustion and in respiration, its properties, its presence in breath, action on lime water.

Meteorological Records and Charts.

IV. *Limestone.*—Lime burning, quick lime, slaked lime, effect of exposure to air.

V. *Acids, Bases, and Salts.*—Their meaning and properties, action on test papers, examples of the more common:—

(1) *Acids.*—Sulphuric, nitric, phosphoric, hydrochloric, carbonic, etc.

(2) *Bases.*—Lime, ammonia, potash, magnesia, iron oxide, etc.

(3) *Salts.*—Nitrates, phosphates, sulphates, chlorides, carbonates, etc.

VI. *The Soil.*—Formation; mechanical analysis; sand and clay; organic matter and micro-organisms; chalk; water; air; typical soils; sands, loams, clays, chalks, marshes, peats, and bogs; soil constituents connected with plant nutrition; solvent action of soil water and of plant roots; the soil as a storehouse of plant food; plant food taken up in solution; the solubility of the plant food in the soil; effect of tillage operations on the water and air in soils; the replacement of plant food removed from the soil, manuring.

VII. *Nutrition of Plants from the Atmosphere.*—The green leaf, external form of various leaves; position of leaves to secure light; upper and lower surface of leaves; green leaves necessary for plant growth; leaves manufacture starch as one form of plant food; iodine as a test for starch in grain of cereals, potato tubers, etc., and in the leaf; starch formed in light and disappears in darkness; growth of growing plants in darkness; greened and ungreened potato tubers; carbon dioxide in atmosphere necessary for production of starch.

VIII. *Water Culture and its Lessons.*—Essential constituents for plant life, nitrates, phosphates, and sulphates of potassium, calcium, magnesium and iron.

IX. *Composition of Plants.*—Water as shown by drying, organic matter and ash (mineral matter) as shown by burning.

Suggested Syllabus of Instruction in the Operations and Practice of Horticulture.

Winter Session, Second Year.

Soils.—Origin, formation, classification, properties of each kind.

Tillage Operations.—Draining, digging, trenching, hoeing, raking, earthing up, weeding, watering, mulching, seed sowing, thinning, transplanting.

Manures.—Natural and artificial, classification, properties of each.

Manuring.—How and when to apply manures for garden crops.

Rotation of Garden Crops.—Intercropping, successional cropping.

Grouping of Cultivated Plants for Garden Purposes.—Trees, shrubs, herbaceous plants (annuals, biennials, and perennials), vegetables, salads, culinary herbs, flowers, fruits.

Classification of vegetables and fruit-bearing crops according to their families and to the portion used as food.

Cultivation of Vegetables.—Root crops, tubers, bulbs, green crops, pod-bearing crops, salads, herbs.

Cultivation of Hardy Fruit.—Apples, pears, plums, cherries, gooseberries, currants, strawberries, raspberries, blackberries.

Cultivation of tomatoes, cucumbers, and vegetable marrows.

Cultivation of Hardy Flowers.—Herbaceous perennials, biennials, annuals.

Cultivation of roses, carnations, sweet peas, and other florists' flowers.

Cultivation of ferns, greenhouse and window plants.

Principles of Pruning.—Fruit trees and bushes, roses, and other shrubs.

Plant Propagation.—Seeds, cuttings, layering, budding, grafting.

Diseases and Insect Pests.—Common diseases and insect pests of fruit, flowers, and vegetables.

Improvement of cultivated plants by selection, cross-breeding, and hybridisation.

Fruit and Vegetable Bottling for use in winter.

PART II.

SOILS, MANURES, AND CULTIVATION OF GARDEN CROPS.

CHAPTER VI.

SOILS.

Classification and Properties.

Classification of Soils.

Some knowledge of the origin, composition, and properties of the various kinds of soil and the methods of cultivation suited to each is of great importance to all engaged in agriculture and horticulture.

The soil may be regarded as the cultivators' raw material from which the various crops of garden and field are produced. It forms an anchorage for fixing plants to the earth, while the soil water supplies the plant with its mineral requirements. Soil is composed of the weathered fragments of rock, with which is mixed the remains of animal and plant life (humus), and may be said to consist of a mixture of sand, clay, carbonate of lime, and organic matter, in varying proportions according to its origin. The principal weathering agents disintegrating the surface of rocks are frost, air, wind, water, worms, and plants, while bacteria also play an important part in soil fertility. Soils may be classified as follows :—

Sands, containing from 0 to 20 per cent. clay, from 80 to 100 per cent. sand.

Sandy loams, containing from 20 to 40 per cent. clay, from 60 to 80 per cent. sand.

Loams, containing from 40 to 60 per cent. clay, from 40 to 60 per cent. sand.

Clay loams, containing from 60 to 80 per cent. clay, from 20 to 40 per cent. sand.

Clays, containing from 80 to 100 per cent. clay, from 20 to 0 per cent. sand.

Marl, containing from 5 to 20 per cent. carbonate of lime.

Calcareous or chalky soils, containing about 20 to 40 per cent. carbonate of lime.

Peat or vegetable soils, containing about 50 per cent. organic matter.

POWER OF SOILS TO HOLD WATER.

Description of Soil.	A Cubic Foot Weighs		Amount of Water Contained in 1 cubic foot of Wet Soil.
	In Air-dry State.	In Wet State.	
	Lb.	Lb.	Lb.
Silicious sand	111·3	136·1	27·3
Calcareous sand	113·6	141·3	31·8
Sandy clay	97·8	129·7	38·8
Loamy clay	88·5	124·1	41·4
Pure grey clay	75·2	115·8	48·3
Humus	34·8	81·7	50·1
Garden mould	67·8	102·7	48·4

Characteristics of the Principal Kinds of Soil.

Sandy soils consist of grains of quartz, silica, and other minerals, and may be described as porous, light, warm, early, and poor. Manurial ingredients are easily washed out of such soils, therefore frequent dressings of manure of a retentive nature should be applied, such as well rotted farmyard manure (cow manure), pig manure, green manure, clay, marl, or peat. The application of marl is not so common now as was the case many years ago, but, nevertheless, marl is very valuable for light or sandy soils, peat or moss land, and also for worn-out soils of town and other gardens.

> "He that marls sand may buy the land,
> He that marls moss shall suffer no loss,
> He that marls clay flings all away."

The chemical or artificial manures suitable for sandy soils are bone meal, phosphatic and other guanos, kainit, and nitrate of soda.

Light soils may be cultivated when convenient, but spring cultivation answers best, when manure, vegetable refuse from a compost heap, weeds, etc., may be added at the same time, or a green crop dug in. The summer crops are able to make use of the fertilising matter as it is liberated from these substances by decomposition. A mulching or top dressing of manure, leaf-mould, spent hops, or lawn clippings is beneficial during dry weather, and in dry districts.

Clayey soils consist principally of the finer particles of soil. They are composed largely of clay along with sand and other substances. Clay soils derived from felspar contain a large amount of potash. Clay soils are very heavy, *i.e.* difficult to work, sticky, and retentive of moisture, phosphates, potash, and ammonia. They may be improved by autumn or winter cultivation (digging, double digging, or trenching), by draining, and generally by the addition of lime, which helps to break up their sticky character, setting free potash and forming new compounds in the soil. Burning (not much practised at the present time) has a similar effect. Stable manure, leaf-mould (decayed leaves), decayed waste products (organic matter) or road scrapings, sand, and other gritty substances will lighten and improve the texture of these soils. The artificial manures suitable for this type of soil are basic slag, superphosphate, boiled or broken bones, sulphate of potash, and sulphate of ammonia, the latter only being used when lime or chalk is present in the soil.

Marl is a kind of clayey soil containing a good proportion of lime or chalk. Its cultivation, manuring, and general management is similar to that recommended for clay soils. Marl is beneficial on peaty or moss land, sandy soil, and exhausted or unproductive garden soil.

Limestone or chalky (calcareous) soils are generally warm and will suit most farm crops and all kitchen-garden crops (peas, beans, and fruit trees), but rhododendrons, nearly all azaleas and heaths, and many hard-wooded plants are poisoned by lime or chalk. Care should be taken, therefore, in selecting the soil to be used for potting or planting these plants in. Soils although overlying a chalky formation may contain very little chalk, as rain washes it away, leaving the flinty, clayey, and sandy portions. Lime is essential to soil fertility, and there should be at least one part of lime to 200 parts of soil. By adding lime sourness of the soil is corrected and plant foods are rendered available for the use of the plant.

Limestone soils are improved by a free use of organic matter such as farmyard manure, leaf-mould, or soil from a compost heap, and also by such artificial manures as Peruvian guano, fish guano, native guano, blood manures, shoddy, hoofs, horns, superphosphate, sulphate of ammonia, and kainit.

Peat is generally black, of a sour nature, having been formed by long and continuous decay of marsh or bog plants. It usually occurs on flat or low-lying ground, and may be improved by drainage, suitable cultivation, and liming. The addition of marl, basic slag, and bone manures will be beneficial to this class of soil. Potatoes, cabbages, turnips, celery, and onions usually do well on peat land, but the quality of the produce is not generally considered so good as when grown on loamy soils. Peat has a beneficial effect on very light soils: it helps to bind the particles together and improves their water-holding capacity, and will also improve the texture of heavy soil. Peat of a very fibrous nature is formed by the decay of ferns, sedges, grasses, heaths, and other plants on upland moors. The very light and fibrous nature of this peat makes it particularly suitable for choice pot plants, such as azaleas, orchids, ferns, etc. The more fibre (decayed roots, etc.) it contains the more valuable it becomes for this purpose.

Loam, when of a fairly medium character, constitutes an ideal soil—neither too heavy nor too light—and is useful for nearly all crops.

Potting loam, *i.e.* loam used in mixture with sand, leaf-mould, or peat for pot plants, is prepared as follows: Take the top sod or turf from an old pasture to a depth of 3 or 4 inches so as to include plenty of root-fibre from the plants forming the herbage, and stack in a heap for some months, grass side downwards. When well decayed it may be chopped down and mixed with sand, leaf-mould, or peat. The proportions of each ingredient depends on the kind of plant to be potted and also on the quality and texture of the loam.

Alluvial soils are those deposited along the banks and at the mouths or estuaries of rivers. They consist of the silt, mud, gravel, and sand brought down by the waters of the river; and being thus composed of the well mixed detritus worn from the various formations which the river system drains, they are usually very fertile, forming rich meadows and pastures. Large tracts of such land occur in many districts and command a high rental. In Lincolnshire the process termed *warping* consists in allowing the waters of the rivers to flow over the land for the sake of the fertilising deposit which they leave on the surface.

The Fertility of Soils.

This depends upon three things:—

1. *Anchorage, i.e.* the mechanical or physical condition of the soil, whether it is light or heavy, deep or shallow, warm or cold—conditions which greatly influence the root system of the plant.

2. *Nutrition or feeding.*—This has reference to its chemical composition, *i.e.* whether the soil contains all the ingredients, such as nitrates, phosphates, potash, iron, lime, etc., necessary for building up the structure of the

plant. A chemical analysis of a soil supplies some knowledge of its composition, but it is not of itself a sufficient test of its actual fertility.

3. *Biological state, i.e.* whether the soil is in a good healthy condition, so that useful bacteria can flourish and carry on their work in the soil. We have to regard the soil as though it were so much living matter. It is known to be teeming with millions of the lower forms of life (useful and harmful bacteria) which are always at war with one another. Good cultivation, drainage, and a liberal supply of organic matter aid the useful bacteria in their struggle for supremacy.

A soil, therefore, to be fertile must not only contain the necessary ingredients which go to make plant food, but must also be able to manufacture and store it until required by the plant.

Almost any kind of soil may be made fertile by intelligent management such as digging, draining, etc., and by the addition of substances known to be lacking.

Soil Moisture.—One of the most important conditions of fertility in soils is their power of absorbing and retaining sufficient moisture for the needs of the crops they bear. A dry soil is a barren one no matter what proportion of plant food it may contain or how good its physical condition. Very few cultivated crops attain their fullest development, owing to lack of sufficient moisture. Larger crops would be obtained if plants were supplied in the growing season with all the water they could use. This is one of the features of intensive cultivation or French gardening.

Barren or sterile soils are so called when they cannot supply the plant with the minimum materials it requires, in a suitable state and quantity. This may be brought about by continuous cropping, and neglect in the way of adding manure in order to replace substances removed by crops and by percolation to the subsoil. Rich virgin soils may produce good crops for a few years, but cannot do so indefinitely without proper treatment. Market-garden land near towns where a good supply of dung is available, and also gardens worked on the "French" or "Intensive" system, gain in fertility owing to the constant cultivation and the large quantity of manure used.

Exporting or marketing corn, seeds, roots, fruits, vegetables, and cattle and dairy produce tends to exhaust the land, whilst the purchase of cotton and other feeding cakes, and maize, wheat, linseed, bones, manures, etc., for use on the farm will add to the fertility of the soil.

Land Rent.—The value of land for market-gardening varies from £2 to £10 per acre, and for agricultural purposes from 5s. to £5 per acre. Forfar red lands, which are very suitable for potatoes, are rented at £4 to £4 10s. per acre. Lincoln warp soils are rented at about £3 per acre, and Black Fen land £2 to £2 10s. per acre.

CHAPTER VII.

THE NEW SOIL SCIENCE AND STERILISATION OF SOILS.

Soil Science.

No book on gardening can be said to be complete that does not make some reference to what is known as the new soil science. This concerns the work performed in the soil by minute organisms (bacteria) breaking down organic matter and changing it so as to form new compounds for the use of the living plant. A good mechanical condition of the soil and an adequate supply of humus (organic matter) are necessary for the well-being of the useful bacteria which inhabit the soil.

These bacteria are universally distributed throughout cultivated soil; any soil in which they are not present would be sterile. They occupy the surface soil in almost countless numbers, as many as four millions having been estimated to occupy one cubic inch. Below the fertile surface soil they rapidly become much less in number, comparatively few being present in the subsoil, which helps to explain why subsoil is sterile when brought to the surface before deep cultivation has had time to make it into a suitable breeding place for bacteria. These organisms are most active in a temperature of 65° F. They cease to work when the temperature falls below 10 or rises above 100 degrees F. To enable them to perform their functions properly it is necessary that the soil should be warm, moist, and well aerated, also that a certain amount of lime is present as a base to neutralise the acids which they produce.

Some crops are supposed to exercise a harmful or even poisonous effect on the soil in which they grow. This is particularly noticeable when the same crop is grown for a number of years in the same situation, and is supposed to be due to some deleterious substance, excreted by the roots, which reacts harmfully on the same kind of crop if grown repeatedly in the same soil. When such a condition arises the land is said to be "sick" of a crop. It is more probable, however, that the repeated growth of the same description of crop uses up certain salts, etc., in the immediate vicinity of the roots, thus upsetting the natural balance which formerly existed. Soil "sickness" is more apparent with certain soils and certain crops than with others. There are various ways of counteracting or "sweetening" "sick" soil, viz. a proper system of rotation (as described in another chapter), suitable manuring, liming, and thorough cultivation to aerate the soil.

In some cases, *e.g.* plants when grown in pots or boxes, or crops of tomatoes, cucumbers, melons, etc., grown under glass—conditions more or less artificial—it may be necessary to obtain a fresh supply of soil in order to be successful with such crops. The soil removed may be mixed with gas lime or burnt lime, and, after a season of rest and exposure to frost and air, may again be used, but preferably for outdoor crops.[1]

Or the soil may be sterilised by heating, steaming, or by chemical treatment, thus changing the conditions under which the inhabitants formerly existed, by destroying those harmful organisms which had gained the ascendency in the struggle for existence.

These matters are now being carefully investigated at Rothamstead Experimental Station and in the United States of America. The results so far obtained promise to be of great practical value to market-gardeners in the near future.

[1] Soils which have been sterilised may again be rendered fertile by adding farmyard or stable manure and a small quantity of lime, which will act as a "starter" to the useful bacteria checked during the process of sterilisation.

Sterilisation of Soils.

There are many methods of sterilising soil for the destruction of insects and other forms of animal life in the soil, the spores of diseases which attack crops, and the seeds of weeds which are troublesome to cultivators. Scarcely any of the under-mentioned methods of sterilisation can be said to be complete on a large scale, but sufficiently so to exterminate a large proportion of the harmful life in the soil and by thus destroying competition give the succeeding crop a better chance.[1]

(1) *Burning the Soil.*—This is only practicable on a small scale.

(2) *Baking or Heating the Soil.*—The temperature should reach 180° to 200° F., and should be kept at this for at least an hour.

(3) *Steaming the Soil* in a specially constructed soil bin as explained below :—

> The subject of apparatus for soil sterilisation is not very far advanced, and there is considerable room for ingenious and useful work on the part of the horticultural engineer. Good results have been obtained—
>
> (i) By leading steam into the soil through a series of pipes made of gas-piping shaped like a harrow, with nine tynes out of the ends of which the steam issues (see Fig. 18). The instrument may be 2 feet 6 inches square with tynes 9 inches long; the best dimensions, however, are not settled. It is placed tynes downwards in a wooden case without top or bottom, capable of holding about a cubic yard or more of soil. Soil is filled in, and steam at a pressure of 50 to 80 lb. is blown in for twenty minutes. As each yard of soil is done it is thrown into a heap to cool gradually. By having two instruments at work the boiler is kept constantly going. The heap should not be exposed

[1] Soils which have been sterilised may again be rendered fertile by adding farmyard or stable manure and a small quantity of lime, which will act as a "starter" to the useful bacteria checked during the process of sterilisation.

unnecessarily to rain, as valuable plant food speedily forms and is liable to be washed out.

(ii) A grid-iron instrument may be used in exactly the same manner with a series of small holes drilled in the pipes (see Fig. 18).

(iii) In the United States of America drainage pipes are sometimes laid in the house at about 9 inches below the surface, steam is then blown in for two hours and allowed to escape through the soil. This method has obvious disadvantages for British greenhouse practice.

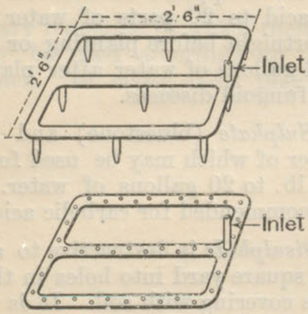


Fig. 18.—The "Harrow" and "Gridiron" methods of sterilising soil.

(iv) Another American device successfully used for sterilising tobacco seed beds is to make a steam-tight oblong box of stout galvanised iron 10 feet by 6 feet by 6 inches, lay it on the soil prepared for sowing, and push it down 1 or 2 inches, then blow steam in at 80 to 100 lb. for forty minutes. On the principle of the warming-pan the soil speedily becomes heated. This is sometimes done by contract at a charge of $\frac{3}{4}$ cents per square foot; its advantage is that it does not necessitate moving the soil from the house. (*Gardeners' Chronicle*, March 2, 1912.)

The temperature should reach 180° to 200° F. and be kept at this for at least one hour. (The cost of treating old soil by heating or steaming is 2s. to 3s. 6d. per ton.)

(4) *Lime* is a great sweetener of soils and may be used with beneficial results. Gas lime may also be used for the destruction of insect pests and harmful bacteria in the soil.[1]

(5) *Frost* also destroys a large amount of animal life in the soil, so that greenhouse soil wheeled outside and exposed to hard frost, and afterwards limed, is in a much better condition for plant growth.

(6) *Carbolic Acid* applied to the soil at the rate of 1 part carbolic acid to 20 parts of water three times at intervals of a fortnight before planting or sowing, and 1 teaspoonful to 4 gallons of water after planting, kills the spores of many fungoid diseases.

(7) *Copper Sulphate* (bluestone) and *Iron Sulphate* (copperas), either of which may be used for watering soil, at the rate of 1 lb. to 20 gallons of water. They should be applied as recommended for carbolic acid.

(8) *Carbon Disulphide* is destructive to all animal life. Inject 1 oz. per square yard into holes in the soil 6 inches deep, afterwards covering with soil. It is very dangerous to use, being a highly inflammable liquid. Cost about 6d. per lb.

(9) *Formalin* at the rate of 1 pint to 20 gallons of water, a 5 per cent. solution of Lysol, or Jeyes' Fluid at the rate of 1 oz. to 1 gallon of soft water, may be used for watering the soil a week before planting or sowing.

(10) *Permanganate of Potash* is a powerful disinfectant. About 1 oz. to 5 gallons of water makes a rose-red solution which may be applied to the soil. Cost about 8d. per lb.

[1] Soils which have been sterilised may again be rendered fertile by adding farmyard or stable manure and a small quantity of lime, which will act as a "starter" to the useful bacteria checked during the process of sterilisation.

(11) *Naphthaline* at the rate of 2 oz. per square yard and well mixed with the soil for the destruction of insect life in the soil.

(12) *Toluol* may also be used, in which case the soil should be thoroughly moistened with it, then spread out in a fairly thin layer, and raked over from time to time until the sterilising substance has evaporated. Cost about 1s. 9d. per lb.

(13) *Ammonium Carbonate* is useful for the destruction of millipedes and worms in grass land. A 2 per cent. solution should be used, and is best applied in the evening.

(14) Proprietary remedies, of which there are many on the market, may be used according to the directions supplied with each. In many cases they are to be depended upon.

CHAPTER VIII.

TILLAGE AND OTHER OPERATIONS CONNECTED WITH THE SOIL.

Drainage.—It is important that water should pass freely through the soil, which would otherwise become water-logged, cold, and sour. Bacteria useful to plant life—excepting, of course, marsh and bog plants—can only flourish in well-drained soil, and by their presence promote a healthy growth of the roots. Soils should be of such a nature that they can absorb and retain moisture, to replace that taken by plants or lost through evaporation.

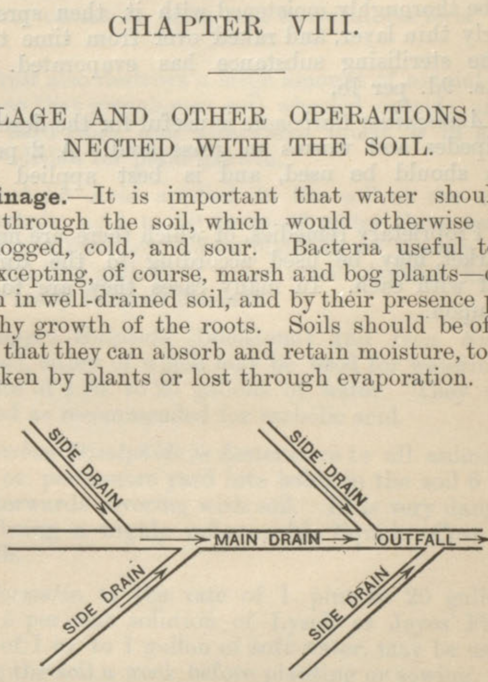


Fig. 19.—Method of Draining Land.

Sand or sandy loams do not generally require draining, as they cannot hold much moisture, in fact sand has the least water-retaining or absorbing power of any soil. The water-retaining capacity of clay and peat is respectively five and six times greater than sand. Water-logged soil requires an enormous amount of sun heat to warm it in the spring, consequently crops are late when grown on such soil. Drainage makes the soil warmer and drier by removing superfluous water, thus enabling warmer atmospheric air to take its place.

Cost of Draining.—The following figures will afford some indication of the cost of draining various types of soil:—

Kind of Soil.	Distance of Drains Apart.	Depth of Drains.	Rods per Acre.	Cost per Rod, Cutting and Filling.	Cost per Acre, Cutting and Filling.	Number 12-inch Drain Pipes required per Acre.	Cost of Drain Pipes at 30s. per 1,000.	Total cost of Drainage per Acre.
	feet.	ft. in.		d.	£ s. d.		£ s. d.	£ s. d.
Sandy loam ...	39	4 0	68	7½	2 2 6	1,117	1 13 6	3 16 0
Medium loam ...	24	3 0	110	6	2 15 0	1,815	2 14 6	5 9 6
Stiff adhesive clay	16½	2 6	160	7	4 13 4	2,640	3 19 2	8 12 6

Irrigation is the operation of causing water to flow over land for nourishing plants.

Irrigation and land drainage are brought into requisition, when needful, in the control of soil moisture for the betterment of conditions in crop production.

Irrigation supplements the natural rainfall or spreads water over lands where the rainfall is slight, and is found necessary in some countries and on some soils for certain crops. There are various ways in which the land may be flooded, when required, such as by laying water mains on the land and cutting channels for the water to run to the various parts of the field or garden, or by allowing the water to form in a continuous sheet or thin veil over the surface. Rivers or streams may have "dams" constructed so that the waters may overflow the surrounding land as required.

Ploughing is the common method of soil cultivation practised on farms, being much cheaper than spade work.

Digging is the common method of soil cultivation practised in gardens.

The various modes of digging are as follows :—

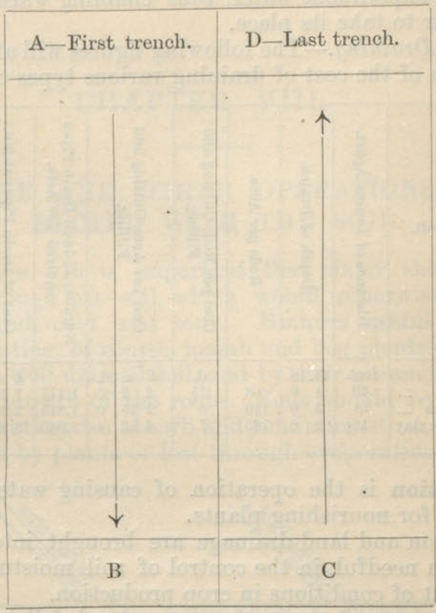


Fig. 20.—Simple Digging.

1. *Simple Digging* consists in turning the soil to the depth of a spade, *i.e.* 9 to 12 inches, or one "spit" (spade) deep, and is performed in the following manner :—

Commence operations at the end of the site to be dug by opening a trench one foot wide and a "spit" deep. If the portion to be dug is narrow, the soil from the first opening will have to be wheeled to the opposite end of the site and deposited there in readiness for filling in the last trench. Should, however, the land be sufficiently wide it will be found convenient to divide it into two portions, as shown in the sketch. In this case the soil from the first trench A should be placed alongside the last trench D, and when B is dug the soil from C will be utilised for filling B.

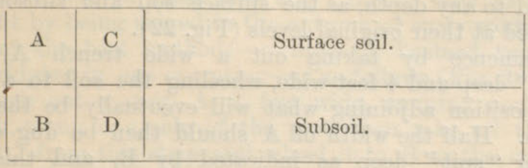


Fig. 21.—Double Digging.

2. *Double Digging or Bastard Trenching.*—In this case the soil is worked two "spits"—about 18 inches—deep, the subsoil being retained in its original position.

Open a trench A a "spit" deep, and two spades (about 18 inches) wide, shovel out the "crumbs"—the loose soil—and wheel the whole to a position convenient for filling in the final trench. The subsoil B should then be forked over, and the soil from C turned over on top of it, levelling off with the "crumbs," prior to forking the subsoil D.

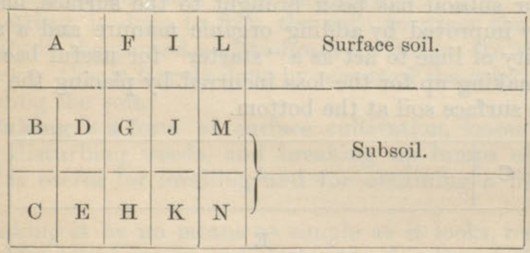


Fig. 22.—Trenching.

3. *Trenching.*—Trenching proper may be defined as digging the soil 2 to 3 feet deep, bringing the subsoil to the top, and placing the top spit at the bottom. It is, however, bad practice to bring to the surface subsoil which has never been previously disturbed, and this mode of trenching should only be resorted to when the subsoil has been gradually brought into a fit state of cultivation.

The following method of trenching is especially applicable to freshly broken land, or land which has never been worked to any depth, as the surface soil and subsoil are retained at their original levels (Fig. 22).

Commence by taking out a wide trench A, one "spit" deep and 4 feet wide, wheeling the soil to a suitable position adjoining what will eventually be the last trench. Half the width of A should then be dug out a further "spit" deep as indicated by B, and this soil should be added to the soil removed from A, as it will be required for filling in the bottom of the final trench. The subsoil C below B should then be forked over, thus working the soil to a total depth of about 30 inches. Now turn D on to C, fork over E, and place F on top of the original position of B, thus completely filling half of the first opening A.

G will take the place of D, and I the second half of A, and so on, each subsequent letter, apart from the lowest series, always representing an opening 2 feet wide. While trenching is in progress suitable manure may be incorporated with the subsoil. Land newly trenched, *i.e.* when inferior subsoil has been brought to the surface, may be greatly improved by adding organic manure and a small quantity of lime to act as a "starter" for useful bacteria, thus making up for the loss incurred by placing the more fertile surface soil at the bottom.

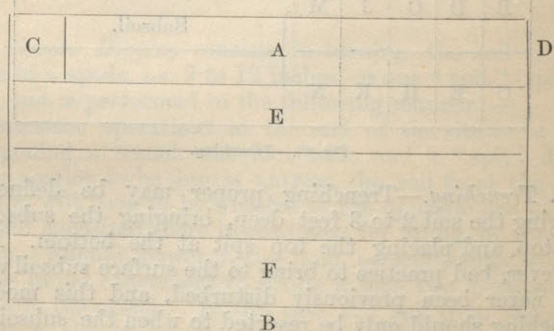


Fig. 23.—Ridging.

4. *Ridging.*—This consists in placing the soil in ridges at the time of digging, in order to expose a larger surface to the action of frost and air. Heavy soils especially benefit by being ridged in the autumn or early winter, and one of the best methods—completing bastard trenching and ridging in one operation—is as follows (Fig. 23):—

Mark out a strip A, 2 feet wide, running north and south, along one side of the plot, then take off the top "spit" from this strip and wheel it to B at the opposite side of the plot. Now turn over the subsoil at A, first removing enough from C to D to admit of easy working, returning the removed portion when the end of the trench is reached. The worked subsoil may then be covered with a layer of manure (the manure should be arranged in several convenient rows running across the plot from east to west) and the top spit removed from the next 2-foot strip E and laid ridge-shaped ($\wedge$) on A, thus completing the first strip.

Repeat the operations on each strip across the plot, using the soil wheeled to B to cover the manure in the last trench F. The work is then completed, the whole plot being laid in alternate ridge and furrow.

Rolling is done to firm the soil, to press the plants tightly in the ground, and to break up lumps. In gardens, however, this is largely done by means of the rake and by treading the soil.

Raking is a form of surface cultivation, loosening the soil, disturbing weeds, and breaking up lumps or clods, and is useful for levelling and for obtaining a fine surface.

Raking is by no means so simple as it looks, requiring considerable practice and dexterity of action. It is not necessary or desirable to remove all the stones from the surface, but only the largest.

Hoeing or surface cultivation is of great advantage to growing crops.

Weeds are killed and checked.

The ground is kept more moist, air admitted, and a fine surface tilth formed which prevents cracking and loss of moisture.

Crops make greater progress, mature earlier, and generally command a better price, which more than compensates for the extra cost of labour incurred.

Stirring or loosening the soil by means of a fork or rake is also beneficial to growing crops.

Mulching, or top-dressing soil with manure, leaf-mould, spent hops, grass clippings, etc., is practised on light soils, thus restricting the evaporation of moisture from the soil during dry weather. By this means the roots are kept cool and moist, watering is saved, and the soil is manured. Straw or grass clippings are placed round strawberry plants to prevent the fruit being damaged or splashed. If applied in winter to newly planted trees or shrubs, the roots are protected from frost by the checking of the radiation of heat.

When the soil is at, or near, freezing point the plant's roots cease to take in water, so that if evaporation is at the same time going on from the surface of the stem or leaves, there is nothing to repair the loss, and the plant may dry up completely and be killed.

Watering, if deemed necessary in spite of hoeing, mulching, etc., should be done by giving a thorough soaking to reach all the roots, as this encourages them to go still deeper. A slight or surface watering tends to keep the roots near the top, and, unless persistently followed up, results in more harm than good to the plants. Watering is best done in the evenings. This allows plenty of time for the water to soak into the soil and the plants are able to fortify themselves against the next day's drought. Moreover growth is probably more active during the night. It is better, however, to water seedlings in the early morning. If done at night the moisture attracts slugs and woodlice and many seedlings are destroyed.

Shortly after watering it is advisable to hoe the surface to prevent the formation of a crust which cracks when thoroughly dry.

Weeding.—This operation in the case of young weeds is best done by means of the Dutch hoe, or if the weeds are very large or occur among seedlings they should be removed by hand. Deep-rooting kinds or those with underground stems, like couch grass, coltsfoot, horsetail, bishop-weed, bind-weed, etc., should be removed by means of a fork or spade and afterwards burnt.

Seed Sowing.—Seeds may be sown broadcast by hand over the surface of the soil, which should then be raked or harrowed to cover the seeds. In garden practice, however, seeds are generally sown thinly in drills, drawn by a hoe or rake, at depths varying from $\frac{1}{2}$ inch to 3 or 4 inches, according to the size and kind of seed and also the character of the soil—the lighter the soil the deeper may the seeds be sown.

Soil for the reception of seed should be even and firm, with a fine loose surface, not pasty or sticky nor dust dry. After sowing, particularly on light land, press the surface down with the back of the spade, or by treading or rolling, to conserve the soil moisture.

Birds are very fond of seedlings and give a lot of trouble, especially in hot weather, the tender and sweet young sprouts being very palatable to them. Freshly mown short grass may be scattered over the surface of seed beds, or the fixing of black thread over the rows will be found a useful protection from birds. The thread may be fixed to pegs six to nine inches in length, these being pushed about three inches into the ground and the thread stretched tightly from end to end, about three inches above the soil.

Mice, too, will sometimes give trouble, especially in the case of large seeds like peas, beans, and the seeds of trees. As a protective measure damp the seeds and shake them up in red lead, or soak them in paraffin oil for an hour before sowing.

Seedlings of vegetables and flowers are often attacked by slugs. The damage, however, may be greatly reduced by applications of soot, or fine slaked lime in the form of powder, over the plants at frequent intervals. In the case of seed sown in pots or boxes it is desirable that the soil be sterilised by pouring boiling water over it. This kills all insects and insect eggs, otherwise tiny slugs and snails are apt to hatch and destroy the seedlings and the seedsman is blamed for "bad" seeds.

Earthing up plants with soil encourages a greater development of stem or leaf-stalk, and by blanching them causes the plants to be more tender and succulent; examples—celery, leeks, seakale, cardoons, and to a certain extent asparagus. Peas, beans, cauliflowers, and cabbages are sometimes earthed up to keep the plants firm in the ground and encourage the production of lateral roots. Potatoes are earthed up (1st) to prevent frost from damaging the tender shoots, (2ndly) to encourage more underground stems to arise from the haulms and thus add to the yield of the crop, and (3rdly) to prevent the tubers greening by exposure to light.

Thinning, or singling, plants such as turnips, carrots, onions, parsnips, beet, or spinach, results in larger and more uniform produce, better suited for marketing, and consequently realising a higher price.

Early thinning prevents the attacks of insect pests and damage to the roots, and all thinning, as already stated, is best done in showery weather.

Transplanting is practised with leeks, onions, cabbage, greens, cauliflower, lettuce, etc., but not with tap-rooted crops. It is best done when the soil is moist, or in showery weather. Should hot dry weather immediately follow, give the soil a good soaking of water at intervals until the plants are established. The soil should be made firm about the roots after planting.

CHAPTER IX.

MANURES.

Classification and Properties.

Manures.

Originally the term "to manure" was used in reference to hand tillage or working the land, but the term is now applied to any substance which by its application contributes to the fertility of the soil. Thus lime, marl, leaf-mould, vegetable refuse, farmyard manure, stable manure, nitrate of soda, etc., are manures, and the application of these to the soil is termed manuring.

Manures may be classified as (*a*) *Artificial or Chemical*, and (*b*) *Natural*.

Artificial or chemical manures are those which have come into use during recent times (since about 1840). These generally pass through the hands of the manure manufacturer or merchant. Examples: nitrate of soda, kainit, basic slag, superphosphate, and sulphate of ammonia.

Natural manures have been in use from time immemorial. They do not generally pass through the manufacturer's hands. Examples: farmyard manure, vegetable refuse from the compost heap, seaweed, marl, and lime.

Artificial or chemical manures may be grouped according to their composition:—

1. *Nitrogenous manures*—containing nitrogen.
2. *Potash manures*—containing potash.
3. *Phosphatic manures*—containing phosphates.
4. *General manures, i.e.* those containing nitrogen, potash, and phosphates, thus constituting a complete manure. The

value of a general manure depends on the amount present of one or more of these substances. Proprietary manures, so widely advertised for general purposes or for special crops, also belong to this group. These manures generally give good results as far as a well-balanced growth is concerned, but many are sold at prices that will not allow of their use on a large scale, or, if the price is low, the quality may be low also—mixing, compounding, and advertising have to be paid for.

ARTIFICIAL MANURES.

(1) **Nitrogenous Manures.**—These promote the growth of stem and leaf.

Nitrate of soda or Chili saltpetre was first imported in 1830, from the rainless districts of Chili and Peru. It is found mixed with earth, salt, and sulphate of lime, which are extracted before exportation. Nitrate of soda is a very soluble and quick-acting manure and must be used sparingly, when the plants are in active growth, and during showery weather if possible, the usual quantity being ½ oz. to 1 oz. per square yard. It becomes damp in moist weather, and should be stored in a dry shed; any lumps should be broken up before being used. It must not be mixed with superphosphate. Nitrate of soda contains about 15 per cent. nitrogen.

Nitrate of potash or saltpetre is imported mostly from India. It is a very soluble manure, and should be used at half the rate of nitrate of soda. For choice plants, when they are coming into flower, it is very valuable. Nitrate of potash contains about 17 per cent. nitrogen.

Lime nitrate (calcium nitrate) is a new source of nitrogen obtained from the air and contains about 12·5 per cent. nitrogen and 25 to 30 per cent. lime. This manure is manufactured at Notodden, in Norway. It is a white substance, only partially ground; is soluble in water and immediately available. Similar methods of application should be adopted as recommended for nitrate of soda. Lime nitrate supplies lime as well as nitrogen. Being of a hygroscopic (deliquescent) nature it should be stored in a tub or box in a dry place. It is supplied in wooden casks holding about 2 cwt.

Nitrolim (calcium cyanamide) or lime nitrogen is another new source of nitrogen and is also obtained from the air; it contains about 18 per cent. nitrogen, and is manufactured in Italy and in Germany.

It possesses a different chemical composition, appearance, and properties to lime nitrate. This manure is a black, heavy powder, similar in appearance to basic slag. Care has to be taken in applying it, as the dust is irritating to the eyes, unpleasant and even injurious to breathe, and also possesses an unpleasant smell, especially when moistened. Nitrolim is inclined to damage seedlings and should be applied about a week or ten days before sowing. It should not be used as a top-dressing on a growing crop. This manure is not so soluble as lime nitrate. It may be mixed with basic slag, bone meal, and potash manures. Like lime nitrate, it should be stored in a dry place.

Sulphate of ammonia is a bye-product from gas works and contains about 20 per cent. of nitrogen. It is soluble in water, but its action in the soil is not so rapid as nitrate of soda or nitrate of lime. It should be applied at the time of planting or sowing, and may be mixed with sand, or soil, to allow of a more even distribution. It should not be mixed with *lime* or *basic slag*, unless the mixture is to be applied immediately to prevent loss, but may be mixed with superphosphate, dissolved bones, kainit, and other potash manures. This manure may be used at the same rate as nitrate of soda. The best results are obtainable on land containing lime or chalk.

(2) **Potash Manures.**—These have a tendency to increase the quality and flavour of vegetables and fruit, the store of sugar in grapes, apples, beetroot, etc., and the scent in flowers. There are several kinds of potash salts available as manures.

Kainit, derived from Stassfurt, Germany, is the commonest and cheapest form of potash. It contains about $12\frac{1}{2}$ per cent. potash and a large percentage of alkaline impurities. Autumn and winter are the best times to apply this manure, and at the rate of 2 to 4 oz. per square yard, or 4 to 6 cwt. per acre. As a potato manure it is not desirable, and especially so on heavy land. Kainit is particularly suitable for light soils.

Muriate of potash contains 50 per cent. of potash and is applied at the rate of ½ to 1 oz. per square yard or 1 to 1½ cwt. per acre, during winter or spring. It increases the size of fruit and promotes growth generally, but is not suitable for potatoes on some soils.

Sulphate of potash contains about 52 per cent. of potash. It is much purer than kainit and may be applied in spring at the rate of ½ to 1 oz. per square yard or 1 cwt. per acre. All crops on practically any kind of soil will be benefited by this manure.

Nitrate of potash (saltpetre). See page 92.

Phosphate of potash supplies both potash and phosphates. It is a very expensive manure, but valuable for choice plants and crops under glass. It is very soluble and may be used at the rate of ½ oz. to a gallon of water as a stimulant for tomatoes, vines, and fruit trees under glass, or with saltpetre, ½ oz. of each to 1 gallon of water. The liquid must not come in contact with foliage.

Wood ashes contain from 5 to 10 per cent. of potash and are very valuable for mixing with artificial manures. They form an excellent top-dressing for strawberries and many other crops when applied at the rate of 5 to 10 cwt. per acre. The quantity of wood ashes available is very limited, but their use is attended with good results.

(3) **Phosphatic Manures,** of which there are several kinds available, promote fruitfulness and early maturity.

Superphosphate of lime is largely imported from Spain and Portugal. This manure is made from rocks containing from 40 to 80 per cent. phosphate of lime, which is rendered available by a chemical process, namely, by treatment with sulphuric acid. Coprolites, the fossil excreta of extinct animals and fossilised bones, found in Cambridgeshire, Bedfordshire, and Suffolk, were formerly dug out, ground to a powder, and treated as above. Superphosphate may be used in spring just before sowing or planting, at the rate of 2 to 3 oz. per square yard, or 4 to 8 cwt. per acre.

Bone superphosphate, or dissolved bone, made in the same way as mineral superphosphate, may contain a small quantity of nitrogen, which would make it more valuable on some soils than mineral superphosphates. This was one of the first artificial manures to come into use. Rate of application as above.

Raw bones are slow in action and should therefore be broken in small pieces of about a quarter of an inch or less. In this state they are valuable for vines and other fruits.

Burnt bones are obtained from some of the large meat works in America. Some of the higher grade superphosphates are manufactured from these.

Bone meal contains about 45 to 50 per cent. of insoluble phosphate of lime and 3 to 5 per cent. of nitrogen. It forms an excellent manure for fruit trees, lawns, and potting soils, and may be used in the open either in autumn or spring at the rate of 3 to 4 oz. per square yard, or 3 to 8 cwt. per acre.

Steamed bone flour contains less nitrogen but more phosphates than raw bones. Used as above it is beneficial on light loams and gravelly or sandy soils.

Basic slag (Thomas' phosphate powder) is obtained as a bye-product in the manufacture of steel by a certain process, the Bessemer Basic Process. For a long time known as a waste product: when ground to a fine powder, it now forms one of the principal phosphatic manures. It is a slow-acting manure, but valuable for the phosphoric acid and lime which it contains. Its value depends on fineness of grinding and the percentage of phosphates contained. Four cwt. of basic slag are equal to 3 cwt. of superphosphate in fertilising value. It should not be mixed with superphosphate or sulphate of ammonia, but may be mixed with nitrate of soda, kainit, or bone meal. Basic slag is valuable on soils deficient in lime, and on sour land in checking the ravages of "Finger and Toe" disease. Moreover it is suitable for most crops, especially those belonging to the Leguminosae (pea and bean family). Basic slag may be applied in autumn, winter, or early spring, at the rate of 4 to 8 oz. per square yard, or 4 to

10 cwt. per acre, or even in larger quantities on newly cultivated land. Fruit plantations may have a dressing of as much as 1 ton per acre.

NATURAL MANURES.

Farmyard manure is one of the most important to the farmer and gardener.

Its value depends on the kind of stock kept, age of the animals, kind of food used for feeding, care in making up the heap, and method of storing. Long exposure to air and rain lessens its value ; a little gypsum sprinkled over the heap may help to retain some of the ammonia which might otherwise be lost.

Turning over to hasten decay and keeping the manure fresh improves its quality for garden purposes. It is especially valuable for light soils.

Farmyard manure is a complete manure containing all the necessary ingredients required by plants from the soil, but in small proportion to its bulk. It contains much humus, which is of great importance in maintaining the fertility of the soil, hence its value on all soils.

Light soil is consolidated and heavy soil is lightened by a free use of farmyard manure.

Quantity to apply.—12½ to 25 tons per acre is the usual quantity applied, but as much as 50 tons or more is sometimes applied by market-gardeners.

Analysis.—A ton of average farmyard manure contains

1275	lb.	organic matter,
225	,,	mineral matter,
10	,,	nitrogen,
12	,,	potash,
8 to 10	,,	phosphoric acid.

Stable manure, or horse dung, is lighter than cow manure and is best suited for heavy soils.

Analysis of stable manure: A ton of good stable manure contains about—

11	lb.	nitrogen
12	,,	potash
8	,,	phosphoric acid
16	,,	lime

Pig manure is also valuable and particularly suited for application to light soils.

Sheep manure, which is only available in small quantities, is very valuable, especially when dissolved in water and used for watering choice pot plants.

Hen manure and pigeon manure, which are four to eight times as valuable as farmyard manure, should be placed in barrels or sacks, and stored in a dry shed. Use carefully at the rate of 1 to 2 lb. per square yard. If desired these manures may be added to the general compost heap for future application to the soil.

Seaweed contains a fair amount of potash and is very valuable for potatoes, onions, mangels, cabbage crops, and asparagus. An analysis shows that it contains the following manurial constituents:—

80	per cent.	water
·5 to 1·5	,,	nitrogen
4 to 5	,,	potash
·5	,,	phosphoric acid

When seaweed is readily obtainable it should be used freely, after it has had time to rot. Placed in heaps with soil or lime added, it can, when decomposed, be used in a similar manner to farmyard manure.

The *compost heap* is composed of all waste products and weeds of the garden, to which may be added road scrapings, ditch scourings, soot, and burnt refuse. Sewage and soap-suds may also be thrown over the heap to hasten decay. Soil from such a heap when properly mixed may give better results than farmyard manure.

Leaf-mould is formed by the decomposition of fallen leaves, which may be collected, placed in heaps, and turned over to hasten decay, after which they make valuable manure suitable for nearly all kinds of soil, especially heavy clay soils, calcareous and light or sandy soils. Potatoes do remarkably well planted in leaf-mould. Leaves of a hard texture such as beech, oak, and Spanish chestnut should be kept separate for potting purposes.

Green manuring, i.e. the growing of a crop for the express purpose of ploughing or digging it into the land to enrich the soil with nitrogen and humus. This system has much to recommend it as a means of restoring the fertility of garden soil which has become unprofitable. It is more particularly suited to light or sandy soil. Apart from the nitrogen, the large quantity of organic matter adds materially to the improvement of the physical properties of soils by enabling them to hold more moisture. In addition the slow decay of the green crop itself supplies moisture, and the gases liberated act beneficially on other substances in the soil.

In farm practice, however, the green crops are usually fed off by cattle or sheep. The dung and residue of the roots, stems, or leaves are afterwards ploughed into the land. Green manuring thus serves the double purpose of feeding the stock and manuring the land. The crops usually grown for this purpose are mustard, rape, rye, buckwheat, and such leguminous crops as crimson clover, red clover, white clover, peas, vetches, lupins, and tares. Leguminous crops through the nodules on their roots have special power in fixing the free nitrogen of the atmosphere, which is a direct gain to the soil.

Peruvian guano was introduced from Peru in 1839 (a similar manure is also imported from the sea coasts of tropical America, Africa, etc.). It is found in rainless districts practically intact, and is a very valuable and complete manure for general purposes. The supplies are, however, running short, and the quality is often much lower now than formerly. It may be applied at the time of planting or as a top-dressing at the rate of 4 to 6 cwt. per acre, 2 to 4 lb. per pole, or $1\frac{1}{2}$ to 2 oz. per square yard.

Fish guano or fish meal is obtained from fish-curing factories and contains more nitrogen and phosphates than raw bones. It is a slow-acting manure, best applied in autumn or winter. Fish guano is a useful manure for fruit trees, flower borders, etc., and should be used at the rate of 2 to 4 oz. per square yard, or 5 to 10 cwt. per acre.

Native guano or sewage treated by the A.B.C. process is a most valuable manure. This process of sewage treatment is one by which certain absorbents and precipitants are added to the sewage, for the purpose of extracting its fertilising constituents. Native guano is a complete manure and may be used at the rate of 10 to 15 cwt. per acre for most garden crops and on nearly all soils.

Spent hops are useful for mulching or top-dressing light, sandy, or gravelly soils, and also for digging into the soil. They will be found beneficial to green crops, turnips, beet, mangels, and onions.

Malt dust, from barley maltings obtained from breweries, is suitable for fruit trees and shrubs, and may be applied at the rate of 30 to 40 bushels per acre, or $\frac{1}{4}$ bushel per pole.

Rape dust is a bye-product from oil mills. It is a complete manure, valuable for soils poor in humus, and contains about 5 per cent. nitrogen, but is poor in potash and phosphates. Rape dust is very valuable for onions, potatoes, and root crops, and may be used at the rate of $\frac{1}{2}$ to $\frac{3}{4}$ lb. per square yard. It is supposed to be a deterrent to wireworms.

Blood, obtainable from slaughter-houses, is a very valuable form of manure, and may be applied to the soil in a dried state, or mixed with other substances. Care in its use is essential.

Horns, hoofs, meat refuse, greaves, shoddy, woollen refuse, etc., are all valuable, but slow-acting, manures containing nitrogen. They are used in the manufacture of some proprietary manures.

Liquid manure may be made from cow, horse, sheep, or poultry manures, or the liquid drainings from cowsheds, stables, or manure heaps may be utilised in a dilute state. Peruvian guano and, indeed, almost any kind of artificial manure may be dissolved in water and applied during showery weather. Should the soil be very dry a soaking of water, given shortly before, will prepare the way for the solution, which will diffuse more readily through the moist soil, and, the roots taking it up with the soil moisture, there will be no damage whatever to the plant. Weak doses should be the rule, and always with judgment as to the quantity to apply. Liquid manure may be applied to fruit crops, most garden crops, and pot plants, and is particularly valuable on light soils in dry seasons, if plenty of water is also used. As far as possible care should be taken to keep the manure from coming in contact with the foliage of the plants.

If 4 oz. of gypsum is added to a gallon of liquid manure the roots will not be burnt or damaged.

Any of the following liquid manures are suitable for watering pot plants, greenhouse crops, and outdoor vegetables, fruit, and flowers:—

1 peck of poultry manure to 30 gallons of water
" pigeon " " " "
" sheep " " " "
" horse " " " "
" cow " " " "
" soot " " "
½ lb. of Peruvian guano " " "
1½ lb. of superphosphate and ½ lb. of nitrate of soda to 30 gallons of water.

Lime exists in soil as carbonate of lime. It is extremely valuable for clay soil, sour soil, peat soil, and heavily manured land. An application of lime will benefit nearly all crops. The old practice was to apply lime every 6 or 10 years, but more frequent applications are now the rule. Ten to 20 cwt. per acre every three years is considered a light dressing, and 1 to 2 tons or more, during the same period, constitutes a good dressing. For garden purposes ½ to 1 bushel per pole, or ½ to 1 lb. per square yard, is the quantity usually applied.

Lime sets free potash in the soil, and acts on vegetable matter (peat, etc.), by setting free ammonia and water and destroying the excess of humus. Lime is therefore best used in conjunction with manures on which it can act.

"Lime and lime without manure,
Will make both farm and farmer poor."

The application of farmyard manure and probably all organic manures, and also nitrate of soda, diminishes the loss of carbonate of lime in the soil. Sulphate of ammonia removes half its own weight of lime and nearly the whole of its own weight of chalk from the soil, but an application of lime restores the balance in the soil. Lime is also being constantly removed from the surface soil by rain.

Lime does not sink in the soil as is generally supposed, but the soil is raised by earthworms on grass land, and on arable land the lime wastes by solution. The application of superphosphate, gypsum, kainit, and kindred manures increases the loss of lime to a certain extent. Only fresh burnt lime, slaked lime, limestone, chalk, and marl contain lime in the grower's sense. In bones, basic slag, superphosphates, gypsum, and gas lime, the lime is combined with the acids, and therefore cannot act as a base when applied to correct sourness or destroy the spores of diseases which exist in the soil, *e.g.* Finger and Toe disease, Wart disease of potatoes, etc.

Forms of Lime :—

(1) *Burnt lime* (quicklime, cob lime, or lime shells) soon changes to carbonate of lime when exposed to the air or added to the soil.

(2) *Ground lime, i.e.* burnt or quicklime ground to a powder, put in bags and kept dry until required for use.

(3) *Slaked lime*, or powdered lime, *i.e.* lime reduced to a fine powder by exposure to damp air or by placing in heaps and covering with soil or adding sufficient water to cause it to fall to powder. It should then be spread evenly, and forked in a few weeks before planting or sowing.

(4) *Ground limestone, i.e.* unburnt limestone ground to a powder at the quarries, is a heavy substance, easily distributed and generally effective on soils deficient in lime.

(5) *Gas lime, i.e.* spent lime or lime which has been used for extracting impurities from coal gas, is useful for soil pests, and may be used at the rate of 1 to 2 tons per acre, $\frac{1}{2}$ cwt. per pole, or 1 lb. to 2 lb. per square yard. It is a virulent plant poison, and should be applied at least two months before cropping. (See also pages 72 and 80.)

(6) *Mortar rubble,* or old plaster, is useful on heavy land and for cacti or other succulent plants.

(7) *Chalk* is impure carbonate of lime obtained from quarries, and may be either white or a grey colour. The former, being of a soft nature, is the kind used for application to the land. It may be used in much heavier dressings than lime.

(8) *Marl,* obtained from marl or clay pits, is a clay soil which contains carbonate of lime; is valuable for application to both sandy and peaty soils.

(9) *Gypsum* or *plaster of Paris* (sulphate of lime) is particularly useful on clay or heavily manured soil, and may be applied in winter at the rate of 8 to 10 cwt. per acre. It gives good results on some soils for such plants as carnations and sweet peas.

Soot.—A good sample of soot may consist of—

1 to 5	per cent.	ammonia,
2 to 3	,,	alkaline salts,
11	,,	carbonate of lime,
2	,,	carbonate of magnesia.

Soot is therefore a very valuable manure, and may be dug into the soil ($\frac{1}{2}$ bushel per pole) or used as a top-dressing for many crops such as sweet peas, onions, carrots, beet, greens, etc. Sprinkled over seedlings it acts as an insecticide, keeping away various pests (snails, caterpillars, etc.). Soot is sometimes of very poor quality indeed, that of a light velvety or fluffy nature being best.

Epsom salts (magnesium sulphate) is a very soluble manure, not much used, but gives good results if used—dissolved in water at the rate of $\frac{1}{4}$ oz. to 1 gallon of water—very sparingly for choice plants coming into flower.

Salt (sodium chloride) acts beneficially on dry soils, but is not required near the sea, and should be applied carefully or damage may result to growing crops. It has been found valuable for cabbage crops of all kinds, turnips, beet, mangels, onions, and asparagus, but not for potatoes. Salt may be used in spring at the rate of 2 to 6 cwt. per acre, or 2 oz. per square yard, or may be applied with an equal quantity of nitrate of soda as a top-dressing.

Sulphate of Iron, also known as green copperas or green vitriol, may be useful in small quantities on some soils. The colouring of fruit, sweet peas, carnations, roses, and hydrangeas is supposed to be influenced by an application of this substance. It may be dissolved in water at the rate of 12 oz. per 30 gallons of water, or applied at the rate of 60 to 80 lb. per acre, ¼ oz. per square yard, or 8 oz. per pole. It costs about 2½d. per lb. at wholesale chemists. Sulphate of iron is said to possess antiseptic properties and therefore may have some effect on soil diseases (club root, potato wart disease, black stripe in tomatoes, and sweet pea diseases).

Average Percentages of Fertilising Matter in the more Important Manures :—

Name of Manure.	Per cent. of Nitrogen.	Per cent. of Phosphates.	Per cent. of Potash.
Sulphate of ammonia (95 per cent. pure) ...	20·2	...	...
Nitrate of soda (95 per cent. pure) ...	15·6	...	...
Basic slag	...	26—45	...
Superphosphate	...	*25—38	...
Kainit	...	...	12·5
Sulphate of potash (90 per cent. pure) ...	...	...	48·6
Muriate of potash (80 per cent. pure) ...	...	...	50·5
Peruvian guano	8·0	30·0	3·0
Raw bones	3·7	50·0	...
Boiled bones	1·3	60·0	...
Dissolved bones	2·5	†34·0	...

* Soluble phosphates.

† About 16 per cent. soluble phosphates.

To convert ammonia into nitrogen multiply by 14 and divide by 17.

To convert phosphate of lime into phosphoric acid multiply by 100 and divide by 218.

To convert sulphate of potash into potash multiply by 100 and divide by 185.

The Unit System of Purchasing Manures.*

To find the price of a unit divide the price per ton by the number of units.

A unit = one per cent. in a ton.

(i) *The Price of a Unit of Nitrogen.*—Nitrate of soda, containing $15\frac{1}{2}$ per cent. of nitrogen, is offered at £11 5s. per ton.

$$\begin{array}{lcl} & & \text{£ s. d.} \\ \text{Price of } 15\tfrac{1}{2} \text{ units} & = & 11\ \ 5\ \ 0 \\ \text{,,} \quad 1 \text{ unit} & = & \dfrac{11\ \ 5\ \ 0}{15\tfrac{1}{2}} = 14\text{s. } 6\text{d.} \end{array}$$

(ii) *The Price of a Unit of Soluble Phosphate.*—Superphosphate, containing 25 per cent. of soluble phosphates, is offered at £2 10s. per ton.

$$\begin{array}{lcl} & & \text{£ s. d.} \\ \text{Price of 25 units} & = & 2\ 10\ \ 0 \\ \text{,,} \quad 1 \text{ unit} & = & \dfrac{2\ 10\ \ 0}{25} = 2\text{s.} \end{array}$$

* A knowledge of this system is of value in the purchasing of artificial manures, especially compound manures. The latter are frequently sold at a price totally out of proportion to the actual value of the manurial ingredients—nitrogen, phosphates, and potash—they contain. The Fertilisers and Feeding Stuffs Act, 1906, provides that in an invoice the actual percentages of nitrogen, soluble phosphates, insoluble phosphates, and potash in any manure must be stated. By ascertaining the current prices of nitrate of soda, sulphate of ammonia, superphosphate, basic slag, and kainit the approximate cost per unit of nitrogen, phosphates, and potash can be found, and the true value of the manure calculated from these data.

(iii) *The Price of a Unit of Insoluble Phosphate.*—Basic slag, containing 30 per cent. of insoluble phosphates, is offered at £1 16s. per ton.

		£ s. d.	
Price of 30 units	=	1 16 0	
,, 1 unit	=	$\frac{1\ 16\ 0}{30}$	= 1s. $2\frac{1}{2}$d.

(iv) *The Price of a Unit of Potash.*—Kainit, containing $12\frac{1}{2}$ per cent. of potash, is offered at £2 10s. per ton.

		£ s. d.	
Price of $12\frac{1}{2}$ units	=	2 10 0	
,, 1 unit	=	$\frac{2\ 10\ 0}{12\frac{1}{2}}$	= 4s.

Application of the Unit System.

(i) *Nitrogen, from Nitrate of Soda, or from Sulphate of Ammonia.*

A unit of nitrogen from nitrate of soda ($15\frac{1}{2}$ per cent. nitrogen) at £11 5s. per ton = 14s. 6d.
A unit of nitrogen from sulphate of ammonia (20 per cent. nitrogen) at £12 15s. per ton = 12s. 9d.
A unit of nitrogen from sulphate of ammonia is the cheaper.

(ii) *Valuation of a Compound Manure.*

Analysis.	Value per Unit.	Total Value.
	£ s. d.	£ s. d.
Nitrogen, $3\frac{1}{2}$ per cent.	0 12 9	2 4 $7\frac{1}{2}$
Soluble phosphates, 18 per cent. ...	0 2 0	1 16 0
Insoluble phosphates, 3 per cent.	0 1 $2\frac{1}{2}$	0 3 $7\frac{1}{2}$
Potash, 12 per cent.	0 4 0	2 8 0
Total value per ton	...	£6 12 3

Table of Manures

showing the cash price per ton (October 1911) and the usual quantity to apply per acre, etc., for garden crops:—

Kind of Manure.	Cash price per ton, October 1911.	Quantity to apply per		
		Acre.	Rod or Pole.	Square Yard.
Nitrate of soda (Chili saltpetre) ...	£10 10s.	1½ cwt.	1 lb.	½ oz.
Nitrate of lime (calcium nitrate)... ...	£9	1½ ,,	1 ,,	½ ,,
Nitrolim (lime nitrogen or calcium cyanamide)	£9 to £10	1½ ,,	1 ,,	½ ,,
Nitrate of potash (saltpetre)	£20 to £21	1½ ,,	1 ,,	½ ,,
Sulphate of ammonia...	£14 10s. to £16	1½ ,,	1 ,,	½ ,,
Kainit	£2 5s. to £2 15s.	10-12 cwt.	8 ,,	4 ,,
Sulphate of potash ...	£11 to £12	3 cwt.	2 ,,	1 ,,
Muriate of potash ...	£9 to £10	3 ,,	2 ,,	1 ,,
Superphosphate of lime	£2 10s. to £3 10s.	8 ,,	6 ,,	3 ,,
Bone superphosphate ...	£3 3s. to £5 5s.	8 ,,	6 ,,	3 ,,
Basic slag (phosphate powder)	£2 to £2 10s.	20 ,,	15 ,,	8 ,,
Broken or ½ inch bones	£6 to £7	10-12 cwt.	8 ,,	4 ,,
Steamed bones	£4 to £5	10-12 ,,	8 ,,	4 ,,
Bone meal	£6 to £7 10s.	10-12 ,,	8 ,,	4 ,,
Phosphate of potash ...	£22	1½ ,,	1 ,,	½ ,,
Peruvian guano ...	£8 to £9	8 ,,	6 ,,	3 ,,
Fish guano	£8 to £9	8 ,,	6 ,,	3 ,,
Native guano	£3 10s.	16 ,,	11 ,,	6 ,,
Seaweed	...	25 tons	3 cwt.	...
Farmyard manure ...	3s. to 6s.	25-50 ,,	3-6 ,,	...
Stable manure	4s. to 7s.	25-50 ,,	3-6 ,,	...
Poultry manure ...		10-12 cwt.	8 lb.	4 oz.
Cob lime (quick or burnt lime)	15s.	1-2 tons	15-30 lb.	½ lb. to 1 lb.
Ground lime	15s.	2 tons	30 lb.	1 lb.
Ground limestone (unburnt)	...	2 ,,	30 ,,	1 ,,
Gas lime	...	2 ,,	30 ,,	1 ,,
Soot	£2 to £2 10s.	10-12 cwt.	8 ,,	4 oz.
Wood ashes	...	10-12 ,,	8 ,,	4 ,,
Salt	£1 10s.	8-10 ,,	6 ,,	3 ,,
Sulphate of iron ...	£4 to £6	½ to ¾ ,,	½ ,,	¼ ,,
Rape dust	£5	10-12 ,,	8 ,,	4 ,,

It must be distinctly understood that the prices of the various manures given above vary from season to season. The figures given represent an average price per ton in 1911. Smaller quantities would be charged for at a much higher rate than that quoted per ton, in fact the smaller the quantity the greater the price in proportion. In some cases 50 per cent. more will be charged for retailing in small quantities, so that for garden purposes it would be advisable to state the quantity required and ask for a quotation from some reliable firm of manure merchants.

The prices given, however, will furnish some guide as to the relative value of the different manures, while the relation between the value and the quantity usually applied to the land must also be compared.

How to Obtain Manures.

Cultivators should take care of all waste products, such as animal manures, leaf-mould, and soot, for application to the soil.

Artificial manures, especially proprietary kinds in small quantities, may be obtained from seedsmen, nurserymen, and stores, but the cost is fairly high, which prohibits their use to a great extent among cottagers and allotment-holders.

Cottage garden or allotment associations and horticultural societies would be doing a great service to their members if they would purchase some of the principal kinds in bulk in the original bags, and retail in small quantities, among those requiring them, at a little over cost price.

The following kinds and quantities would be sufficient to provide a supply for a large garden (about 1 acre) for about two years. Store each separately in a dry place and use as required.

2 cwt. nitrate of soda, cost about £1 6s.
2 cwt. sulphate of ammonia, cost about £1 12s.
2 cwt. sulphate of potash, cost about £1 6s.
4 cwt. superphosphate, cost about £1.

Manures Generally Suited for Light Soils.

Nitrate of soda, nitrate of lime, nitrolim, kainit, muriate of potash, salt, superphosphate, bone meal, fish meal, leaf-mould, farmyard manure, green manure or catch crops, and marl.

Manures for Heavy Soils.

Sulphate of ammonia, sulphate of potash, raw bones, steamed bones, basic slag, lime, stable manure, leaf-mould, and road scrapings.

Mixture Suitable for Light Land.

25 tons farmyard manure, 6 cwt. superphosphate, 1 cwt. sulphate of potash, and 2 to 4 cwt. nitrate of soda per acre. On light soils it may be advisable to increase the amount of farmyard manure and use smaller quantities of artificial manures.

Mixture for Heavy Land.

$12\frac{1}{2}$ tons stable manure or farmyard manure, 6 cwt. superphosphate, 1 cwt. sulphate of potash, and 2 cwt. sulphate of ammonia per acre.

Two Examples of Mixed Fertilisers.

(*a*) General mixed fertiliser: rape dust, 4 parts; basic slag, 5 parts; steamed bone flour, 1 part; nitrate of potash, 2 parts. This is a rich phosphatic manure, costing about £6 to £6 10s. per ton and equal to many proprietary manures.

(*b*) General mixed fertiliser: fish guano, 6 parts; superphosphate, 2 parts; sulphate of potash, 1 part; sulphate of ammonia, 2 parts. This is a rich nitrogenous manure, costing about £6 10s. to £7 per ton.

Either of the above may be mixed and applied as a top-dressing at the rate of 3 to 5 oz. per square yard, or to a bushel of potting soil.

When to Apply Manures.

(1) Autumn or winter. All natural manures, *e.g.* farmyard manure, leaf-mould, etc., also lime, kainit, basic

slag, bones, and gas lime may be applied in the autumn or winter at the time of digging.

(2) In the spring, sulphate of ammonia, sulphate of potash, superphosphate, and bone meal may be applied before planting or sowing.

(3) During spring and summer top-dressings in small doses, every week or ten days—during showery weather if possible—of such manures as nitrate of soda, Peruvian guano, nitrate of potash (saltpetre), and liquid manures of all kinds may be applied to growing crops.

How to Apply Manures.

Natural manures are dug into the soil, whilst basic slag, kainit, lime, bone meal, and superphosphate may be applied to the surface and forked in.

Sulphate of ammonia, sulphate of potash, nitrate of soda, Peruvian guano, superphosphate, etc., may be used as top-dressings and should be accurately weighed and spread evenly to ensure good results.

The Mixing of Manures.

In making up mixtures of different manures great care is necessary. If the wrong kinds are put together certain chemical reactions will take place and much loss may result.

The following may be mixed with safety :—

Nitrate of soda with raw bone manures, phosphatic guanos, or basic slag.

Sulphate of ammonia with bones, superphosphate, or phosphatic guanos.

Basic slag with bones, kainit, or sulphate of potash.

The following should not be mixed unless they are to be applied almost immediately :—

Nitrate of soda with superphosphate or sulphate of ammonia.

Nitrate of lime with superphosphate.

Nitrate of potash with superphosphate.

Lime with organic manures, superphosphate, soot, basic slag, guano, farmyard manure, or sulphate of ammonia.

Sulphate of ammonia with basic slag, lime, or nitrate of soda.

Superphosphate with basic slag.

CHAPTER X.

MANURING GARDEN CROPS.

The Application of Manures for Garden Purposes.

Farmers and fruit growers having large areas of land usually calculate the quantity of manure in cwt. per acre, but in garden practice it is found more convenient to calculate quantities per square yard or by the pole. With this end in view the following table has been drawn up as a guide for those cultivating small areas:—

Quantity per Acre.	Equivalent quantities per		
	Rood ($\frac{1}{4}$ of an Acre).	Square Rod, Pole, or Perch ($30\frac{1}{4}$ Square Yards, or $\frac{1}{40}$th of a Rood, or $\frac{1}{160}$th of an Acre).	Square Yard ($\frac{1}{4840}$th of an Acre).
Cwt.	Lb.	Lb.	Oz.
1	28	$\frac{3}{4}$	$\frac{3}{8}$
2	56	$1\frac{1}{2}$	$\frac{3}{4}$
4	112	$2\frac{3}{4}$	$1\frac{1}{2}$
6	168	$4\frac{1}{4}$	$2\frac{1}{4}$
8	224	$5\frac{1}{2}$	3
10	280	7	$3\frac{3}{4}$
15	420	$10\frac{1}{2}$	$5\frac{5}{8}$
20	560	14	$7\frac{1}{2}$

Notes on Manuring.

A manure to be complete and to give the best results should contain nitrates, phosphates, and potash, the proportion of which should vary according to the character of the soil and the kind of crop grown.

Farmyard manure.—About 12 to 15 tons of farmyard or stable manure is the usual quantity per acre applied to heavy land for garden crops; this may be supplemented with advantage by the use of chemical manures, but on light land a much larger quantity of farmyard manure will be required to assist in retaining moisture; in such cases chemical manures may be reduced or even dispensed with altogether.

Basic slag (a phosphatic manure) should be used on heavy land in place of superphosphate, especially if lime is somewhat deficient. Being a slow-acting manure, it should be applied in the autumn or winter so that it may have time to dissolve before being required by the crop.

Superphosphate.—When it is decided to use this manure, half the amount may be applied in spring before sowing or planting the crops, and the remaining half given later as a top-dressing, taking care that it does not fall on the leaves more than possible, as it has a burning effect. Bone meal and phosphatic Peruvian guano are similar to superphosphate, but slower in action, and contain a varying quantity of nitrogen.

Kainit (a potash manure) should be applied in winter or early spring and worked into the soil; it is useful in dry seasons, and on light soils, but should it be found unsuitable for any crop, it can be replaced by sulphate of potash, 1 cwt. of sulphate of potash being equivalent to 4 cwt. of kainit.

Nitrate of soda (a nitrogenous manure), being a quick-acting manure, must only be used when the crops are making growth, and then only in small doses, 1 to 2 cwt. per acre, at intervals of two to three weeks in spring and summer. Nitrate of soda has a burning effect on leaves; size, colour, and crispness are imparted by using this manure. In wet seasons or on damp soils sulphate of ammonia may take the place of nitrate of soda.

Lime.—Soils deficient in lime, or where insect pests and diseases, such as club-root of cabbages, wart disease of potatoes, etc., occur, may have a dressing of cob lime (burnt lime) applied in winter at the rate of 1 to 2 tons per acre.

MANURING GARDEN CROPS.

(*a*) **Fruit Trees and Bushes.**

Apples, pears, and plums planted on arable land will, after four or five years, require some assistance in the form of manure. Any kind of animal manure will be beneficial applied as a mulch or top-dressing, or in liquid form. Artificial manures (superphosphate 3 lb., kainit 3 lb.—or sulphate of potash $1\frac{1}{2}$ lb.—and nitrate of soda $1\frac{1}{2}$ lb. per pole) may be applied as a top-dressing.

Gooseberries and currants will benefit by the application of superphosphate 3 lb. (or basic slag 10 lb.), kainit 2 lb., and sulphate of ammonia $1\frac{1}{2}$ lb. (or nitrate of soda $1\frac{1}{2}$ lb.) per pole, applied as a top-dressing.

Raspberries and brambles.—Fish guano or any other kind of guano is useful for these crops; or a mixture consisting of basic slag 10 lb., kainit 3 lb., and sulphate of ammonia $1\frac{1}{2}$ lb. per pole.

Strawberries when grown on good retentive soil give good results with farmyard or stable manure, and, as a top-dressing, superphosphate 3 lb., and nitrate of soda or sulphate of ammonia $1\frac{1}{2}$ lb. per pole. Potash does not seem to be required in addition except on light soil, when kainit 3 to 4 lb. per pole might be added. When rank growth results from the application of too much dung, a dressing of 56 lb. of lime per pole may be applied in February as a corrective.

(*b*) **Vegetable Crops.**

Onions, celery, and leeks require a good dressing of well rotted manure, and also of soot if obtainable. Artificial manures such as superphosphate 3 lb., sulphate of potash 1 lb., and nitrate of soda 1 lb. per pole, may be applied two or three times during the season of growth.

Summer cabbage, coleworts, and cauliflowers require good rich soil in addition to an application of basic slag 10 lb., sulphate of potash 1 lb., and nitrate of soda 1 lb. per pole.

Winter greens and root crops.—The following crops (savoys, kales, sprouts, borecole, cabbage, winter lettuce, carrots, parsnips, beet, salsify, and scorzonera) should succeed other crops which have been well manured, in which case they may be grown without any additional animal manure. An application of artificial manures, such as superphosphate 3 lb., sulphate of potash 1 lb., and nitrate of soda 1 lb. per pole, may be given as a top-dressing.

Potatoes on poor soil should have farmyard or some other form of natural manure, but on good rich land they do well with a dressing of lime 28 lb., superphosphate 3 lb., sulphate of potash $1\frac{1}{2}$ lb., and nitrate of soda $1\frac{1}{2}$ lb. per pole.

Leaf-mould dug into the soil, or placed in the drills before planting, favours the production of nice clean tubers.

Summer lettuce, radishes, and garden turnips grow best in deep, rich, cool soil, and require plenty of moisture to encourage quick growth in order to give succulent, tender, and sweet produce. Artificial manures as recommended for potatoes will also be suitable for these crops.

Cucumbers and tomatoes should be grown in a good compost of loam, 3 parts, and rotted manure, 1 part, which may be supplemented when the plants commence to fruit by a top-dressing composed of superphosphate 2 oz., sulphate of potash 1 oz., and nitrate of soda $\frac{1}{2}$ oz. per square yard.

Asparagus delights in plenty of manure and deep sandy soil; seaweed or common salt may be applied in autumn or winter. On light land a dressing of superphosphate 3 lb. and kainit 3 lb. per pole may be given in winter or early spring, and nitrate of soda 1 lb. per pole fortnightly during growth. Guano 4 lb. and common salt 2 lb. per pole will also give good results.

On heavy land basic slag 10 lb., sulphate of potash 2 lb., and sulphate of ammonia 1 lb. may be applied per pole.

Rhubarb requires a liberal application of farmyard manure, which may be supplemented by the addition of basic slag 10 lb. and nitrate of soda 1 lb. per pole. A good crop of stalks should be allowed to mature and die away on the plant, to encourage strong growth the following spring.

Peas and beans of all kinds succeed with animal manures placed in trenches and covered with soil before sowing the seeds. Basic slag ½ lb. (or superphosphate 4 oz.) and kainit 2 oz. (or sulphate of potash 1 oz.) applied per yard run of row gives excellent results.

(*c*) **Flowers.**

Flower borders for annuals, perennials, etc.—The annual dressing of farmyard or stable manure dug into the soil may be supplemented in the autumn by the addition of basic slag 10 lb. and sulphate of potash 1 lb. per pole, followed in March by superphosphate 3 lb. and sulphate of ammonia 1 lb. per pole. Lime 15 lb. per pole may take the place of basic slag if thought desirable. Nitrate of soda 1 lb. per pole may be applied when the plants are in full growth.

Pot plants.—Nitrate of potash ¼ oz. and phosphate of potash ¼ oz. to one gallon of water may be used for watering purposes, or ¼ oz. of each mixed with each bushel of potting soil. Bone meal, at the rate of 4 to 8 oz. per bushel of soil, is a useful ingredient in the compost for pot plants.

Liquid manure made from various substances may be utilised with advantage for nearly all pot plants (see Liquid Manures).

Carnations succeed best in soil to which has been added lime, chalk, crushed oyster shells, old plaster, mortar rubble, or basic slag. A mixture of superphosphate 4 oz. and sulphate of ammonia 2 oz. per square yard gives good results. Nitrate of potash and phosphate of potash, ½ oz. of each per square yard, or similar quantities dissolved in two gallons of water as a liquid manure, are also beneficial.

Roses are often too heavily manured with farmyard or stable manure containing a good deal of nitrogen and potash but deficient in phosphate. For this reason lime 15 lb. per pole, or basic slag 10 to 15 lb. per pole, should be added in the autumn or winter to correct this deficiency.

Where a sufficient quantity of lime is present in the soil a spring dressing of superphosphate 8 lb. and sulphate of ammonia 2 lb. per pole may be applied. A special stimulant for the production of choice exhibition flowers may consist of nitrate of potash ½ oz. and phosphate of potash ½ oz. per bush, applied during the flowering season, either as a top-dressing or dissolved in two gallons of water.

Liquid manures for roses and other choice plants may be made from cow, pig, poultry, or sheep manure. If these are not available, rape dust 10 to 20 lb. and Peruvian guano 4 to 6 lb. per pole may be used instead. The essential points in connection with the application of liquid manure are dealt with on page 99.

Sweet peas require a deeply cultivated soil with liberal manuring. Cow manure should be used on light soils and horse manure on heavy soils. The most suitable artificial manures to apply are sulphate of potash 1 oz., superphosphate 3 oz., and bone meal 3 oz. per square yard, or sulphate of ammonia (or nitrate of soda) ½ oz. to 1 gallon of water or 1 oz. per yard run of row.

Sulphate of iron, ½ oz. to 6 gallons of water, promotes healthy plants and improves the colours of the flowers. Phosphate of potash and nitrate of potash, ½ oz. of each to 2 gallons of water, benefit the plants when in bloom. Bone meal, crushed oyster shells, or lime may be used with good results on land intended for sweet peas.

Chrysanthemums require a good mixture of loam, sand, and leaf-mould, with the addition of basic slag ½ lb., or bone meal ½ lb., to every bushel of the compost for potting. Peruvian guano, or any proprietary guano or fertiliser, may be applied as a top-dressing, or in liquid form, at the rate of 1 oz. to 2 gallons of water. Or as a top-dressing a mixture of sulphate of ammonia 2 parts, superphosphate 6 parts, and sulphate of potash 1 part will also be found a useful stimulant. Epsom salts, ½ oz. to 2 gallons of water, improves the appearance and quality of the flowers, while saltpetre (nitrate of potash) gives vigour to the whole plant and increases the size of the blooms.

Violas and pansies should have a change of soil and do well after a potato crop. Liquid manure made from sheep dung is useful, and $\frac{1}{2}$ oz. of sulphate of ammonia to a gallon of water increases the brilliancy of colour of the flowers.

A mulching of rotted manure worked well round the plants will keep them cool, moist, and feed them at the same time.

Old soot, bone meal, lime, sand, or leaf-mould will also be found beneficial for these plants.

(*d*) **Lawns.**

To get rid of daisies on lawns a combined manure and daisy-killer is used. For heavy soils this consists of sulphate of ammonia 3 parts, sulphate of potash 3 parts, and sulphate of iron 1 part, and should be mixed and applied during showery weather at the rate of 3 oz. per square yard, fortnightly, in May, June and July. The manure falling on the broad leaves of the daisies and other weeds burns them, whilst the narrow leaves of the grasses offer no impediment to the manure, which reaches their roots, thus stimulating their growth. For light soils kainit 3 oz. and sulphate of ammonia 1 oz. per square yard may be used in a similar manner and at the same intervals.

To eradicate moss on lawns.—It is important to first ascertain that the drainage is efficient. The lawn should be vigorously raked with a sharp-toothed rake, and the rakings burnt, after which the lawn may receive a top dressing consisting of good soil, slaked lime, wood ashes, and well-rotted manure, the whole of which has been sifted. This dressing should be spread evenly over the lawn, and the turf raked and rolled. Basic slag 4 oz. and bone meal 4 oz. per square yard may be applied in autumn or winter as a further top-dressing.

To get rid of clover on lawns.—When too much clover is present it may be necessary to returf the lawn, and when applying manures all phosphates or lime should be omitted, as these encourage the production of clover. A dressing of nitrate of soda 1 oz., or a similar quantity of sulphate of ammonia, per square yard may be mixed with peat dust, sand, or good soil, and applied in spring during showery weather.

General improvement of the lawn.—The general condition of the lawn may be improved by an application of either soot, sand, charcoal, wood ashes, or well-rotted manure, applied as a top-dressing during winter, or a dressing of basic slag 10 lb. and nitrate of potash 1 lb. per pole may be applied in the autumn.

CHAPTER XI.

SYSTEMS OF CROPPING AND THE ROTATION OF CROPS.

Systems of Vegetable Cropping.

The following are some of the methods adopted in cropping gardens :—

(1) The separate system, or one crop at a time. This is suited to large gardens.

(2) Successional cropping, *i.e.* following one crop by another as soon as the ground is cleared. This entails more labour, more skill or forethought, and more manure, but is profitable for market-gardeners, who, as a rule, follow no system of rotation, but plant or sow all land as it becomes vacant. For example they will follow peas or early potatoes with winter greens, winter onions, or spring cabbage. They manure heavily, and trench frequently to maintain the fertility of the soil.

(3) Intercropping or simultaneous cropping, *i.e.* two or more crops being grown at the same time, *e.g.* potatoes—especially the dwarf and early kinds—may have kales, savoys, or sprouts planted between the rows after earthing up.

Lettuce and radishes between carrots and onions.

Lettuce, radishes, or mustard and cress may be sown on the ridges of celery trenches.

Spinach, radishes, lettuce, or turnips between rows of peas.

Broad beans between spring cabbage.

This system entails more careful attention, more manure, and less opportunity for winter cultivation of the soil, which is so important especially in the case of heavy land.

(4) Rotational cropping, *i.e.* changing the position of the crops so that those of the same character, or of close relationship, do not follow one another two years in succession.

Rotation of Crops.

By rotation of crops is meant that order of succession whereby large quantities of produce are obtained whilst the fertility of the land is maintained.

Rotations are the result of experience.

It is well known that the same kind of crop cannot, as a rule, be grown successfully on the same land for many years in succession.

Different crops require different plant food and in different proportions—what is left by one crop may be useful to another.

Some plants are deep rooters, others are surface rooters. Some crops occupy the land for a long period, *e.g.* rhubarb, seakale, asparagus, strawberries, and fruit bushes; others only for a few weeks—lettuce, peas, spinach, radish, etc.

Some crops are a good preparation for others, *e.g.* celery for onions, beans or clover for wheat, potatoes for most crops. Deep rooters enrich the soil for surface rooters.

Rotation affords better opportunities for cleaning the land, for checking the attacks of insects and plant diseases, and in addition the crops are more vigorous. Less manure is required by a change of crops. Crops of the same family should not as a rule follow one another.

Rotation in gardens may extend to two, three, or four years.

It is important to keep a record of actual cropping.

In making a rotation we have to consider:—

(1) Local requirements.

(2) Kind of soil.

(3) Amount of manure at our disposal.

(4) Amount of land at our command.

Examples of crops which may follow or succeed one another.—Peas and beans may follow root crops or the cabbage family, or come before celery, leeks, lettuce, turnips, or greens. They collect and store nitrogen; phosphates and lime suit this class.

Root crops such as carrots, parsnips, beet, salsify, and scorzonera may follow celery, onions, lettuce, cabbage, or leeks.

They like deep rich land which has been well manured for the previous crop. Soot, salt, and lime are beneficial to root crops, but fresh farmyard manure should on no account be used.

Cabbage crops may follow peas, beans, lettuce, potatoes, onions, celery, and root crops.

This class require liberal manuring, and are benefited by the use of potash and phosphates.

Potatoes may succeed any crop—cabbage crops, peas, beans, etc.

Strawberries do very well after potatoes.

SYSTEMS OF ROTATION.

Two Years' Rotation.—The garden is roughly divided into two more or less equal parts and the crops arranged as shown on the plans below.

1st year's cropping.	(PLOT 1.) Potatoes or other important crop.	(PLOT 2.) Root crops, onions, leeks, cabbages, etc.

2nd year's cropping.	(PLOT 1.) Root crops, onions, leeks, cabbages, etc.	(PLOT 2.) Potatoes or other important crop.

Three Years' Rotation for an allotment or cottage garden :—

1st year's cropping.	(PLOT 1.) Potatoes.	(PLOT 2.) Cabbage crops, turnips, peas, and beans.	(PLOT 3.) Carrots, parsnips, beet, onions, leeks, celery, lettuce, radish.

2nd year's cropping.	(PLOT 1.) Cabbage crops, turnips, peas, and beans.	(PLOT 2.) Carrots, parsnips, beet, onions, leeks, celery, lettuce, radish.	(PLOT 3.) Potatoes.

3rd year's cropping.	(PLOT 1.) Carrots, parsnips, beet, onions, leeks, celery, lettuce, radish.	(PLOT 2.) Potatoes.	(PLOT 3.) Cabbage crops, turnips, peas, and beans.

Four-Year System of rotation of crops :—

First year's cropping.	(PLOT No. 1.) (Farmyard manure.) Peas, broad beans, French beans, runner beans, celery, leeks, spinach.	(PLOT No. 2.) (No manure.) Carrots, parsnips, beet, salsify, scorzonera.	(PLOT No. 3.) (Farmyard manure.) Turnips, cabbage, sprouts, savoy, kale, cauliflowers, lettuce, radish, onions, shallots.	(PLOT No. 4.) (Lime and artificial manures.) Potatoes.

Second year's cropping.	(PLOT No. 1.) (No manure.) Carrots, parsnips, beet, salsify, scorzonera.	(PLOT No. 2.) (Farmyard manure.) Turnips, cabbage, sprouts, savoy, kale, cauliflowers, lettuce, radish, onions, shallots.	(PLOT No. 3.) (Lime and artificial manures.) Potatoes.	(PLOT No. 4.) (Farmyard manure.) Peas, broad beans, French beans, runner beans, celery, leeks, spinach.
Third year's cropping.	(PLOT No. 1.) (Farmyard manure.) Turnips, sprouts, cabbage, kale, cauliflowers, savoy, lettuce, radish, onions, shallots.	(PLOT No. 2.) (Lime and artificial manures.) Potatoes.	(PLOT No. 3.) (Farmyard manure.) Peas, broad beans, French beans, runner beans, celery, leeks, spinach.	(PLOT No. 4.) (No manure.) Carrots, parsnips, beet, salsify, scorzonera.
Fourth year's cropping.	(PLOT No. 1.) (Lime and artificial manures.) Potatoes.	(PLOT No. 2.) (Farmyard manure.) Peas, broad beans, French beans, runner beans, celery, leeks, spinach.	(PLOT No. 3.) (No manure.) Carrots, parsnips, beet, salsify, scorzonera.	(PLOT No. 4.) (Farmyard manure.) Turnips, sprouts, cabbage, kale, savoy, cauliflowers, lettuce, radish, onions, shallots.

For the cropping of **School Garden Plots** see pp. 19-23.

ROTATION OF FARM CROPS.

Fuller details of Farm Rotations will be found in text-books of Agriculture. The following particulars may be of some use, however, to show the underlying principles of the subject.

Norfolk Rotation.—Four years; suitable for light soils.

1*st Year, Roots.*—Turnips, swedes, beet, mangels, carrots, and potatoes. With the exception of the last named all these are grown for their roots and require light soil, with the addition of potash and soda, but little or no silica is necessary.

Roots are, as a rule, consumed on the farm. Root crops keep the soil open, and the hoeing required cleans and improves the land.

2*nd Year, Barley.*—A fibrous rooted plant grown for its seed (fruit or grain). This crop requires silica but very little potash.

Barley is generally sold off the farm.

3*rd Year, Clover.*—A deep, fibrous rooted plant grown for its herbage (foliage). The roots bind the soil together for the wheat crop which is to follow, and, as clover is mostly fed off the land, the soil is further consolidated by the treading of the sheep. Under this crop the land is difficult to clean. Lime is beneficial to clover.

4*th Year, Wheat.*—A deep rooting plant which does best on a heavy soil, as it is very exhausting to the land.

This crop requires silica, but little or no lime.

Under wheat air cannot disintegrate the soil, and the land is difficult to clean.

Wheat is generally sold off the farm.

The continuous growth of wheat is possible on heavy land by practising good deep cultivation, a free use of the hoe, liberal manuring, and allowing the crop plenty of room.

East Lothian Rotation.—For six years on rich medium loams.

1. Swedes.	2. Barley.	3. Seeds (ryegrass and clover hay).
4. Oats.	5. Potatoes or beans.	6. Wheat.

Holderness Rotation.—For six years on rich clays.

1. Bare or cropped fallow.	2. Wheat.	3. Clover.
4. Wheat.	5. Beans.	6. Wheat.

South of England Rotation, where warmer and longer summers prevail.

A second or "later" crop is taken in the same season, after wheat, and before the turnips are sown the following year. This crop is sown after harvest and consumed in the autumn or the following spring. The crops adapted for spring use are rye, winter vetches, and crimson clover, and either rape or mustard may be sown for autumn feeding.

The following are the various farm crops most suited to the **different types of soil**:—

Light Soils.—Barley, rye, turnips, and green crops.

Heavy Soils.—Wheat, beans, swedes, mangels, and rape.

Calcareous Soils.—Clover, lucerne, sainfoin, vetches, peas, and beans.

Peaty Soils.—Oats, rape, and potatoes.

CHAPTER XII.

THE GROUPING OF VEGETABLES, SALADS, AND HERBS,* AND SELECTION OF VARIETIES.

Classification or grouping of plants for garden purposes.

The material world is divisible into—

The animal kingdom.
The vegetable kingdom.
The mineral kingdom.

The vegetable kingdom may for garden purposes be grouped as follows :—

(*a*) *Woody plants* (all perennial).

(1) Trees of all kinds.
(2) Shrubs of all kinds.
(3) Woody climbers of all kinds.

(*b*) *Half-woody or suffruticose plants* (all perennial), *e.g.* thyme, sage, rock rose (*Helianthemum*), rue, hyssop, etc.

(*c*) *Herbaceous or non-woody stemmed plants, i.e.* soft stemmed plants which die down after a season's growth.

(1) Annuals—Plants which complete their life cycle in the course of one year; *e.g.* Virginian stock, green pea, sweet pea, mignonette.

* For Botanical names *see* Chapter XXIII.

(2) Biennials—Usually taking two years to complete their life cycle, *e.g.* wallflower, turnip, carrot, cabbage, foxglove.

(3) Perennials—Plants which under normal conditions live for several years. The rootstock is perennial, producing annual shoots which die down after the flowering and fruiting season, *e.g.* *Phlox decussata*, Michaelmas daisies, dahlia, potato. This group includes bulbs, corms, tubers, rhizomes, etc.

Cultivated plants may be grouped as follows:—

(*a*) *Vegetables*—Plants which after being cooked serve as foods for human beings, or another definition may be given: vegetables from a garden point of view indicate any such plants as are cultivated for some edible part such as root, stem, leaf, and sometimes—as in the case of the tomato, vegetable marrow, and cucumber—that part is the fruit, *e.g.* potato, cabbage, turnip.

(*b*) *Salads*—Those plants which are generally eaten without first being cooked, *e.g.* lettuce, radish, celery.

(*c*) *Sweet herbs and pot herbs*—Plants used for flavouring soups and for making sauces and stuffing, *e.g.* parsley, sage, mint, thyme.

(*d*) *Fruits*—Plants grown for their fruits, which may be eaten either raw or cooked.

(*e*) *Ornamental plants*—Plants grown in the flower garden, shrubbery, or on the lawn, either for their flowers or foliage. This group includes all the popular garden plants—annuals, biennials, perennials, trees, shrubs, and undershrubs.

VEGETABLES.

1. Root crops.

Beetroot or Beet:—

(*a*) Red or crimson flesh—Nutting's Selected Red.
(*b*) Black or dark flesh—Pine Apple.
(*c*) Round, globe, or turnip-rooted—New Early Round.

(*d*) Ornamental beet—grown for its leaves (*see* under Spinach, page 129).

Carrot:—

(*a*) Short horn—Early Gem.
(*b*) Intermediate—Nantes, James's Intermediate.
(*c*) Long—Long Red Surrey.

Parsnip—Hollow Crown, The Student.
Bulbous-rooted Chervil.
Salsify or Vegetable Oyster.
Scorzonera.

Turnip:—

(*a*) White-fleshed—Snowball.
(*b*) White-fleshed—French forcing varieties.
(*c*) Yellow-fleshed—Golden Ball.

2. Tubers.

Potato:—

(*a*) Round—Up-to-Date, The Factor.
(*b*) Kidney—Ninetyfold, Midlothian Early.

Jerusalem Artichoke.
Chinese Artichoke.

3. Bulbs.

Onion:—

(*a*) Flat—Danver's Yellow.
(*b*) Globe or round—Ailsa Craig.
(*c*) Tripoli (June to September)—Giant Rocca, Golden Globe.
(*d*) White or silver-skinned—White Lisbon, The Queen.
(*e*) Blood red—Red Champion, Southport Red Globe.

Egyptian onion.
Shallot—Giant Red.
Potato onion.
Garlic.
Welsh onion—leaves used for salads.
Rocambole—milder than garlic.

4. Stem or leaf vegetables.

Cabbage.
Red cabbage—for pickling.
Savoy—Early Ulm, Sugarloaf, Drumhead.
Cauliflower—Early London, Autumn Giant.
Broccoli—Self-protecting, Walcheren, Purple Sprouting.
Brussels sprouts—Solidity, Wroxton.
Chou de Burghley, or cabbage broccoli.
Kale, curly green, or Borecole.
Spinach :—

(*a*) Summer spinach.
(*b*) Winter, or prickly-seeded.
(*c*) New Zealand spinach.
(*d*) Spinach beet.
(*e*) Seakale spinach or Chilian beet (also ornamental).
(*f*) Wild spinach, Good King Henry, or Lincolnshire Asparagus.

Kohl Rabi (Fig. 24)—Turnip-rooted Cabbage.
Asparagus—Connover's Colossal.
Seakale—Lily White.
Globe artichoke.
Leek—Dobbie's Champion, Holborn Model.
Celery.
Cardoon.

5. Fruits or seeds.

Vegetable marrow.
Cucumber :—

(*a*) Long-shaped (grown under glass)—Telegraph Improved.
(*b*) Ridge (grown in the open in warm districts).

Melon—Scarlet and white fleshed varieties. (The melon is regarded as a fruit; *see* list of fruits.)

Tomato :—

(*a*) Fruits large, red—Conference.
(*b*) Fruits medium, red—Chiswick Red, Sunrise.
(*c*) Fruits yellow—Blenheim Orange, Golden Nugget.

(*d*) Fruits small and ornamental—Pear-shaped, Cherry-shaped, and Currant Tomatoes.

Broad bean.

Fig. 24.—Kohl Rabi (Sutton's Earliest White).

Runner bean (scarlet runner).
Dwarf, French, or kidney bean.
Green pea.

SALADS.

1. Root salads.

Radish.—Roots may be long, medium, or very short, and of various colours—red, pink, black, white, etc.

Beetroot.—The roots when boiled are sliced and mixed with other salads in the salad bowl. They are also used for pickling, and as an ordinary vegetable.

Rampion.—The roots and leaves are used in winter salads.

Celeriac or turnip-rooted celery.

2. Leaf salads.

Mustard.
Cress.
Watercress.
American or land cress.
Lettuce :—

(*a*) Cos lettuce (white and coloured varieties)—Paris White.
(*b*) Cabbage lettuce (green and coloured varieties)—Tom Thumb, All the Year Round, Continuity.

Endive :—

(*a*) Curled endive—green curled, moss curled.
(*b*) Batavian endive—broad-leaved, improved round.

Chicory.—Witloof (white leaf) or Christmas salad.
Dandelion.
Corn salad or lamb's lettuce :—

(*a*) Common or round.
(*b*) Italian.

Purslane.—The leaves are eaten as a salad and are sometimes pickled or cooked.

Sorrel :—

(*a*) English.
(*b*) French.

Celery :—

(*a*) White—Dwarf White, Sandringham.
(*b*) Red—Covent Garden Red, Aylesbury Prize Red.

3. Fruit salads.

Tomato (*see* also under vegetables, page 129).
Cucumber (*see* also under vegetables, page 129).

HERBS.

"Sweet Herbs" and "Pot Herbs."

(a = *annual*, b = *biennial*, p = *perennial.*)

Angelica.—The leaf stalks, midribs, and tender stems are preserved and candied in sugar. The seeds and root are used for liqueurs, etc. (b).

Aniseed.—The seeds are used for flavouring, cough medicines, and lozenges (a).

Balm.—The leaves are used in salads, balm tea, and for flavouring.

The variegated or golden-leaved form is ornamental as well as useful (p).

Basil (Bush).—The fresh or dried leaves are used for flavouring soup (a).

Basil (Sweet).—Is also used for flavouring. For winter use the shoots may be cut before the flowers open (a).

Borage.—The leaves and flowers are used in a fresh state for cooling purposes in summer drinks and claret cup (a or b).

Caraway.—The seeds are used in confectionery (b).

Chamomile.—The flowers make a stimulant tonic useful in debility. They are also used for fomentations (p).

Chervil.—The leaves are used for flavouring soups and salads (a).

Chervil (Bulbous-rooted).—A root crop to be treated like carrots (b).

Chives.—The leaves are used for flavouring soups, salads, etc., as a substitute for onions (p).

Clary.—The leaves are used for flavouring soups, and the leaves and flowers for making wine (b).

Coriander.—The seeds are used for flavouring, and the leaves in salads and soups (a).

Costmary (Ale Cost, or Sweet Mary).—Formerly used as an ingredient in ale. In flavour the leaves resemble garden mint (p).

Dill.—Distilled dill-seed water is given to children for colic (a).

Fennel.—Used for garnishing and for sauces for fish, also for flavouring soup (*p*).

Horehound.—This is used in confectionery and also for coughs (*p*).

Horseradish.—Used in sauces (*p*).

Hyssop.—Is used for coughs (*p*).

Lavender.—The flower spikes are used in perfumery (*p*).

Marigold.—The herb is chiefly used as a homeopathic remedy, a tincture for cuts and wounds. The flower heads are used for flavouring soups (*a*).

Marjoram (Common).—Is not much used at present (*a*).

Marjoram (Sweet or Knotted).—A tender plant, the leaves of which are used in soups and sauces (*b*).

Marjoram (Pot).—The leaves are used in soups and sauces (*p*).

Mint.—Green or spearmint is used for sauces and flavouring (*p*).

Mugwort.—This herb is used as a fomentation and in female disorders (*p*).

Parsley.—For flavouring soups, sauces, and stuffings, and for garnishing. To maintain a good supply sow in March or April, and again in July, on fresh ground which has been given a dressing of lime (*b*).

Pennyroyal.—Is useful for flatulent colic, and for eruptive diseases in children (*p*).

Peppermint.—Is principally cultivated for the distillation of the oil for the well known cordial which bears its name. This cordial is useful in stopping vomiting, and as a cure for flatulence. Peppermint is largely used in confectionery (*p*).

Rosemary.—Is used in perfumery and hair-dressing solutions. Rosemary tea is said to be good for headache (*p*).

Rue.—The leaves are bitter, and are used in preparing tonics, as an infusion in spirits, especially gin, and as a remedy for roup in fowls (*p*).

Sage.—The leaves are used in sauces and stuffings (*p*).

Samphire (*Crithmum maritimum*).—Found on the sea-shore and cliffs round Britain. The leaves are used in pickling, in salads, and for seasoning (*p*).

This plant is not cultivated, and the marsh samphire (*Salicornia herbacea*) is often mistaken for it.

Savory (Summer or Annual).—Is used for flavouring (*a*).

Savory (Winter or Perpetual).—Is used for flavouring (*p*).

Sorrel, Common, *Rumex Acetosa* varieties (*p*).

Sorrel, French or round-leaved, *R. scutatus* (*p*).

Sorrel, mountain, *R. montanus* (*p*).

Southernwood.—An old favourite herb with aromatic leaves (*p*).

Sweet Cicely.—The leaves are used for flavouring, for garnishing, and for salads (*p*).

Tansy.—The leaves are used for flavouring, and are also given for worms (*p*).

Tarragon.—The leaves are used in soups and sauces, for flavouring, and for the manufacture of Tarragon vinegar (*p*).

Thyme (Common or Garden).—Is used in seasonings and stuffings (*p*).

Thyme (Lemon) (*p*).

Wormwood.—Infusions or decoctions are used as a vermifuge (*p*).

CHAPTER XIII.

THE CULTURE OF VEGETABLES, SALADS, AND HERBS.*

VEGETABLES.

The potato delights in a good friable loam, well drained, and well worked. Clay soil should be trenched or double dug in autumn or winter, and road scrapings, sand, leaf-mould, or burnt garden refuse worked in. Light land should have plenty of well rotted manure applied.

The soil should be well forked over in March to sweeten it, and the potatoes planted about the end of April when the soil is fairly dry. The sets may be planted 4 inches deep and 14 to 18 inches apart, the rows being 2 feet 3 inches from one another.

Sprouted sets are more satisfactory than unsprouted sets. Sprouting may take place in shallow boxes kept in a light, dry, but frost-proof shed. When the shaws (stems) are six inches high the soil may be loosened by means of a fork, and the plants earthed up.

Early varieties:—Epicure, Sir John Llewellyn, Duke of York, Ashleaf Kidney, and Midlothian Early.

Main crop varieties:—Langworthy, Golden Wonder, Snowball, British Queen, Up-to-Date, Duchess of Cornwall, and The Factor.

* Manures and insect and fungoid pests are treated in other chapters.

Green peas require plenty of space, and soil in a high state of cultivation. The seed may be sown, 3 to 4 inches deep, from January to July, for a succession of crops over a long period, or from March to June in cold localities. Deep trenches should be dug in order that plenty of manure may be applied. The soil displaced during this operation, after being returned to the trenches, must be

Fig. 25.—Clamping Potatoes.

trodden firm. Where mice or birds are troublesome the rows may be covered with fine cinders and frequently sprayed with paraffin emulsion or some other strong smelling insecticide. Or pea guards, as shown in Fig. 27, may be used to keep away birds. Earthing up of the young plants must be attended to as soon as they attain a height of 4 to 6 inches.

Early staking is necessary in the case of tall growers. During dry weather the plants may be mulched with short manure or lawn clippings, and watered freely.

Varieties recommended:

Dwarf kinds (with or without short sticks).—The Sherwood, 1 foot; English Wonder, 1 foot; Ameer, $2\frac{1}{2}$ feet; Bountiful, $2\frac{1}{2}$ feet; Chelsea Gem, 1 foot; and William Hurst, 1 foot.

Tall kinds (3 to 4 feet).—Gradus, Autocrat, The Bell, Gladstone, and Eureka.

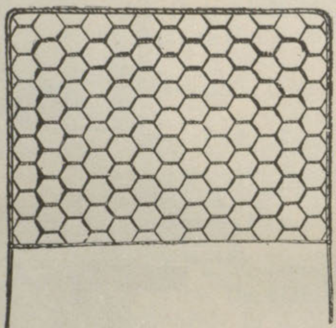


Fig. 26.—Wire Pea-Trainer.

Scarlet runner beans are an important crop in the south. They require similar culture to green peas, and may be sown in May, 4 inches deep and 6 inches apart. They will climb up tall sticks (Fig. 28), trellis, wire-work, or strings, or may be grown without support by pinching the growing shoots when 2 to 3 feet long.

Varieties:—Scarlet Emperor, Sutton's Best of All, etc.

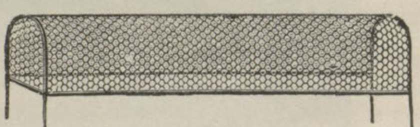


Fig. 27.—Pea and Seed Guard.

Kidney, dwarf, or French beans require the same general treatment as for scarlet runners, with the exception that no support is necessary. Sowings for a succession may be made from May to July.

Canadian Wonder is a good variety.

Broad beans are very hardy, and usually find a place

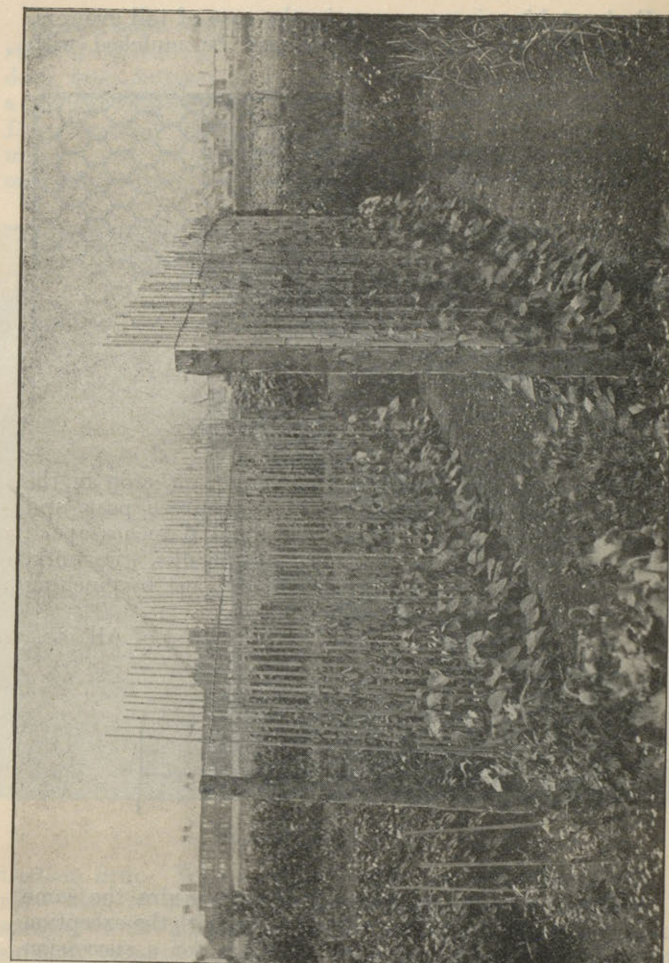


Fig. 28.—Scarlet Runner Beans growing on bamboo canes.

in every garden, but are not appreciated to the same extent as green peas.

Seeds may be sown from February to March or April, 4 inches deep and 6 inches apart. It is advisable to pinch the tips out of the plants as soon as the lower pods are forming.

Short-podded varieties:—Broad Windsor and Green Windsor.

Long-podded varieties:—Bunyard's Long Pod, Mammoth Long Pod, etc.

Turnips do best in good, rich, cool, moist soil, with a supply of phosphates such as bone meal, basic slag, or superphosphate.

Seeds may be sown from April to June for a succession of tender roots. Very early sowing will cause the plants to "bolt," especially in the north. Sow thinly in drills 1 inch deep and 1 to 1½ feet apart, and thin out when large enough to handle.

A late sowing of "Orange Jelly" or "Golden Ball" will give roots during the autumn or winter, but it is advisable to store them in a "clamp" ("pit") to prevent damage by frost.

There are some splendid varieties in cultivation, such as Early Milan, Snowball, Petrowskii, etc.

In the north swede turnips are greatly in request during the winter. These are hardy and keep well for a long period. Garden varieties of the swede are very good for this purpose.

Cabbage for spring and early summer use may be sown on a nicely prepared seed-bed from the end of June to the first week in August. Early sowing is necessary in some parts of Scotland in order to obtain sturdy plants able to withstand the winter and produce heads during June or July. Those sown in the south at the end of July, or early in August, will be ready for cutting from April to May, according to the locality.

McEwan's Early (Vanack) is a good kind for Scotland, whilst Sutton's April, Harbinger, and Flower of Spring are suitable for England.

Cabbage for summer, autumn, and winter use are obtained by one or two successive seed sowings, in April or May, on a sheltered and well prepared seed bed, and transplanting the seedlings in May, June, or July, when the weather is suitable.

Suitable varieties:—Sutton's Imperial, Maincrop, Winningstadt, Early York, etc.

Savoy cabbage, broccoli, Brussels sprouts, curly kale (borecole), asparagus kale, cottagers' kale, sprouting broccoli (Fig. 29), and *coleworts* may all be sown in April and planted out when the weather is favourable, or when the land is ready for their reception. They require good, firm, not over rich soil, and may be planted 18 inches to 2 feet apart, with 2 to 3 feet between the rows, according to kinds.

Cauliflowers are gross feeding plants, and therefore require deeply trenched soil with plenty of manure. The addition of one bushel of lime per pole, before planting, will be beneficial to the plants. When grown on poor ground growth is slow, and the plants are liable to "button," *i.e.* to form small heads, prematurely. This may also occur if the plants have received a check in the young state.

Seeds are sometimes sown in the autumn, wintered in frames, and planted out in April for early crops. Or seed may be sown in heat from February to March, or outdoors on a warm sheltered border in April, for providing "heads" for summer and autumn use.

Varieties:—

Early.—Sutton's First Crop, Early Erfurt.

Midseason.—Eclipse, Mont Blanc.

Late.—Veitch's Autumn Giant, Webb's Peerless Purity.

Onions.—Every allotment-holder and cottager delights in growing large onions. Their successful cultivation, however, depends upon a variety of circumstances, such as well manured, deeply worked soil, and facilities being available for bringing on the seedlings in readiness for planting out in April. Firm soil is essential to good growth. Seeds are sown in pots or boxes, under glass, from January to March, the seedlings pricked out into boxes of rich soil, kept near the glass, and eventually gradually hardened off preparatory to being planted out. Seeds may also be sown outdoors from March to April, but it is only in warm districts that outdoor sown onions grow to a large size. A good useful crop may

Fig. 29.—Sprouting Broccoli.

be obtained by outdoor sowing if the ground is treated liberally, and plenty of soot, powdered lime, or some soil fumigant such as "Naptho-Nicotyl," "Vaporite," or "Clubicide" worked into the soil before sowing, and frequent dustings of soot given when the seedlings appear. The seedlings should be thinned to about 6 to 9 inches apart, and the thinnings may be utilised for transplanting or for salad purposes.

Young onion plants from hothouses or frames may be planted 9 to 12 inches apart, 14 inches being allowed between the rows. A trowel will be found useful for this operation and care should be taken to spread out the roots, to keep the upper half of the young bulb above the surface of the soil, and to press the soil firmly round each. Transplanted onions are less liable to the attack of the onion fly maggot than those raised in the open.

Constant attention to the seedlings by frequent dustings of lime or soot, or spraying with some insecticide, will do much to prevent egg laying by the onion fly. The use of bone meal, superphosphate, or potash will assist the plants.

The bulbs are lifted, dried, and stored in a dry, frost-proof place until required for use.

Pickling onions may be grown on poor soil, without thinning.

Reliable varieties for general cultivation:—Ailsa Craig, Bedford Champion, Carter's Record, Sutton's A 1, James' Long Keeping, and Danver's Yellow.

Onion sets, i.e. small onion bulbs of the previous year's growth, in a dry dormant condition, are now obtainable from seedsmen from 1s. to 1s. 6d. per pound. One pound will contain about 400 of these small bulbs. They may be planted in March, 6 to 8 inches apart, on well prepared ground, in the same way as shallots. Fairly good crops are produced in this manner, and usually free from the onion fly maggot.

The shallot is a perennial, and its bulbs are planted in March, 6 to 9 inches apart, being lifted when the leaves turn yellow. The bulbs (cloves) may be pickled or used in the same way as onions, but a few should be retained for planting the following year.

Carrots do best on light sandy soil, especially when newly broken. Seed should be sown thinly in drills, 1 inch deep, from April to May, and again in June or early in July. The late sowing generally escapes an attack of the carrot fly maggot, and provides nice tender roots for autumn and winter use.

Showery weather is the most suitable time for thinning the seedlings, and care should be taken to keep the shoulders well covered with soil. The use of soot, etc., as recommended for onions, will do much to minimise attacks of the carrot fly.

Carrots may be stored in sand or ashes, in a cold cellar or shed. In some favourable districts, however, they may be left in the ground practically all the winter—especially those sown late, say in June or July—and lifted as required.

Varieties :—Long Red Surrey, James' Intermediate, Early Nantes, Early Gem, etc.

Parsnips, as regards soil and general culture, may receive much the same treatment as carrots.

Seed may be sown in February, March, or April, 1 inch deep, in rows 18 inches apart, and the seedlings thinned to 9 inches apart.

Parsnips, on account of their hardiness, may be left in the soil all the winter, and lifted as required for use.

Varieties :—Sutton's Tender and True, Hollow Crown.

Beetroot is a tender plant and should not be sown quite so early as the carrot; April or May will be early enough. The general culture is the same as for carrots. A slight dressing of common salt or rotted seaweed is beneficial. The round turnip-rooted kinds are early and do well on soils that are not adapted to deep-rooted varieties.

The roots must be lifted carefully in the autumn, to prevent them being damaged, as this would cause a loss of colour through "bleeding." They may be stored in a frost-proof shed or cellar, being placed in layers and covered with sand to keep them fresh.

Varieties :—Sutton's Globe, Dobbie's Blood Red, Dell's Crimson, Nutting's Selected Red.

When difficulty exists in growing good carrots, parsnips, or beetroot, holes may be bored in the ground 2 to 3 feet deep and 3 to 4 inches in diameter, and filled with a prepared compost. This compost should consist of two parts sifted sandy loam or old potting soil, two parts sifted leaf-mould, and one part burnt vegetable refuse or wood

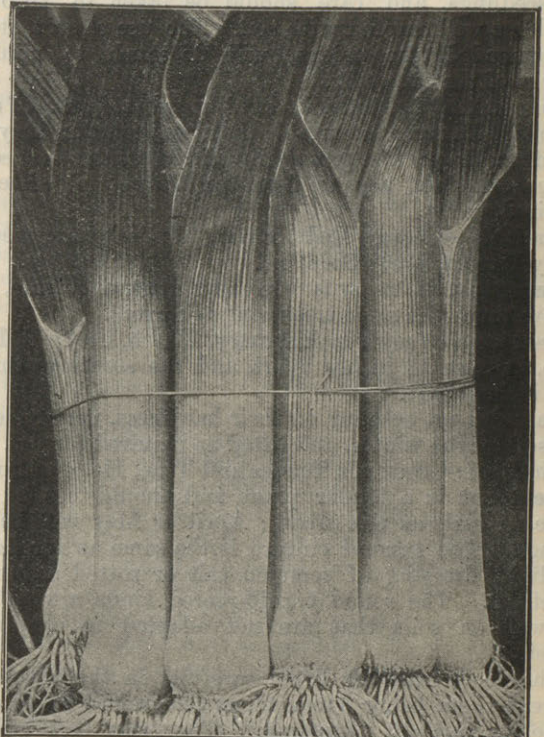


Fig. 30.—Leek *Prizetaker*.

ashes, with the addition of 1 lb. of bone meal to every bushel of the compost. Three or four seeds are then placed in each filled-up hole and the seedlings finally thinned, leaving one plant in each.

Leeks are very hardy and form a most useful garden vegetable. Large leeks are obtained by sowing the seed under glass as recommended for onions, planting outdoors in well manured trenches, and gradually earthing up to cause blanching and larger growths. Paper collars for blanching purposes are used by some growers.

Fig. 31.—Summer Spinach (Sutton's Long-standing).

Good useful crops may be had by sowing the seed outdoors in April, transplanting in June or July, 6 to 12 inches apart in trenches on well manured ground, and earthing up as required.

Varieties :—The Musselburgh, The Lyon, Dobbie's Exhibition, Prizetaker (Fig. 30).

Celery plants are generally raised under glass, hardened off, planted out 9 inches apart in well manured trenches, and earthed up when 8 to 10 inches high, care being taken to prevent any soil falling into the centres of the plants. For this purpose strong brown paper, 15 inches by 8 inches, may be wrapped round each plant before earthing up, but for ordinary requirements this is not essential.

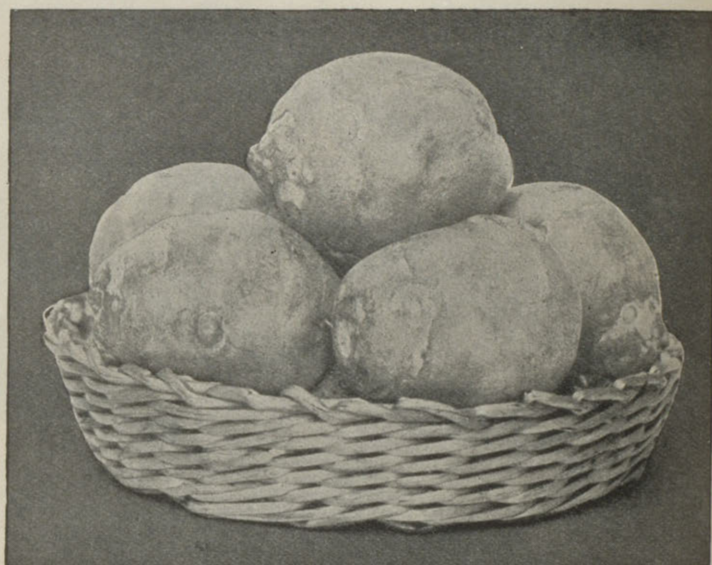


Fig. 32.—Jerusalem Artichoke.

This crop requires plenty of manure, and ample supplies of water to the roots.

Celery may be lifted as required for use, and during very severe weather the plants can be protected with mats, straw, or bracken.

Spinach.—The round or summer kinds (Fig. 31) and prickly or winter kinds are useful vegetables, and may be grown as intercrops or catch crops. Good, deep, cool soil, to produce large leaves and prevent premature seeding, and careful thinning are essential points in their cultivation.

Jerusalem artichoke (Fig. 32), a tall growing, hardy, perennial tuberous plant, closely related to the common

Fig. 33.—Globe Artichoke.

sunflower and of easy cultivation, being remarkably free from disease or attacks of insect pests. The tubers are ready for use in the winter, and may be lifted as required. In March or April those remaining may be carefully dug up and replanted 18 inches apart in rows 3 feet distant from each other.

Globe artichoke (Fig. 33), cultivated for its large flower heads, is seldom grown in school gardens, but the illustration will be of interest for comparison with the Jerusalem artichoke.

Fig. 34.—Seakale.

Rhubarb will grow practically anywhere, and with little attention, but it is advisable to give plenty of manure in the winter or early spring, and not to pull the stalks too closely. A fair proportion should be left to strengthen the plants for another year.

Plants not doing well should be lifted and divided, the best pieces only being again put in on well manured and deeply cultivated soil.

Varieties:—Victoria, The Sutton, Dawe's Champion.

Seakale (Fig. 34) has thick fleshy leaves and a large perennial rootstock. Plants are easily obtained by sowing seeds in drills, or by taking the young slender portions of the roots and inserting them in good, fairly light, but deep soil.

Full-grown roots may be forced into growth by covering each rootstock ("crown") with a large pot, box, or tub, with fermenting manure or leaves placed over the covered plants. When 5 or 6 inches long the tender leaf-stalks are ready for cutting.

Another method is to cover the "crowns" with 6 to 9 inches of soil, sand, or ashes, and when sufficient growth has been made the covering can be carefully removed and the produce cut.

Market gardeners usually lift the plants, cut away side roots and tips of roots—which are used for further plantations—and place them in a dark, moderately heated house, shed, or cellar to induce growth, which, being produced in the absence of light, is "blanched" and very tender.

Asparagus is a native perennial plant found near the sea. It delights in a deep, sandy, well-drained soil and plenty of manure.

Fresh beds or plantations are easily obtained by sowing seed in drills, or by purchasing the roots ("crowns") in the spring and planting on soil as already described. Once the plants are well established they throw up strong shoots, which are cut when 6 to 9 inches in length. Asparagus is easily cultivated on some soils, but on cold, heavy, or damp soil it is very difficult to grow at a profit.

Vegetable marrows (Fig. 35) are very tender plants, but are a great success in the south, especially when grown on old manure heaps. In the north they do not succeed at all well unless grown in a frame. The plant is deep-rooting and requires abundance of manure, moisture, and heat.

When properly cooked the fruit is much esteemed by all classes.

Fig. 35.—Vegetable Marrow (Sutton's Long White).

Cucumbers are very tender plants, requiring very special conditions as to heat, air, and moisture, and forcing-houses or hotbed frames are necessary for their successful cultivation. The "Ridge" varieties, however, are grown out of doors in the south and south-western counties of England.

To be successful in the cultivation of cucumbers requires expert knowledge, and cultural details, to be of any value, would need to be given at some length, scarcely fitting in with the scope of this work.

Tomatoes are not cultivated as an outdoor crop except in the extreme south of England.

Seeds are sown thinly in a sandy compost, under glass, in March or April, and, when germinated, placed near the glass to encourage sturdy growth. The plants should not be allowed to become dry or be exposed to sudden variations of temperature, as this will give them a check. The side shoots should be removed as they form, thus restricting the growth to a single stem.

The plants must be potted on as required, the final potting being into large pots or tubs where they are to fruit, or they may be planted out in the bed of the tomato house in rows 3 feet apart, and 1 foot apart in the rows. A suitable compost for the final potting consists of three parts good loam and one part rotted dung.

A dry, warm, buoyant atmosphere suits these plants, and tends to prevent disease. The forenoon is the best time for watering, to allow the house to become dry before night and to facilitate the setting of the fruit. The use of fresh or green manure should be avoided, as it encourages rank, unfruitful growth. Stimulating manures should not be given until the plants are in fruit.

There are numerous varieties to select from.

Mushrooms (Fig. 36).—The mushroom is a member of the toadstool or fungus family, and since it is not grown from seed or cuttings in the ordinary sense of these terms, the cultivation is generally regarded as requiring some very special conditions. As a result of this the cultivation of mushrooms is seldom attempted by the cottager, allotment-holder, or the amateur gardener generally. In addition they are looked upon as a luxury during the greater part of the year, but in the autumn they are usually to be found in pastures all over the country, thus bringing them within the reach of the masses.

Mushrooms are grown on a specially prepared bed, consisting of stable dung and straw litter. The manure should be obtained in a fresh condition, and placed in large heaps under the protection of a shed, being turned and mixed two or three times at intervals of four or five days. If not uniformly moist a little warm water may be

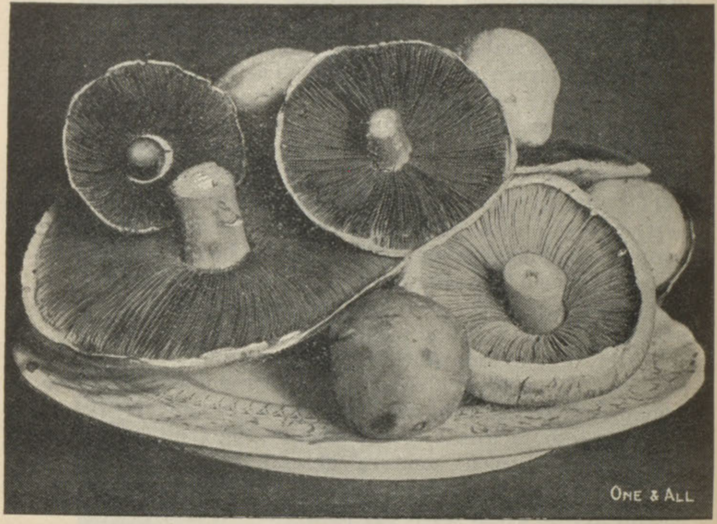


Fig. 36.—Mushrooms.

sprinkled over the heaps to ensure an even rate of fermentation and to keep the whole mass "sweet," moist, and at an equable temperature. In from two to three weeks the temperature will begin to fall, when the manure may be used in the construction of the beds, which should be nine to twelve inches deep after being made. The beds should be formed on the floor or shelves of the mushroom house or cellar, or in large pots or boxes placed under the stage of a greenhouse or potting shed. When grown as an outdoor crop, or in large market-garden plant houses, it is usual to make the manure in the form of a ridge, two feet wide at the base and fifteen inches high.

In the course of a few days the manure will have settled and the heat have declined somewhat, and when the temperature has fallen to 75°-80° F. the beds are ready for spawning. The bricks containing the spawn of the mushroom plant may then be broken into small pieces, one and a half to two inches square, and carefully imbedded in the bed—vertically, about one to two inches deep and six to ten inches apart—by means of a trowel. After "spawning" the beds may again be firmed, and then "cased," one to one and a half inches deep, with good loam. Heavy watering should be guarded against, merely keeping the surface moistened if the beds show a tendency to become dry.

If the mushrooms are not to be grown in caves, cellars, or special mushroom houses, the beds, pots, or boxes should be kept dark by covering them with straw or mats. The pieces of spawn, under favourable circumstances, commence to grow in the new compost, and in about six weeks should be strong enough to produce the mushrooms. Properly prepared beds may continue in bearing for two months or more, and about 1 to $1\frac{1}{2}$ lb. per square foot is a good yield.

The gathering of the crop should receive careful attention, daily if necessary. In the half open stage, when the gills are still pink and all parts are fresh and tender, is the proper time to gather mushrooms. They should be removed by twisting the stalk at the base, when it will easily part from the mycelium.

After a crop has been taken the compost may be removed and be used for manuring garden crops.

Successful mushroom culture depends upon:—

(*a*) A supply of fresh spawn from a reliable seedsman —old spawn will not grow.

(*b*) A suitable medium for the growth of the spawn, *i.e.* the underground portion of the plant, known as the mycelium. Manure and straw litter from corn-fed animals give better results than without straw, or manure from grass-fed animals.

(*c*) An atmospheric temperature of 53°-60° F. is desirable for the production of mushrooms of good quality.

(*d*) A proper amount of moisture in the air. The place in which mushrooms are grown should not be very damp or dripping with water, nor, on the other hand, very dry. The aim should be to have the air sufficiently moist to allow a slight evaporation of moisture from the surface of the beds, and just enough ventilation should be afforded to ensure this taking place.

The only practical test of the proper moisture content of the manure which can be relied upon is when, upon compression, water cannot readily be squeezed out of it.

Mushroom bricks or spawn are made from stable manure litter and soil permeated with the mycelium of the mushroom plant which has been inserted and allowed to develop to a certain stage. It is then cut into flat oblong pieces which, when dry, measure 8 to 10 inches long, 5 to 6 inches wide, and about 1½ inches thick. They are sold at fourpence to sixpence each. Sixteen bricks equal one bushel, which is sufficient for fifty square feet of surface.

SALADS.

Lettuce (Figs. 37, 38).—Both cos and cabbage varieties are generally sown on seed beds and transplanted to any vacant ground, 9 to 12 inches apart. Early supplies are obtained by sowing under glass in February or March, gradually hardening off, and planting out on a sheltered border. Three or four sowings may be necessary to keep up a supply.

Lettuce requires fairly rich, cool, moist soil to encourage quick growth, giving succulent and tender plants.

Radishes, of which there are several kinds—long, short, red, pink, white, olive, and black—require to be sown on

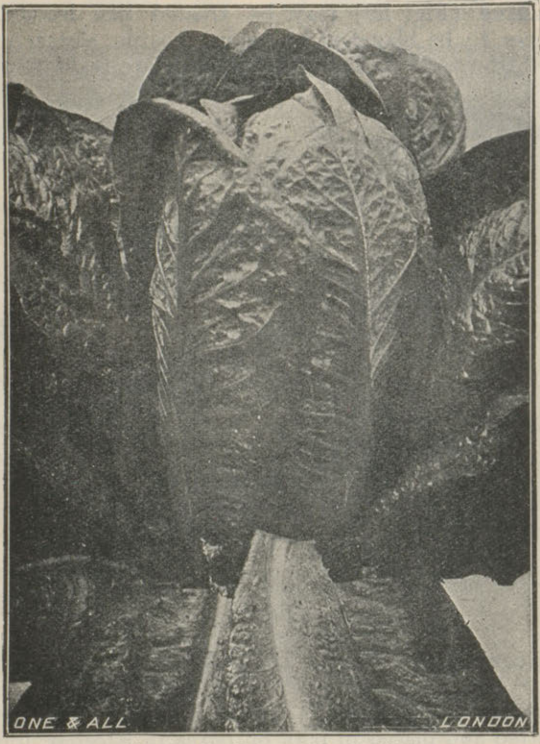


Fig. 37.—Cos Lettuce (Giant White).

rich, cool, moist soil to encourage rapid growth, which results in tender juicy roots. Radishes, like other salad plants, require to be grown quickly, or they may be tough and bitter. They should be used in a fresh, young state.

Mustard and Cress are two popular annuals easily grown. A little warmth and shade encourages quick growth. They are cut when about 2 inches high, and frequent sowings will be necessary to keep up a supply. Winter and spring crops must be sown under glass.

Endive (Fig. 39) may be treated like lettuce, but requires to be blanched by having boards, slates, or pots placed over the plants just before they are ready to cut.

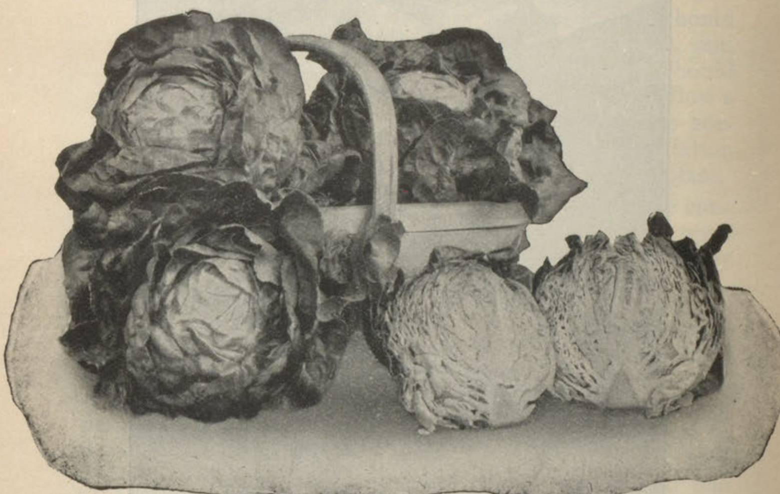


Fig. 38.—Cabbage Lettuce (Sutton's Matchless).

Chicory or Christmas salad ("Witloof") is a biennial plant. Seeds are sown in May, in drills 18 inches apart, and the seedlings thinned. In the autumn the strong roots are lifted and placed in pots or boxes in a cellar, forcing-house, or any structure which will encourage growth, and kept dark to blanch the leaves thoroughly.

The young growths are cut and eaten in the same manner as endive or lettuce.

Other salads such as beetroot, celery, cucumbers, and tomatoes have already been dealt with.

HERBS.

Herbs for Flavouring or making sauces are of considerable interest and importance in nearly all households.

There are several kinds. The tender annuals such as

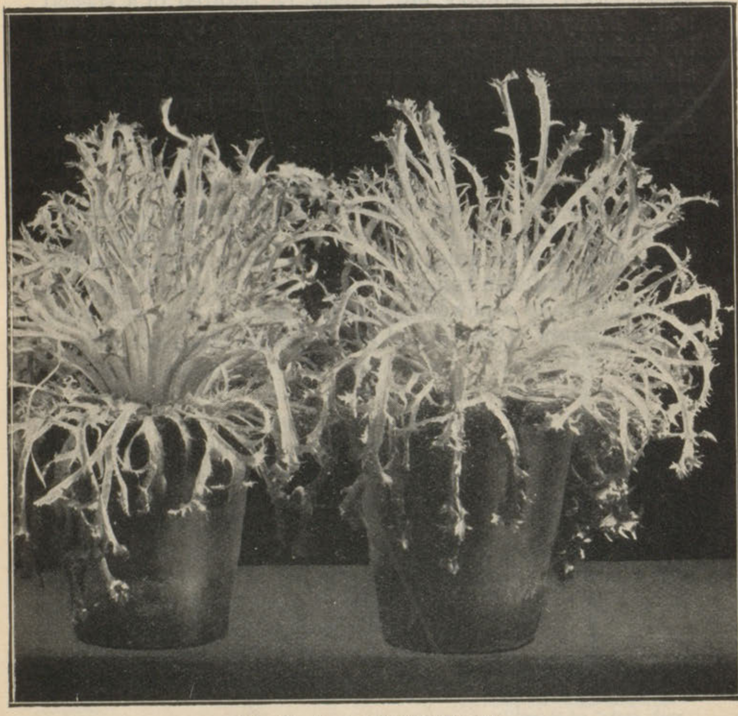


Fig. 39.—Curled Endive (Forced).

sweet basil may be sown under glass and planted out when danger of frost is over.

Hardy annual or biennial kinds such as parsley, borage, caraway, chervil, marigold, summer savory, coriander, dill, etc., may be sown in small circular patches or in drills about 1 foot apart, kept free from weeds and thinned if required.

Perennial herbs such as sage, mint, thyme, balm, chives, marjoram, winter savory, hyssop, tarragon, fennel, horehound, mugwort, wormwood, lavender, rosemary, rue, sweet cicely, costmary, etc., might be planted in a special bed. Many of them are easily propagated by cuttings or by division of the root-stock. Some will not succeed in all districts, *e.g.* rue, rosemary, lavender, pot marjoram, etc., in which case a plant of each might be kept in a frame during winter.

Herbs for flavouring and sauces may be used in a fresh state when obtainable, but for winter use some of the shoots may be cut in summer when in a good condition, hung up to dry, and placed in paper bags. Parsley, sage, mint, etc., may be quickly dried in a warm oven or on the rack of the kitchen range. When dry the leaves may be rubbed down to a powder, placed in jars or tins, and kept for future use. (See special list of herbs, etc., page 132.)

CHAPTER XIV.

FRUIT CULTURE * AND LISTS OF VARIETIES.

Soil.—Good loamy soil containing lime or chalk in its composition is the best for practically all kinds of fruit trees and bushes; but almost any land that will produce good corn, beans, or vegetables will be found suitable for fruit culture.

If the land is heavy or wet (clay soil or water-logged), artificial drainage will be necessary or the trees will not flourish. Arable land is better suited for fruit culture than is grass land. If, however, the land selected for forming a fruit plantation is already under grass, and for some reason or other it is desirable to retain the field as a pasture, then it would be an advantage to trench the space of soil intended for each tree—or better still trench a strip about 10 feet wide for each of the rows of trees to be planted. The surface should be kept free from grass or weeds for several years to allow the trees to become well established.

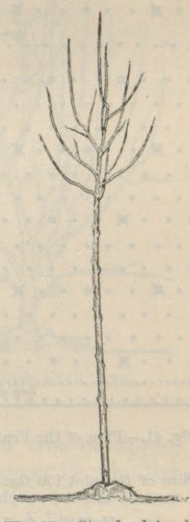


Fig. 40.—Standard Apple Tree (6 to 7 feet clear stem).

Planting.—In planting apples, pears, or plums, standard or half standard trees may be planted at 24 to 30 feet apart,

* For fuller particulars of pruning, propagation, insect pests, diseases, and manuring see under the respective chapters.

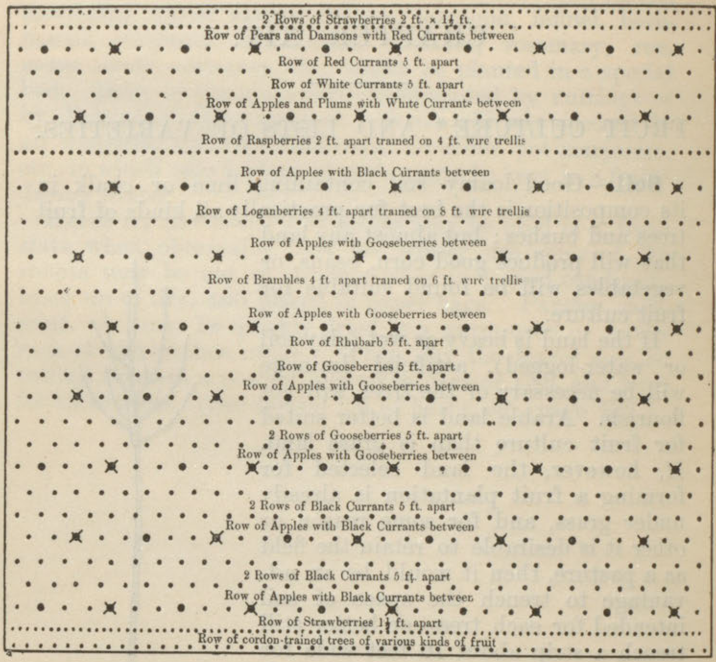


Fig. 41.—Plan of the Fruit Plot at the West of Scotland Agricultural College Farm, Kilmarnock, Ayrshire.

(Size of the plot 150 feet by 137 feet. The large fruits, *i.e.* Apples, Pears, Plums, and Damsons, are planted 15 feet apart from row to row and tree to tree.)

✖ = Half Standards, and ● = Bush or Dwarf trees, planted alternately.

The small or soft fruits, *i.e.* Gooseberries and Currants, are planted 5 feet apart.

according to the kinds to be grown and the locality. In the north of England and in Scotland it is generally advisable to plant half standards or pyramids at 24 feet apart and not to plant the taller specimens, which are difficult to establish in cold and bleak districts. Alternately with the standards (Fig. 40) or half standards

Fig. 42.—Half Standard Fruit Tree.

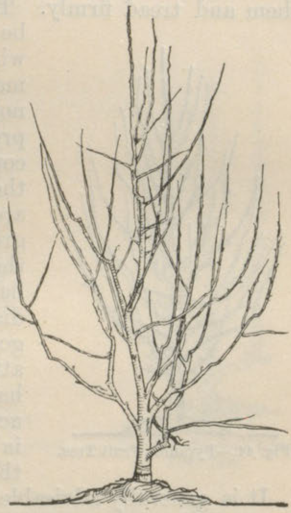


Fig. 43.—Bush Fruit Tree.

may be planted the bush or dwarf form of tree of apple, pear, or plum, and the intervening spaces may be planted with currant or gooseberry bushes; thus the whole space of the rows will be occupied with trees and bushes. In plantations where there is no grass, other fruit bushes—gooseberries, currants, raspberries, brambles—may be planted in rows about 5 feet apart, or vegetables such as rhubarb, asparagus, potatoes, greens, etc., may be grown for a number of years, until the fruit trees require the whole of the space.

Planting may be done in autumn as soon as the leaves have fallen from the trees. If autumn planting is not possible or desirable on account of soil or climate, then planting may be done in the spring. All damaged roots should be cut away, especially those which have a tendency to strike deep into the soil. Avoid planting deeply, carefully spread out the roots and work the soil well among them and tread firmly. Those having tall stems should be staked to prevent damage by wind. A mulching of farmyard manure over the roots of the trees not only nourishes the trees but protects the surface roots and encourages a good root system near the surface. Very few kinds of apples, pears, or plums should be grown in any one plantation; those selected should be good reliable sorts and suited to the district. If grown for profit, then good market sorts only should be attempted. It is a great mistake having too many kinds—twenty acres of about six to ten varieties is better than growing about thirty to forty sorts.

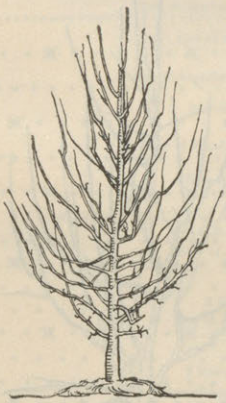


Fig. 44.—Pyramid Fruit Tree.

It is generally advisable to have each kind in a separate row. Different varieties have different habits of growth and seasons of maturity. The gathering of fruit, pruning, etc., will be more expeditiously carried out and the regularity of the trees greatly enhance the appearance of the orchard. Moreover the mixing of sorts in a plantation (a row or two of each kind) will ensure more perfect pollination of the flowers and consequently greater chances of a crop. The presence of a crabtree—Dartmouth, John Downie, or Siberian—will render apple trees more fruitful by the cross pollination of the flowers.

Purchasing.—In purchasing fruit trees and bushes it is best to deal with a reliable firm. The cheap rubbish usually dumped down at auction marts from foreign countries may have roots damaged by long exposure, and the varieties cannot be depended upon as being true to name. If possible a visit should be made to the nursery for the purpose of selecting plants ; these would then be carefully lifted and planted with as little delay as possible, but planting in frosty weather or when the soil is very pasty, should be avoided.

Fig. 45.—Single Cordon Pear Tree.

Fig. 46.—Double Cordon Pear Tree.

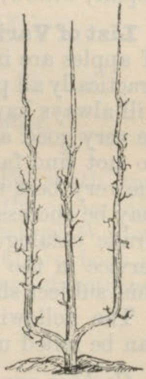


Fig. 47.—Triple Cordon Pear Tree.

Pruning.—The pruning of newly planted apples, pears, plums, gooseberries, and currants may take place in the spring after planting. The young growths of the previous summer may be shortened to about two-thirds of their length, being cut back to a good bud that points outwards from the centre of the tree. Fairly hard pruning may be practised for a few years until a good form of tree is produced. After that period—for standards and half standards (Figs. 40 and 42)—thin out the branches and keep the centres of the trees open. With pyramids, bushes, cordons (Figs. 43 to 47), and espaliers, summer pruning should be done during August in addition to the winter pruning.

Manure and Shelter.—When the trees have commenced to bear heavy crops they may have some assistance in the form of top dressings of farmyard manure, or liquid manure from cowshed, stable, or dung-heap. Superphosphate, basic slag, sulphate of potash, and occasionally lime, will be useful if used with discretion.

If the position of the fruit plantation is an exposed one, it will be well to plant a belt of Austrian pine, sycamore, poplar, willow, Hessle pear, or damsons to provide shelter.

List of Varieties of Apples.—Several hundred varieties of apples are in cultivation, but only a few are popular in practically all parts of the British Isles. Different localities will always have their favourite sorts, and while these may be very good and useful in their respective localities they do not find favour in other districts. Likewise some of the very best varieties of apples, both cooking and dessert, may be successful in one locality and a failure in another. Trade catalogues and fruit exhibitions can be of little service in the selection of sorts to grow; information on this subject should be obtained locally.

The following kinds, however, are standard sorts and can be relied upon in most districts:—

Cooking apples:—

Bismarck, October to December.
Bramley's Seedling, November to April.
Early Victoria, August to September.
Ecklinville Seedling, September to October.
Golden Spire, September to November.
Grenadier, September to October.
Lane's Prince Albert, October to March.
Lord Derby, November to December.
Lord Grosvenor, September to November.
Newton Wonder, November to May.
Potts' Seedling, September to October.
Stirling Castle, August to November.

Dessert apples:—

Allington Pippin, November to January.
Baumann's Red Reinette, October to January.

Beauty of Bath, July to August.
Blenheim Orange, November to January.
Cox's Orange Pippin, November to February.
Cox's Pomona, October to December.
Court Pendu Plat, December to May.
Devonshire Quarrenden, August to September.
Gascoigne's Scarlet, November to January.
Irish Peach, August.
James Grieve, September to October.
King of the Pippins, October to January.
Lady Sudeley, August to September.
Mother (American), October.
Mr. Gladstone, August.
Worcester Pearmain, September to October.

Pears.—Choice varieties succeed in the south and midlands of England, but in the north only the commoner and hardier kinds, such as Hessle, Early Crawford, Walton Weeper, etc., are a success, unless some special provision is made for them, such as good soil, walls, or glass structures.

A select list of varieties :—

Beacon, August.
Beurre Bosc, October to November.
Beurre Hardy, October.
Beurre Superfin, September to October.
Bon Chrétien (Williams), August to September.
Conference, October to November.
Doyenne du Comice, October to November.
Durondeau, October to November.
Fertility, September.
Jargonelle, August.
Josephine de Malines, December to February.
Louise Bonne of Jersey, October.
Marie Louise, October to November.
Pitmaston Duchess, October to November.
Winter Nelis, December to February.

Plums, like pears, succeed in the south and midlands on suitable soil, but in the north they are very uncertain, except under special conditions as regards soil and situation. The variety "Victoria" is perhaps the best for the north. Plums are an important crop in some districts in the open. They also do well on walls with east or west exposure.

A select list of varieties:—

Czar, large, early, purple, August.
Early Prolific, early, purple, July to August.
Jefferson, large, yellow, September.
Kirke's, one of the best blue plums, September.
Magnum Bonum, yellow, September.
Monarch, large, purple, September to October.
Victoria, large, oval, red, September.

Greengage plums, of which there are three or four kinds, thrive only on warm, well drained soils, and like other stone fruits do best on soil of a calcareous nature; even then they may not be regular bearers.

Damsons and **Bullaces** are very hardy, but, by reason of their early flowering, are often damaged by spring frosts. They are sometimes planted to provide shelter to orchards or gardens.

Varieties:—

Farleigh Prolific or Cluster Damson.
Bradley's King.
King of the Damsons.
Prune Damson.
Merryweather.
Shepherd's Bullace, golden fruit.
Langley Bullace, black fruit.

Cherries are, as a rule, only profitable in the south and midland counties, although in some northern gardens they may be grown for private use but not on a commercial scale. Birds are very fond of the fruit. Netting the trees is essential, therefore, for choice kinds. The Morello cherry is fairly hardy, useful as a cooking variety, and may be grown on north walls. In the latter case, cut away all shoots that have produced a crop of fruit, and shorten back to two or three buds all new growths not required for tying in; lay in the young shoots six inches apart.

Varieties of cherries:—

Bigarreau.
Black Heart.
Early Rivers.
May Duke.
Morello.
White Heart.

Peaches, Nectarines, Apricots, and the **Grape Vine** require special treatment in the way of soil for the borders, training, and pruning. Their culture, therefore, need not be considered here.

Gooseberries require a deep, well-cultivated soil. A beginning may be made with young, vigorous bushes, planted about five feet apart. Prune back the young shoots after planting; this encourages vigorous growth for fruiting in the second year. Keep the bushes thin and open by removing any shoots which cross one another or have a tendency to crowd the bushes. Encourage the production of young wood; pinching the lateral shoots during summer will be beneficial in promoting fruitfulness. The ground should be manured occasionally.

As a rule, gooseberries are grown in bush form with good results, but I would strongly advise growers, especially those with small gardens, to try a few as "cordons." By adopting this method some could be planted in a warm situation for early use and others on a north wall, where they will provide fruit for dessert as late as September. Fences of "cordons" may also be arranged, the supports being bamboo sticks, or a wire trellis work. Cordons as a rule bear large crops, and if in July the side shoots are pinched back to the fourth leaf the swelling of the berries is materially assisted. During dry weather it is advisable to syringe the trees occasionally, and to feed them with liquid manure if the fruits are desired for exhibition purposes.

A select list of varieties :—

Green sorts—

Pitmaston Green Gage.
Whitesmith.
Langley Gage.
Hedgehog.
Keepsake.

Red sorts—

May Duke.
Ironmonger.
Warrington.
Whinham's Industry.

Yellow sorts—

Langley Beauty.
Golden Gem.
Leader.
Early Sulphur.

Varieties for a late supply—

Clayton.
Dan's Mistake.
Keen's Seedling.
Rifleman.
Warrington.
Golden Lion.

Black currants do best in a cool, moist, rich soil. Treat the young plants much in the same way as recommended for gooseberries. Encourage young, vigorous shoots from the base of the bushes by cutting out the older branches. Old worn out plants with their weak shoots are useless. A sharp look out for big bud (black currant gall mite) should be kept, and all bushes attacked destroyed. Care in cutting away the older branches and liberal doses of manure will have a tendency to keep the bushes healthy.

Varieties :—

Victoria.
Boskoop Giant.
Black Naples.
Goliath.

Red and White currants may be grown in the open as bushes, four to five feet apart, or planted among the taller fruit trees (apples, pears, and plums) to fill up the intervening spaces. They may also be grown as cordons on walls with a north, west, or east aspect. The principal requirements in pruning being to build up strong bushes, with a number of main branches, the lateral shoots are annually spurred back in the dormant season, *i.e.* the young wood is cut to within two or three buds of the main branches (Figs. 48 and 49) which carry the fruit. Summer pruning of the young shoots is advisable in July. Red and white currants bear fruit on the old wood (spurs), black currants on new vigorous shoots of the previous year. Gooseberries bear both on the old wood (spurs) and young shoots of the previous year.

Varieties of red currants :—

Comet.
Raby Castle.

Varieties of white currants :—

White Dutch.
White Transparent.

Raspberries thrive best on a strong retentive soil, which may be lightened by incorporating stable manure, decayed leaves, or any other decayed vegetable matter. A plantation once well established will last for years with care in cleaning, manuring, etc. They may be grown in continuous rows, tied to wires or grown in clumps. Planting may be done in autumn or spring ; all the canes should be cut down to about one foot from the ground after planting. The after treatment will consist in cutting away all the old canes after fruiting and thinning out some of the weaker new canes. The young shoots are then

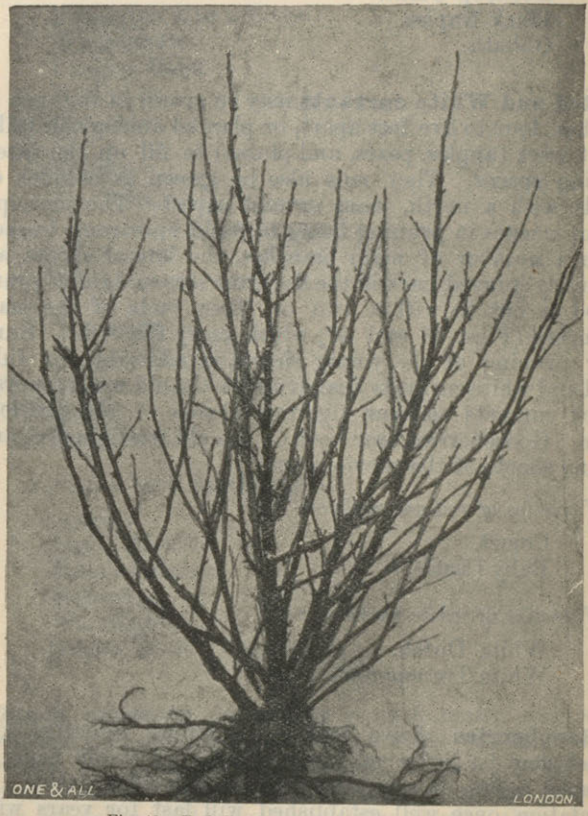


Fig. 48.—Red Currant Bush (before Pruning).

tied to wires for the next summer's fruiting. Avoid digging deeply near the roots or the underground stems will be injured.

Varieties :—

Fillbasket.
Red Antwerp.
Superlative.
The Guinea, a yellow-fruited kind.

Fig. 49.—Red Currant Bush (after Pruning).

Autumn-fruiting raspberries.—Several varieties are suitable for this purpose; it is, however, necessary to cut all canes close to the ground in March. The young canes produced during spring and summer should fruit in the autumn.

Varieties :—

Belle de Fontenoy.
Everbearing Feldbrummen.
Fastolf Surpasse.

Blackberries (brambles) and allied fruits.—During recent years much attention has been paid to the cultivation of brambles, which, although common hedgerow plants, do well under cultivation, producing large clusters of fruit which ripen earlier than in the wild state. There are several forms of our native bramble, therefore only good fruiting kinds should be introduced into the garden. It is generally better to purchase young plants from nurseries. Several new forms have been brought about by selection of kinds and hybridising with the raspberry, a notable instance of this being the loganberry (Fig. 50), raised in America as a result of crossing the raspberry with an American bramble. Several British firms have taken up this subject, and by crossing the loganberry with other brambles have obtained new kinds. Thus we have :—

The Laxtonberry (Laxton Bros., Bedford).
Lowberry (Low and Co.).
Phenomenal (Low and Co.).
Mahdi (James Veitch and Son).

The following is a list of the principal kinds of brambles in cultivation :—

Common bramble, selected forms (*Rubus fruticosus*).
Parsley-leaved bramble (*Rubus laciniatus*).
Loganberry (raspberry crossed bramble) (Fig. 50).
Lowberry.
Phenomenal.
Mahdi.
Newberry.
Cumberland Black Cap.
Laxtonberry.

The first three kinds are well known, and give good

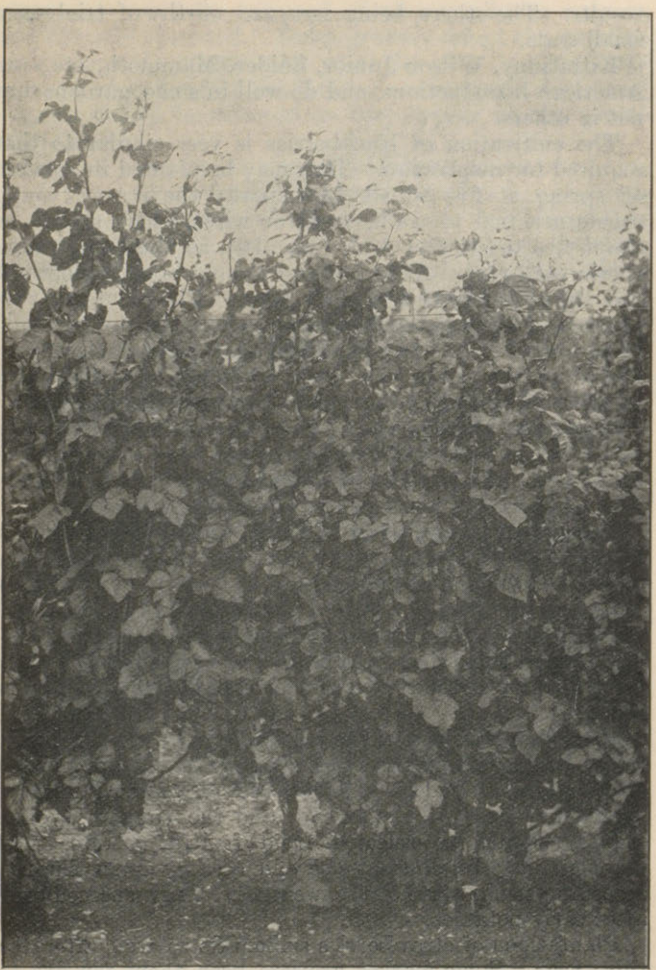


Fig. 50.—Loganberry growing on wire trellis 6 feet high.

results. The others, being new, are worthy of trial on a small scale.

Kittatinny, Wilson Junior, Snider, Mammoth, etc., are American introductions, and do well in some gardens but not in others.

The cultivation of blackberries is very similar to that required for raspberries. They may be planted in autumn or spring at five to six feet apart; the strong young shoots are tied to trellis work or wires, which should be about five to six feet high (Fig. 50), as they make long shoots each year. After fruiting the old canes are cut out and the new ones tied in their place. The plants may be propagated by pegging down the growing tips to the soil; when rooted they may be lifted and planted elsewhere. Pieces of the roots, too, may be lifted, cut into short lengths, and placed in the soil to form new plants.

Japanese wineberry (*Rubus phœnicolasius*) has very small, bright red fruit, very sweet, and therefore suitable for dessert; also good for making into a jelly. It is hardy in some districts, but does not ripen well in Scotland.

Strawberry-raspberry (*Rubus sorbifolius*) is not a hybrid between the strawberry and the raspberry, as some people would have us believe, nor is it of much use as a fruit-bearing plant. It is a dwarf-growing ornamental plant, producing underground stems which spread rapidly. The foliage somewhat resembles the raspberry leaf, and the fruit that of the strawberry in appearance but not in flavour.

Strawberries have taken a leading place among hardy fruit. Being the first to ripen they are much appreciated by all classes. Deeply cultivated soil of a retentive nature should be chosen for planting, and the runners (young plants) should be selected from fruitful plants. The planting may be done at the end of July or in August, according to the state of the weather. They succeed well after early potatoes.

Plantations of strawberries seldom do so well after the third year. Some market growers keep them for five to six years in one position. This is possible only when the soil is suitable—good heavy soil is best—and when the plants are carefully trimmed of all superfluous runners and liberally manured. Some growers adopt the practice of keeping the plants one year—for this system early planting of well-rooted runners is necessary, and any young runners should be removed as they appear on the plants after planting.

The runners may be layered in June in pieces of turf, or small pots. Sometimes it is possible to obtain good plants by pegging the young runners to the soil, and lifting when rooted—this system answers well in cool, damp districts. The planting is best done during showery weather. They may be planted in rows two feet apart and one foot between the plants for a one year's plantation, and two and a half feet by eighteen inches for a three years' plantation.

Straw should be placed around the plants before flowering to keep the fruit clean and the soil moist. It is important to cut away all runners not required for increasing the stock, and to keep the ground free from weeds by hoeing. This allows the crowns to ripen and so increases the quantity of fruit the following year.

Varieties :—

Royal Sovereign.
The Laxton.
Fillbasket.
Elton Pine.
Sir Joseph Paxton.
Dumbarton Castle.
Laxton's Latest.
Givon's Late Prolific.

CHAPTER XV.

THE CULTURE OF HARDY FLOWERS.

Selection.—By a judicious selection of hardy flowers it is possible to have something of interest in our flower gardens nearly the whole year round.

We should, however, pay some attention to those most likely to succeed in our own district, and having found by experience—or profiting by the experience of others—the plants best suited to our soil or climate, we should develop these and specialise to a certain extent, growing the very best varieties obtainable, and not be satisfied with such plants as are sometimes thrown away or are to be had for the asking from our neighbours.

Arrangement.—The flower garden may be arranged so as to possess several distinctive features such as formal beds or borders annually planted with bedding plants, rockeries, water gardens, rose gardens, wild gardens, or a garden so arranged that we can combine a little of each, *i.e.* provision being made for roses, shrubs, herbaceous and rock plants, with a few annuals, biennials, bulbs, and bedding plants.

The mixed herbaceous border may have a wall at the back covered with creepers or other suitable plants, or a background of shrubs will give a natural and pleasing effect to the other occupants of the border.

Flower borders should be well prepared by deep cultivation and suitable manuring. The length and width will be dependent upon the size of the garden or the area at our disposal for flower culture. A border 6 to 12 feet wide and 100 feet long will give scope for planting a great variety of things. With a border of this width we may have bold displays of certain plants—keeping the taller ones at the back and finishing off with the dwarf or trailing plants in the foreground.

Plants arranged in fairly good-sized clumps are most effective, but very large patches of any one kind must be guarded against, because when not in flower, or when the plants have died back, large gaps or bare places will be apparent. Ample space for the development of each plant and for cleaning the borders should be provided.

In addition to perennial herbaceous plants we may plant various kinds of bulbs or corms, and when these have died down a few annuals or bedding plants may be planted or sown to keep the borders full and attractive.

General Hints on Cultivation.

Perennials.—Some of the strong growing herbaceous plants such as Rudbeckia (cone flower), Michaelmas daisies (Aster), *Phlox decussata*, and perennial sunflowers (Helianthus) will require dividing every second year. Some growers divide each year, putting back only the strong pieces to produce fine large flowers. Such plants as paeony, Eryngium (sea holly), Statice (sea lavender), Acanthus (bear's breech), Oriental poppy (Papaver), Christmas rose, and other deep fleshy rooted plants resent interference, and are best left undisturbed for many years, the ordinary cleaning, forking, and manuring of the soil being all they require.

Spring flowering bulbs, such as crocus, daffodils, hyacinths, tulips, squills, glory-of-the-snow, snowdrops, etc., may be planted in October and November. On heavy or low-lying ground, sand placed under the bulbs will be beneficial.

Summer flowering bulbs—Spanish Iris, English Iris, Gladiolus, lilies, Montbretia, etc.—may be planted in the spring.

Autumn flowering bulbs, such as *Crocus speciosus*, *C. zonatus*, *C. longiflorus*, *C. Salzmanni*, *C. Tournefortii*, etc., and meadow saffron (Colchicum), of which there are several kinds, may be planted after flowering or when the foliage dies down.

Biennial plants may be sown, on well-prepared seed beds, during May, June, or July, transplanted into nursery beds, and finally planted either in October or in the spring

Fig. 51.—Thinning Annuals.—Eschscholzias before Thinning.

—according to the locality and character of the soil—in the position where they are intended to flower. On light soils, and in warm or sheltered districts, planting out in the autumn gives good results. Some biennials are best sown under glass and grown on for planting out later on.

Annuals of a hardy nature may be sown outside, the soil being previously prepared for their reception. April and May are good months for sowing, but the precise date will depend upon the district, the kind of plant, and the state of the weather. In the south sowing may take place three to four weeks earlier than in the north. Whatever method is adopted for sowing the seed—whether in circular patches or in lines (drills)—great care should be exercised in obtaining an even and thin distribution.

Finely sifted soil forms the best covering for the seeds, but failing this the surface may be lightly raked to cover them, this being an expeditious method and answering

Fig. 52.—Thinning Annuals.—Eschscholzias after Thinning.

well for all ordinary purposes. The depth to which the seeds may be covered depends upon their size; large seeds such as Tropaeolum, Convolvulus, lupins, or sweet peas may be covered to a depth of two to three inches. The seeds of red flax, cornflower, candytuft, etc., may be placed one to two inches deep, while fine seeds such as purple toadflax, bellflower, Gilia, and mignonette should not be covered with more than half an inch of soil.

When large enough to handle the seedlings should be thinned out, preferably during showery weather (Fig. 52).

Sometimes it is possible to transplant the seedlings, but, as a rule, they succeed best when not transplanted.

Figs. 51 and 52 will give some idea of the extent to which hardy annuals should be thinned. As a rule they are not thinned sufficiently; consequently their true beauty is not seen, and their value for garden decoration is not appreciated to the extent it would otherwise be. The distance apart to which a hardy annual should be thinned will depend upon its height, habit—whether branching, bushy, or spreading—and the nature of the soil. But if ample room for development be allowed the resulting plants will be strong and sturdy, more floriferous, and will continue in flower for a much longer period.

Frequent hoeing will keep the soil free from weeds, and dead flowers and leaves should be removed as they appear.

Half-hardy annuals may be sown in pots or boxes in a greenhouse, hotbed, or cold frame. The seedlings must be carefully pricked off, and when thoroughly hardened—a process which must not be hurried—may be planted out when all danger from frost is past.

Florists' flowers.—This term refers to plants of garden origin which do not exist anywhere in a wild state. These flowers have been produced, or evolved, by careful selection, hybridisation, and altered cultural conditions. Florists' flowers include annual and biennial plants which usually come true from seed, and perennial herbaceous plants and shrubs, including roses, which do not generally reproduce themselves true from seed, so that some other method of propagation is necessary for increasing the last-named group of plants. The majority of popular garden flowers belong to this section. For example: Begonia, carnation, Chrysanthemum, Dahlia, Gladiolus, pansy, rose, sweet pea, and Viola. Details of culture cannot be entered upon in this work. It may be stated, however, that ordinary methods of cultivation will suit the majority of florists' flowers.

Lists of the names of popular garden varieties of the different kinds in cultivation may be obtained from the catalogues issued by the leading nurserymen, seedsmen, and florists, or from books dealing with special garden subjects.

SELECT LISTS OF PLANTS.

(A) Hardy Herbaceous Perennials.

Period of flowering:—

(1) Early spring: February and March.
(2) Spring and early summer: April and May.
(3) Summer: June to the end of August.
(4) Autumn: September to November.

Common Name.	Botanical Name.	Height in feet.	Period of flowering.
*Silvery yarrow	*Achillea Clavennae*	$\frac{3}{4}$	3
Double sneeze-wort	,, *Ptarmica fl. pl.*	2	3
Golden alstroemeria	*Alstroemeria aurantiaca*	3	3
*Mountain madwort	*Alyssum montanum*	$\frac{1}{3}$	2
*Rock madwort	,, *saxatile compactum*	1	2
*Apennine windflower	*Anemone apennina*	$\frac{1}{2}$	1
Japanese windflower	,, *japonica* (Fig. 53)	2-3	3
St. Bruno's lily	*Anthericum Liliastrum major*	$1\frac{1}{2}$	3
Yellow columbine	*Aquilegia chrysantha*	3	2
*Alpine rock-cress	*Arabis alpina fl. pl.*	$\frac{1}{2}$	1
*Variegated shining rock-cress	,, *lucida variegata*	$\frac{3}{4}$	2
*Balearic sandwort	*Arenaria balearica*	$\frac{1}{12}$	3
*Mountain sandwort	,, *montana*	$\frac{1}{4}$	2
Bright pink thrift	*Armeria Laucheana*	$\frac{1}{2}$	2
King's spear	*Asphodelus ramosus*	3-5	2
*Alpine aster	*Aster alpinus*	$\frac{1}{2}$	3
Italian starwort	,, *Amellus bessarabicus*	2	3
Heath-like Michaelmas daisy	,, *ericoides*	$2\frac{1}{2}$	4
Smooth Michaelmas daisy	,, *laevis*	5	3 & 4
New England ,, ,,	,, *Novae-Angliae praecox*	$3\frac{1}{2}$	3

* These are dwarf plants suitable for rockeries.

Fig. 53.—White Japanese Anemone (*Anemone japonica alba*).

This is one of our most useful late summer and autumn flowering perennials. It is sometimes rather difficult to establish, but thrives splendidly when once the roots secure a hold.

Common Name.	Botanical Name.	Height in feet.	Period of flowering.
New England Michaelmas daisy	*Aster Novae-Angliae pulchellus*	4½	4
Michaelmas daisies (Fig. 54)	,, garden varieties	3-4	4
*Leichtlin's aubrietia	*Aubrietia Leichtlinii*	½	1
*Purple aubrietia	,, *purpurea*	½	1
Plume poppy	*Bocconia cordata*	6	3
*Alpine harebell	*Campanula alpina*	⅓	3
Carpathian harebell	,, *carpatica*	1	3
*Gargano harebell	,, *garganica*	½	3
*G. F. Wilson's harebell	,, *G. F. Wilson*	½	3
Clustered bellflower	,, *glomerata*	1½	3
Great bellflower	,, *grandis*	2	3
Large-flowered bellflower	,, *macrantha*	5	3
Peach-leaved bellflower	,, *persicifolia*	2	3
*Dwarf bellflower	,, *pumila*	½	3
Pyramidal harebell	,, *pyramidalis*	4-6	3
*Vase harebell	,, *turbinata*	½	3
Great-headed centaurea	*Centaurea macrocephala*	5	3
Mountain cornflower	,, *montana*	1½	3
Large ox-eye daisy	*Chrysanthemum maximum*	2	3
Lily-of-the-valley	*Convallaria majalis*	¾	2
Large-flowered tickseed	*Coreopsis grandiflora*	3	3
*Ivy-leaved cyclamen	*Cyclamen hederaefolium*	¼	4
Larkspur	*Delphinium*, many garden varieties	4-5	3
*Maiden pink	*Dianthus deltoides*	¾	3
*Grass rose	,, *neglectus*	⅓	3
Lyre-flower or Bleeding heart	*Dicentra* (*Dielytra*) *spectabilis*	2	2
Burning-bush	*Dictamnus Fraxinella*	1½	3
Plantain leopard's-bane	*Doronicum plantagineum*	2½	1
Globe-thistle	*Echinops ruthenicus*	3½	3
Winter aconite	*Eranthis hyemalis*	¼	1
*Winter heath	*Erica carnea*	½	1
*Dwarf ,,	,, *herbacea*	½	1
Showy heron's-bill	*Erodium Manescavei*	1½	3

* These are dwarf plants suitable for rockeries.

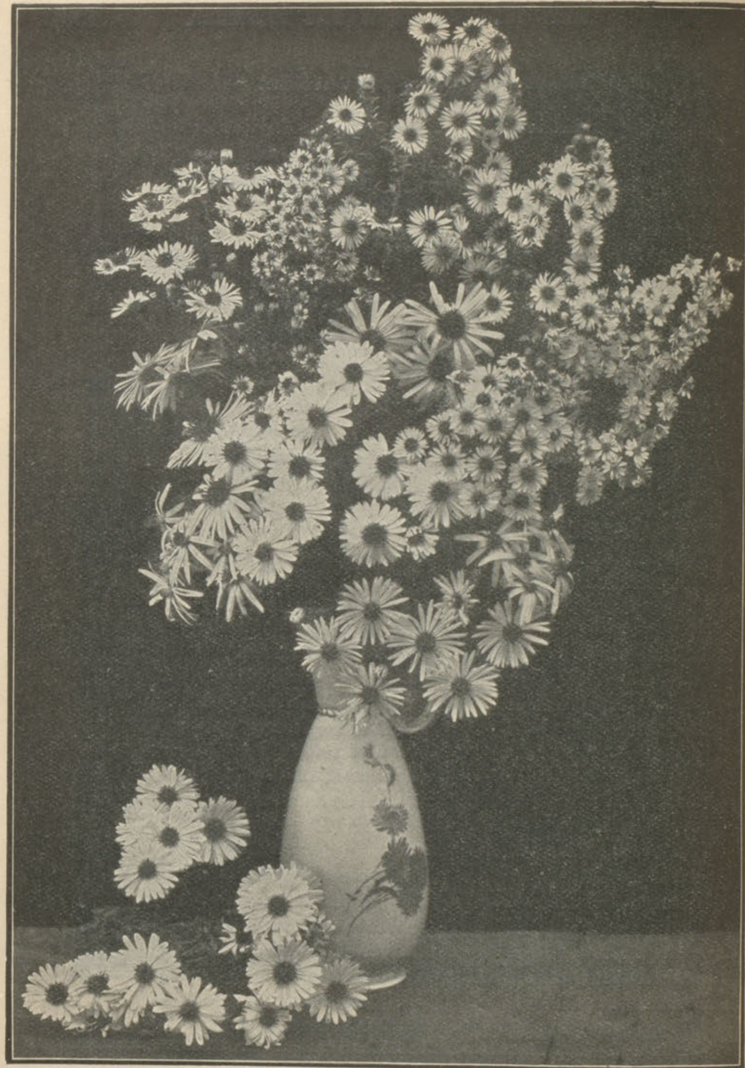


Fig. 54.—Michaelmas Daisies (Aster).

Common Name.	Botanical Name.	Height in feet.	Period of flowering.
*Alpine sea holly (Fig. 55)	*Eryngium alpinum*	1½	3
Amethystine sea holly	,, *amethystinum*	2½	3
Oliver's sea holly	,, *Oliverianum*	2	3
Plantain lily	*Funkia grandiflora*	1½	3
,, ,, Siebold's	,, *sieboldiana*	1½	3
Blanket-flower	*Gaillardia grandiflora*	2	4
*Stemless gentianella	*Gentiana acaulis*	¼	1
Cranesbill	*Geranium ibericum*	1½	3
*Mountain avens	*Geum montanum*	1	2
*Globe daisy	*Globularia trichosantha*	¾	3
Chalk-plant	*Gypsophila paniculata*	3	3
Smooth helenium	*Helenium autumnale striatum*	4½	3
Dwarf ,,	,, *pumilum*	1½	3
Sunflower	*Helianthus multiflorus maximus*	5	3
Prairie Sunflower	,, *rigidus*	3	3
Greatest Christmas rose	*Helleborus maximus*	2	1
Christmas rose	,, *niger* var. *altifolius*	1¼	1
Lenten Rose	,, *orientalis*	1½	1
Yellow day lily	*Hemerocallis flava*	3	3
*Blue hepatica	*Hepatica triloba coerulea*	½	1
*Late candytuft	*Iberis correaefolia*	1	2
German iris	*Iris germanica*	1½	2
Torch lily	*Kniphofia* (*Tritoma*) *Uvaria*	4	3
Large-flowered everlasting pea	*Lathyrus grandiflorus*	4	3
Everlasting pea	,, *latifolius*	6	3
*Pale-flowered toadflax	*Linaria pallida*	¼	3
*Gentian gromwell	*Lithospermum prostratum*	½	2
Nootka lupin	*Lupinus nootkatensis*	1½	2
Perennial lupin	,, *polyphyllus*	3	3
Double scarlet lychnis	*Lychnis chalcedonica fl. pl.*	3	3

* These are dwarf plants suitable for rockeries.

Common Name.	Botanical Name.	Height in feet.	Period of flowering.
Shaggy lychnis	*Lychnis Haageana hybrida*	$1\frac{1}{2}$	3
Double white lychnis	,, *vespertina fl. pl.*	$2\frac{1}{2}$	3
Double German catchfly	,, *Viscaria splendens plena*	$1\frac{1}{2}$	3
White musk mallow	*Malva moschata alba*	$2\frac{1}{2}$	3
Welsh poppy	*Meconopsis cambrica*	1	2
Bee balm or bergamot	*Monarda didyma*	$2\frac{1}{2}$	3
*Golden drop	*Onosma taurica*	$\frac{3}{4}$	2
Paeony	*Paeonia*	2	2
Iceland poppy	*Papaver nudicaule*	1	3
Oriental ,,	,, *orientale*	3	3
Torrey's bearded pentstemon	*Pentstemon barbatus Torreyi*	5	3
*Dwarf phlox	*Phlox amoena setacea*	$\frac{1}{2}$	2
Early-flowering phlox	,, *suffruticosa*	2	3
Late ,, ,,	,, *decussata*	3	3 & 4
Richardson's Jacob's ladder	*Polemonium Richardsonii*	$2\frac{1}{2}$	3
Cinquefoil	*Potentilla hybrida*	1	3
*Auricula	*Primula Auricula*	$\frac{1}{2}$	3
Toothed primrose	,, *denticulata*	1	1
Japanese ,,	,, *japonica*	$1\frac{1}{2}$	2
Himalaya ,,	,, *rosea*	$\frac{3}{4}$	1
Common ,,	,, *vulgaris*	$\frac{1}{2}$	1
Herbaceous pyrethrum	*Pyrethrum (Chrysanthemum) roseum*	$2\frac{1}{2}$	3
Purple cone-flower	*Rudbeckia purpurea*	2	3
*Pyramidal saxifrage	*Saxifraga Cotyledon*	2	2 or 3
*Opposite-leaved saxifrage	,, *oppositifolia*	$\frac{1}{6}$	2
Caucasian scabious	*Scabiosa caucasica*	2	3
*Ewer's stonecrop	*Sedum Ewersii*	$\frac{1}{2}$	3
*Grey ,,	,, *glaucum*	$\frac{1}{3}$	3
*Showy ,,	,, *spectabile*	$1\frac{1}{2}$	4
*Lagger's houseleek	*Sempervivum Laggeri*	$\frac{3}{4}$	3
*Mountain ,,	,, *montanum*	$\frac{1}{2}$	3
*Alpine catchfly	*Silene alpestris*	$\frac{2}{3}$	2-3

* These are dwarf plants suitable for rockeries.

Fig. 55.—Alpine Sea Holly (*Eryngium alpinum*).

Common Name.	Botanical Name.	Height in feet.	Period of flowering.
*Twin-leaved lily-of-the-valley	*Smilacina bifolia*	½	2
Dwarf golden rod	*Solidago nana*	1	3
Goat's-beard spiraea	*Spiraea Aruncus*	4½	3
Palmate spiraea	,, *palmata*	2½	3
Great sea lavender	*Statice latifolia*	2	3
Columbine meadow rue	*Thalictrum aquilegifolium*	2-3	2
*Crimson thyme	*Thymus Serpyllum coccineum*	¼	3
*Foam-flower	*Tiarella cordifolia*	¾	2
Asiatic globe-flower	*Trollius asiaticus*	1½	2
*Rock tunica	*Tunica Saxifraga*	¾	3
Violet mullein	*Verbascum phoeniceum*	2½	2
Long-leaved speedwell	*Veronica longifolia*	2	2
Speedwell	,, *subsessilis*	2½	3
*Prostrate speedwell	,, *prostata*	¼	2
Violet	*Viola odorata* variety	¼	1 & 2
*Viola or tufted pansy	,, *cornuta* × garden pansies	¼	3
Pansy	,, *tricolor* varieties	¼	3

(B) Hardy Bulbs, Corms, and Tuberous Plants.

Common Name.	Botanical Name.	Natural Order.	Average height in feet.
Sky-blue allium	*Allium azureum*	*Liliaceae*	1
Lily leek	,, *Moly*	,,	1¼
Daffodil garlic	,, *neapolitanum*	,,	1
Belladonna lily	*Amaryllis Belladonna*	,,	1½
Crown anemone	*Anemone coronaria*	*Ranunculaceae*	1
Scarlet windflower	,, *fulgens*	,,	1
Italian cuckoo-pint	*Arum italicum*	*Araceae*	¾
Cuckoo-pint or lords-and-ladies	,, *maculatum*	,,	½

* These are dwarf plants suitable for rockeries.

Common Name.	Botanical Name.	Natural Order.	Average height in feet.
Crimson satin-flower	*Brodiaea coccinea*	*Liliaceae*	$1\frac{1}{2}$
Spring meadow saffron	*Bulbocodium vernum*	,,	$\frac{1}{3}$
Mariposa lily or butterfly tulip	*Calochortus venustus*, etc.	,,	1
Quamash	*Camassia esculenta*	,,	$1\frac{1}{2}$
Glory-of-the-snow	*Chionodoxa Luciliae*	,,	$\frac{1}{3}$
Autumn crocus or meadow saffron	*Colchicum autumnale*	,,	$\frac{1}{3}$
	,, *Parkinsoni*	,,	$\frac{1}{3}$
	,, *speciosum*	,,	$\frac{1}{3}$
Fumitory	*Corydalis bulbosa*	*Fumariaceae*	$\frac{3}{4}$
,,	,, *nobilis*	,,	$\frac{3}{4}$
*Crocus	*Crocus asturicus atropurpureus*	*Iridaceae*	$\frac{1}{3}$
,,	,, *aureus*	,,	$\frac{1}{3}$
,,	,, *biflorus*	,,	$\frac{1}{3}$
,,	,, *chrysanthus*	,,	$\frac{1}{3}$
,,	,, *Imperati*	,,	$\frac{1}{3}$
* ,,	,, *longiflorus*	,,	$\frac{1}{3}$
,,	,, *reticulatus*	,,	$\frac{1}{3}$
* ,,	,, *Salzmanni*	,,	$\frac{1}{3}$
*True saffron	,, *sativus*	,,	$\frac{1}{3}$
*Crocus	,, *speciosus*	,,	$\frac{1}{3}$
* ,,	,, *speciosus Aitchisonii*	,,	$\frac{1}{3}$
,,	,, *versicolor violacea*	,,	$\frac{1}{3}$
,, Spring	,, *vernus*	,,	$\frac{1}{3}$
,,	,, *vitellinus*	,,	$\frac{1}{3}$
* ,,	,, *zonatus*	,,	$\frac{1}{3}$
Sowbread or cyclamen	*Cyclamen Coum*	*Primulaceae*	$\frac{1}{2}$
Swiss cyclamen	,, *europaeum*	,,	$\frac{1}{2}$
Ivy-leaved cyclamen	,, *hederaefolium*	,,	$\frac{1}{2}$
Winter aconite	*Eranthis hyemalis*	*Ranunculaceae*	$\frac{1}{4}$
Dog's-tooth violet	*Erythronium*, several species	*Liliaceae*	$\frac{1}{2}$
Crown Imperial	*Fritillaria imperialis*	,,	$2\frac{1}{2}$

* Autumn flowering kinds.

Fig. 56.—English Iris.

Common Name.	Botanical Name.	Natural Order.	Average height in feet.
Snake's-head	*Fritillaria Meleagris*	*Liliaceae*	1
Snowdrop	*Galanthus nivalis, etc.*	*Amaryllidaceae*	½
Corn-flag	*Gladiolus,* numerous species and varieties	*Iridaceae*	2
White hyacinth	*Hyacinthus candicans*	*Liliaceae*	5
Common ,,	,, *orientalis*	,,	¾
Roman ,,	,, ,, var. *albulus*	,,	1
Iris, scorpion	*Iris alata*	*Iridaceae*	½-¾
,,	,, *Grant-Duffii*	,,	2
,, Persian	,, *persica*	,,	½
,, netted	,, *reticulata*	,,	¾
,, ,,	,, ,, var. *Histrioides*	,,	½
,,	,, *sindjarensis*	,,	1
,, Tangier	,, *tingitana*	,,	2
,, Snakeshead	,, *tuberosa*	,,	¾
,, Spanish	,, *Xiphium*	,,	2
,, English (Fig. 56)	,, *xiphioides*	,,	2
Ixia lily	*Ixiolirion tartaricum*	*Amaryllidaceae*	1½
Summer snowflake	*Leucojum aestivum*	,,	1¼
Autumn ,,	,, *autumnale*	,,	1
Spring ,,	,, *vernum*	,,	1
,, ,,	,, ,, *carpaticum*	,,	1
Golden lily of Japan	*Lilium auratum*	*Liliaceae*	4
Yellow Canadian lily	,, *canadense*	,,	4
Madonna lily	,, *candidum*	,,	3
Scarlet Turk's-cap lily	,, *chalcedonicum*	,,	3
Turk's-cap lily	,, *Martagon*	,,	2
Orange lily	,, *croceum*	,,	2½
Trumpet lily	,, *longiflorum*	,,	4
Bermuda ,,	,, ,, var. *Harrisii*	,,	4
Shell-like ,,	,, *testaceum*	,,	3
Tiger lily	,, *tigrinum*	,,	3½
Montbretia	*Montbretia* (*Tritonia*) several kinds	*Iridaceae*	1½

Common Name.	Botanical Name.	Natural Order.	Average height in feet.
Grape hyacinth	*Muscari botryoides*	*Liliaceae*	$\frac{3}{4}$
Tassel ,,	,, *comosum*	,,	$\frac{3}{4}$
Hoop-petticoat	*Narcissus Bulbocodium*	*Amaryllidaceae*	$\frac{1}{2}$
Jonquil	,, *Jonquilla*	,,	1
Pheasant's-eye	,, *Poeticus*	,,	1
Daffodil	,, *Pseudo-narcissus*	,,	1-1$\frac{1}{2}$
Polyanthus daffodil	,, *Tazetta*	,,	1
Paper-white narcissus	,, ,, var. *papyraceus*	,,	1
Star of Bethlehem	*Ornithogalum umbellatum*	*Liliaceae*	$\frac{1}{2}$
Drooping Star of Bethlehem	,, *nutans*	,,	1
Striped squill	*Puschkinia scilloides*	,,	$\frac{1}{2}$
Asiatic buttercup	*Ranunculus asiaticus*	*Ranunculaceae*	1
Bloodroot	*Sanguinaria canadensis*	*Papaveraceae*	$\frac{1}{2}$
Wood hyacinth	*Scilla nutans* (*festalis*)	*Liliaceae*	$\frac{1}{2}$
Cuban lily	,, *peruviana*	,,	1
Siberian squill	,, *sibirica*	,,	$\frac{1}{2}$
Mount Etna lily	*Sternbergia lutea*	*Amaryllidaceae*	$\frac{1}{2}$
Triplet lily	*Triteleia* (*Brodiaea*) *laxa*	*Liliaceae*	1$\frac{1}{4}$
Missouri hyacinth	,, *uniflora*	,,	$\frac{1}{3}$
Tulip	*Tulipa cornuta*	,,	
,,	,, *elegans*	,,	
,,	,, *fulgens*	,,	
,,	,, *Greigi*	,,	
,,	,, *kaufmanniana*	,,	
,,	,, *mauriana*	,,	
,,	,, *persica*	,,	
,,	,, *retroflexa*	,,	
,,	,, *Sprengeri*	,,	
,,	,, *tubergeniana*	,,	
Swamp lily	*Zephyranthes candida*	*Amaryllidaceae*	$\frac{1}{2}$
,, ,,	,, *Atamasco*	,,	$\frac{1}{2}$

(C) Hardy Biennials.

Common Name.	Botanical Name.	Colour of Flower.	Height in Feet.
Italian alkanet	*Anchusa italica* (*Dropmore* var.)	blue	2½
Snapdragon	*Antirrhinum majus*	various	1½
Double daisy	*Bellis perennis* var.	,,	¼
Canterbury bell (Fig. 57)	*Campanula Medium*	,,	1½
Wallflower	*Cheiranthus Cheiri*	,,	1½
Sweet William	*Dianthus barbatus*	,,	1½
Foxglove	*Digitalis purpurea*	,,	3-4
Rocket or Dames'-violet	*Hesperis matronalis*	,,	2
Honesty	*Lunaria biennis*	,,	1½
Brompton stock	*Matthiola incana*	,,	1½
Alpine forget-me-not	*Myosotis alpestris*	blue	½
Early forget-me-not	,, *dissitiflora*	,,	½
Evening primrose	*Oenothera Lamarckiana*	yellow	2½
Iceland poppy	*Papaver nudicaule*	various	½
Olympian evening primrose	*Verbascum olympicum*	yellow	6
Pansy	*Viola tricolor* vars.	various	¼

(D) A Select List of Hardy and Half-Hardy Annuals

h = Hardy Annual; **hh** = Half-hardy Annual.

Common Name.	Botanical Name.	Colour.	Height in Feet.	Degree of Hardiness.
Everlasting-flower	*Acroclinium roseum* (Fig. 58)	pink	1½	**hh**
Mask-flower	*Alonsoa Warscewiczii*	scarlet	1	**hh**
Sweet alyssum	*Alyssum maritimum*	white	½	**h**
Love-lies-bleeding	*Amaranthus caudatus*	purple	1½	**hh**
Prickly poppy	*Argemone grandiflora*	white	1½	**h**
Blue woodruff	*Asperula azurea setosa*	blue	1	**h**
Golden bartonia	*Bartonia aurea*	yellow	1	**hh**

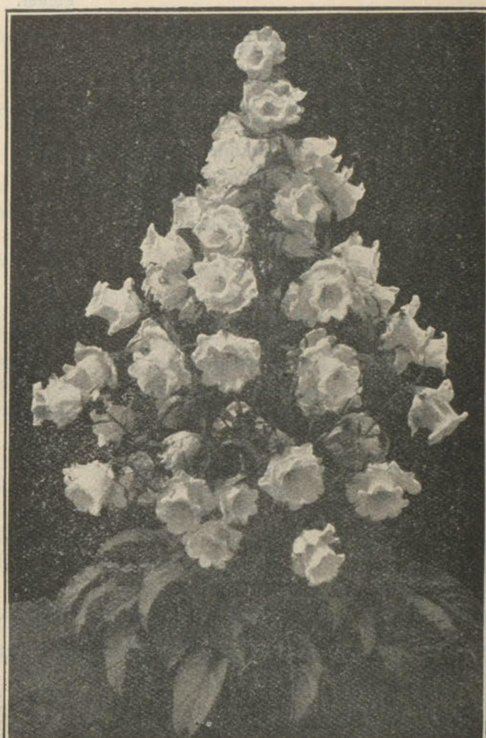


Fig. 57.—Cup and Saucer Canterbury Bell (*Campanula Medium* var. *calycanthema*).

Fig. 58.—Everlasting Flower (*Acroclinium roseum*).

Fig. 59.—Sutton's Hybrid Nemesia (*Nemesia strumosa*).

Common Name.	Botanical Name.	Colour.	Height in feet.	Degree of Hardiness.
Swan river daisy	*Brachycome iberidifolia*	blue	1	hh
Pot marigold	*Calendula officinalis*	orange-yellow	1½	h
China aster	*Callistephus hortensis*	various	1½	hh
Cornflower	*Centaurea Cyanus*	,,	1½	h
Keeled daisy	*Chrysanthemum carinatum*	,,	1½	h
Crown daisy	,, *coronarium*	yellow	2	h
Summer marguerite	,, *tricolor*	various	1½	h
Elegant clarkia	*Clarkia elegans*	red or white	1½	h
Two-coloured collinsia	*Collinsia bicolor*	various	1½	h
Large-flowered ,,	,, *grandiflora*	purple	1½	h
Morning glory	*Convolvulus tricolor*	various	½	hh
Coreopsis	*Coreopsis atkinsoniana*	,,	1½	h
,,	,, *bicolor*	,,	1½	h
Annual larkspur	*Delphinium Ajacis*	blue	2	h
Indian pink	*Dianthus chinensis Heddewigii*	various	½	hh
Californian poppy	*Eschscholzia californica* (Fig. 61)	,,	1	h
Blanket-flower	*Gaillardia grandiflora*	orange & yellow	2	h
Leptosiphon	*Gilia androsacea*	various	½	h
Three-coloured gilia	,, *tricolor*	,,	1	h
Godetia	*Godetia amoena*	,,	1½	h
Chalk-plant	*Gypsophila elegans*	white	1½	h
Sunflower	*Helianthus annuus*	yellow	7	h
Everlasting-flower	*Helichrysum bracteatum*	various	2	hh
,, ,,	*Helipterum* (*Rhodanthe*) *Manglesii*	pink	1	hh
Candytuft	*Iberis umbellata*	various	1	h
Common balsam	*Impatiens Balsamina*	,,	1	hh
Indian balsam or Touch-me-not	,, *Roylei*	,,	4	hh
Sweet pea	*Lathyrus odoratus*	,,	cl'm'r	h
Mallow	*Lavatera trimestris*	white or pink	2	h
Douglas's beeflower	*Limnanthes Douglasii*	yellow	½	h
Annual toadflax	*Linaria reticulata*	various	1	h

Common Name.	Botanical Name.	Colour.	Height in feet.	Degree of Hardiness.
Red flax	*Linum grandiflorum*	red	1	h
Various-leaved lobelia	*Lobelia heterophylla*	blue	1	hh
Blue lobelia	,, *speciosa*	blue	½	hh
Annual lupin	*Lupinus bicolor*	various	2	h
,, ,,	,, *mutabilis*	,,	2	h
Rose of heaven	*Lychnis Coeli-rosa*	pink	1	h
Virginian stock	*Malcolmia maritima*	various	½	h
Mallowwort	*Malope grandiflora*	,,	2	h
Ten-week stock	*Matthiola incana* var.	,,	1	hh
Evening ,,	,, *bicornis*	,,	1	h
Ice-plant	*Mesembryanthemum crystallinum*	pink	½	hh
Cape nemesia	*Nemesia strumosa* (Fig. 59)	various	¾	hh
Blue nemophila	*Nemophila insignis*	blue	½	h
Spotted nemophila	,, *maculata*	spotted	½	h
Sweet-scented tobacco	*Nicotiana affinis*	white	2	hh
Sander's hybrid ,,	,, *Sanderae*	various	2	hh
Love-in-a-mist	*Nigella sativa* (Fig. 60)	blue	1	h
Venus's navelwort	*Omphalodes linifolia*	white	½	h
Shirley poppy	*Papaver Rhoeas* var.	various	1½	h
Carnation poppy	,, *somniferum* var.	,,	2½	h
Petunia	*Petunia hybrida* (Fig. 67)	,,	1	hh
Phacelia	*Phacelia campanularia*	blue	¾	h
,,	,, *grandiflora*	,,	½	h
Drummond's phlox	*Phlox Drummondii*	various	1	hh
Sun-plant	*Portulaca grandiflora*	,,	½	h
Mignonette	*Reseda odorata*	yellow	1	h
Scalloped tube-tongue	*Salpiglossis variabilis*	various	1½	hh
Calabrian soapwort	*Saponaria calabrica*	red	½	h
German scabious or pincushion-flower	*Scabiosa atropurpurea*	various	1½	h
Butterfly-flower	*Schizanthus pinnatus*	,,	2	hh
,, ,,	,, *retusus*	red	1½	hh
Elegant groundsel	*Senecio (Jacobaea) elegans*	various	1	hh
Drooping catchfly	*Silene pendula*	pink	½	h
Yellow statice or sea lavender	*Statice Bonduelli*	yellow	1	hh

Fig. 60.—Love-in-a-mist (*Nigella sativa* var. Miss Jekyll).

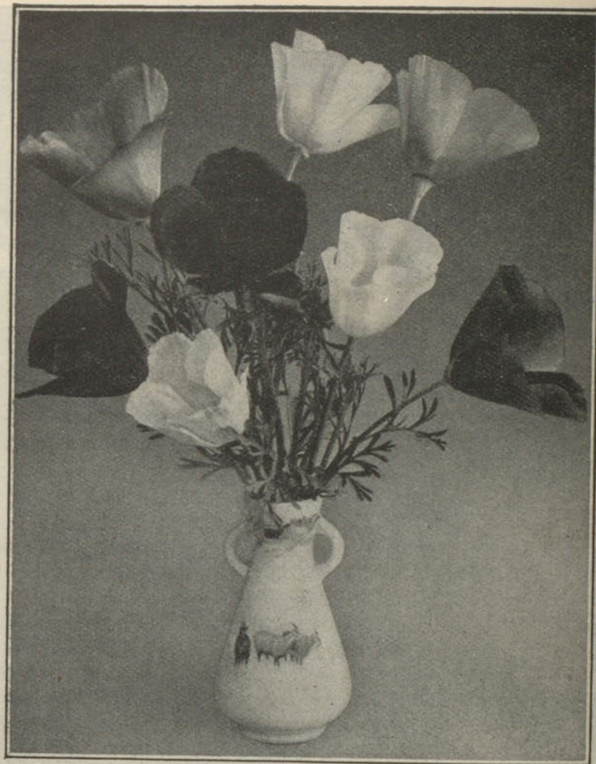


Fig. 61.—Californian Poppy (*Eschscholzia californica*).

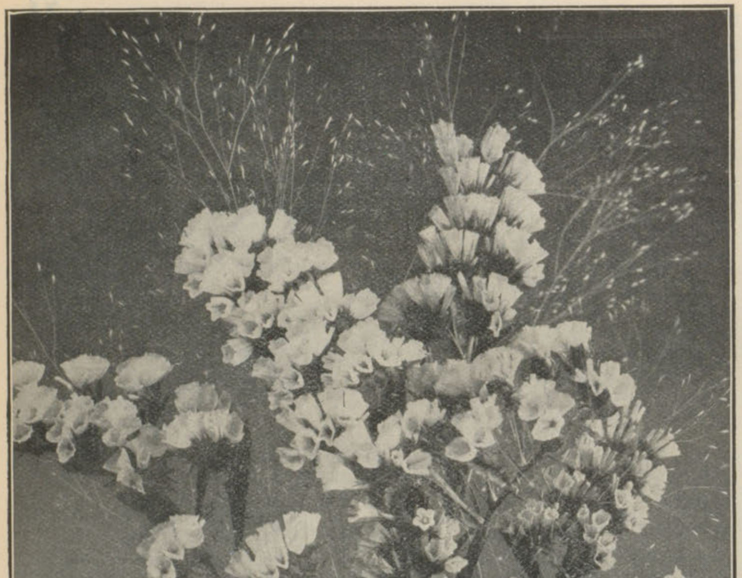


Fig. 62.—Wavy-leaved Sea Lavender (*Statice sinuata hybrida*).

Common Name.	Botanical Name.	Colour.	Height in feet.	Degree of Hardiness.
Wavy-leaved sea lavender	*Statice sinuata* (Fig. 62)	purple	1	hh
African marigold	*Tagetes erecta*	orange	1½	hh
French ,,	,, *patula*	various	1½	hh
Indian cress or nasturtium	*Tropaeolum majus*	yellow,&c.	cl'm'r	hh
Canary creeper	,, *canariense*	,,	,,	hh
Verbena	*Verbena tenera* (*pulchella*)	various	½	hh
Zinnia	*Zinnia elegans*	,,	1	hh

(E) Hardy Ornamental Grasses.

Common Name.	Botanical Name.	Height in Feet.	Annual or Perennial.
Cloud-grass	*Agrostis nebulosa*	½	a
Beautiful cloud-grass	,, *pulchella*	½	a
Great showy reed-grass	*Arundo conspicua*	2	p
,, ,, ,, ,,	,, *Donax*	4	p
Animated oat or barren oat-grass	*Avena sterilis*	2	a
Large quaking-grass	*Briza maxima*	¾	a
Heath ,, ,,	,, *media*	½	a
Quaking brome ,,	*Bromus brizaeformis*	1½	a
Large-stemmed brome	,, *macrostachys*	1½	a
Rye brome	,, *secalinus*	1½	a
Elegant chloris	*Chloris elegans*	½	a
Elegant cocksfoot-grass	*Dactylis glomerata elegantissima*	1	p
Variegated ,, ,,	*D. g. variegata*	1	p
Love-grass	*Eragrostis elegans*	1	a
Zebra ,,	*Eulalia zebrina*	3	p
Sea-green fescue	*Festuca glauca*	½	p
Rigid fescue	,, *rigida*	½	p
Pampas-grass	*Gynerium* (*Cortaderia*) *argenteum*	4	p

Fig. 63.—Ornamental Grasses.

Common Name.	Botanical Name.	Height in Feet.	Annual or Perennial.
Bearded barley or squirrel's-tail-grass	*Hordeum jubatum*	1½	a
Hare's-tail ,,	*Lagurus ovatus*	1	a
Lamark's golden-grass	*Lamarkia aurea*	½	a
Variegated lavender-grass	*Molinia caerulea variegata*	1	p
Tall panick-grass	*Panicum altissimum*	1½	p
Hair-grass	,, *capillare*	½	a
Variegated reed-grass	*Phalaris arundinacea variegata*	2	p
Variegated cat's-tail-grass	*Phleum pratense variegatum*	1	p
Feather-grass	*Stipa pinnata*	1½	p

(F) Select List of Hardy Shrubs.

Common Name.	Botanical Name.
Japanese laurel	*Aucuba japonica*
Barberry, Holly-leaved	*Berberis Aquifolium*
,, Darwin's	,, *Darwinii*
,, Japanese	,, *japonica*
,, Narrow-leaved	,, *stenophylla*
,, Thunberg's	,, *Thunbergii*
Orange-ball tree	*Buddleia globosa*
Showy Buddleia	,, *spectabilis*
Mexican orange-flower	*Choisya ternata*
Cotoneaster, Horizontal	*Cotoneaster horizontalis*
,, Small-leaved	,, *microphylla*
,, Round-leaved	,, *rotundifolia*
Lawson's cypress, many varieties	*Cupressus lawsoniana*
Andrea's broom	*Cytisus Andreanus*
Early-flowering broom	,, *praecox*
Spurge laurel	*Daphne Laureola*
Mezereon	,, *Mezereum*

Common Name.	Botanical Name.
Deutzia	*Deutzia crenata*
Japanese spindle-tree	*Euonymus japonicus*
Golden bell	*Forsythia suspensa*
Tree ivy	*Hedera Helix arborescens*
Hedysarum	*Hedysarum multijugum*
Hydrangea	*Hydrangea paniculata*
Holly in variety	*Ilex Aquifolium*
Dwarf jessamine	*Jasminum humile*
Juniper	*Juniperus virginiana, etc.*
Jew's mallow	*Kerria japonica*
Daisy-bush	*Olearia Haastii*
Mock-orange	*Philadelphus coronarius*
Purple-leaved plum	*Prunus Pissardi*
Three-lobed plum	,, *triloba*
Free-flowering pyrus	*Pyrus floribunda*
Japanese quince	,, *japonica*
Tree rose	*Rhododendron*, many kinds
Yellow-flowering currant	*Ribes flavum*
Red-flowering currant	,, *sanguineum* vars.
Smoke-tree, wig-tree, or Venetian sumach	*Rhus cotinus*
Roses	*Rosa*, several species and many varieties
Kilmarnock weeping willow	*Salix Caprea pendula*
Skimmia	*Skimmia japonica*
Spiraea	*Spiraea Aitchisoni*
,,	,, *lindleyana*
,,	,, *prunifolia*
,,	,, *Thunbergi*
Lilac	*Syringa vulgaris*
Tamarisk	*Tamarix gallica*
Golden-leaved yew	*Taxus baccata aurea*
Irish yew	,, ,, *fastigiata*
New Zealand speedwell	*Veronica speciosa*
,, ,, ,,	,, *Traversii*, etc.
Snowball-tree	*Viburnum Opulus flore pleno*
Laurustinus	,, *Tinus*
Bush honeysuckle	*Weigela (Diervilla) amabilis*
,, ,,	,, ,, *rosea*
Adam's needle	*Yucca gloriosa*

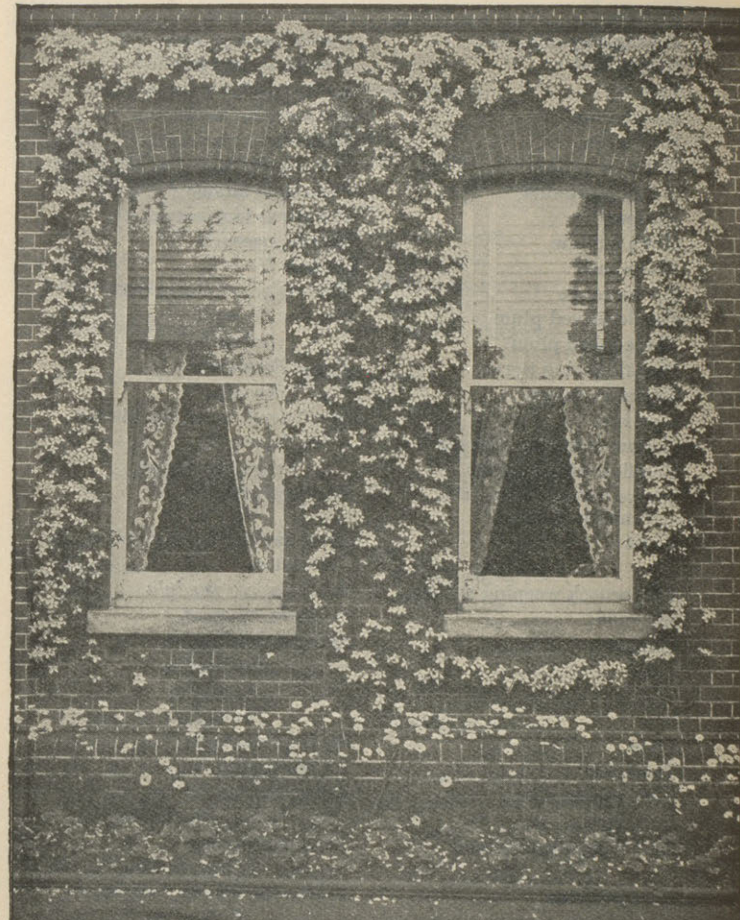


Fig. 64.—Mountain Clematis or Virgin's Bower (*Clematis montana*).

(G) Climbing and Other Plants (for Walls, Porches, or Trellis Work).

1. *Woody Climbers*:—

Common Name.	Botanical Name.
Self-clinging Virginian creeper	*Ampelopsis Veitchii*
Dutchman's pipe	*Aristolochia Sipho*
Virgin's bower	*Clematis Flammula*
Jackman's clematis	,, *Jackmani*
Mountain ,,	,, *montana* (Fig. 64)
Small-leaved cotoneaster	*Cotoneaster microphylla*
Firethorn	*Crataegus Pyracantha* var. *Laelandi*
Tassel-bush	*Garrya elliptica*
Ivy	*Hedera Helix* in variety
Yellow jessamine	*Jasminum nudiflorum*
Sweet jessamine	,, *officinale*
Woodbine Honeysuckle	*Lonicera Periclymenum*
Perfoliate honeysuckle	,, *Caprifolium*
Passion-flower	*Passiflora coerulea*
Climbing buckwheat	*Polygonum Baldschuanicum*
Japanese quince	*Pyrus japonica* (*syn. Cydonia japonica*)
Ayrshire rose Crimson Rambler Dorothy Perkins Carmine Pillar Gloire de Dijon Polyantha rose, etc. Aglaia rose Waltham Rambler rose	*Rosa*, several species and varieties
Climbing solanum	*Solanum jasminoides* (in the south of England)
Trumpet-flower	*Tecoma radicans* (in the south of England)
Purple-leaved vine	*Vitis vinifera purpurea*
Coignet vine	*Vitis Coignetiae*
Grape-flower vine or Chinese kidney bean tree	*Wistaria chinensis*

2. *Herbaceous climbers* :—

Common Name.	Botanical Name.
Ornamental gourds	*Cucurbita sp.*
Chilian glory-flower	*Eccremocarpus scaber*
Japanese hop	*Humulus japonicus*
Common hop	,, *Lupulus*
Everlasting pea	*Lathyrus grandiflorus*
Broad-leaved pea	,, *latifolius*
Sweet pea	,, *odoratus*
Canary creeper	*Tropaeolum canariense* (*T. aduncum*)
Nasturtium or Indian cress	*Tropaeolum majus*
Flame-flower	,, *speciosum*
Tuberous-rooted nasturtium	,, *tuberosum*

(H) Plants Suitable for Providing Cut Flowers or Foliage for Home Decoration, or for Market Purposes.

1. *Annuals and Biennials* :—

China aster
Coreopsis
Cornflower
Gaillardia
Gypsophila elegans
Iceland poppy
Mignonette
Scabious
Statice
Stocks
Sweet pea
Wallflower

2. *Herbaceous Perennials* (*including bulbous plants, etc.*) :—

Arum lily
Carnation
Chrysanthemum
Dahlia

Fig. 65.—Coreopsis grandiflora.

Gladiolus
Gypsophila paniculata
Hyacinth
Iris (Spanish and English)
Lily-of-the-valley
Large ox-eye daisy (*Chrysanthemum maximum*)
Marguerite (,, *Broussonetti*)
Paris daisy (,, *frutescens*)
Pyrethrum (,, *roseum*)
Pink
Narcissus
Tulip
Tuberose

3. *Foliage Plants*:—

(*a*) Leaves of Berberis, Epimedium, Galax, ivy, myrtle, striped grass, beech, scarlet oak, etc.

(*b*) Fronds of maidenhair fern.

(*c*) Trailing shoots of *Asparagus medeoloides* (*Myrsiphyllum asparagoides*), so-called "smilax."

(I) Plants Suitable for Shady Places.

Shrubs:—

Common Name.	Botanical Name.
Japanese laurel	*Aucuba japonica*
Holly-leaved barberry	*Berberis Aquifolium*
Spurge laurel	*Daphne Laureola*
Shallon or salal	*Gaultheria Shallon*
Tutsan	*Hypericum Androsaemum*
St. John's-wort or Rose of Sharon	,, *calycinum*
St. John's-wort	,, *hircinum*
Butchers' broom	*Ruscus aculeatus*

Herbaceous and Bulbous Plants:—

Monkshood	*Aconitum Napellus*
Baneberry	*Actaea spicata*
Bugle	*Ajuga reptans*

Common Name.	Botanical Name.
Apennine anemone	*Anemone apennina*
Wood ,,	,, *nemorosa*
Lords-and-ladies	*Arum maculatum*
Asarabacca	*Asarum europaeum*
Woodruff	*Asperula odorata*
Masterwort	*Astrantia major*
Deadly nightshade, or Belladonna	*Atropa Belladonna*
Broad-leaved bellflower	*Campanula latifolia*
Coral-wort or tooth-cress	*Cardamine bulbifera*
Lily-of-the-valley	*Convallaria majalis*
Yellow corydalis	*Corydalis lutea*
Crocus	*Crocus aureus*, *C. vernus*, etc.
Ivy-leaved cyclamen	*Cyclamen hederaefolium*
Foxglove	*Digitalis purpurea*
Leopard's-bane	*Doronicum plantagineum*, etc.
Rose-bay willow-herb	*Epilobium angustifolium*
Barrenwort	*Epimedium pinnatum*
Winter aconite	*Eranthis hyemalis*
Dusky cranesbill	*Geranium phaeum*
Meadow ,,	,, *pratense*
Wood ,,	,, *sylvaticum*
Lent rose	*Helleborus orientalis*
Gladwyn iris	*Iris foetidissima*
Yellow archangel	*Lamium Galeobdolon*
Spotted dead-nettle	,, *maculatum*
Turk's-cap lily	*Lilium Martagon*
Creeping Jenny	*Lysimachia Nummularia*
May lily	*Maianthemum Convallaria*
Welsh poppy	*Meconopsis cambrica*
Forget-me-not	*Myosotis sylvatica*
Sweet Cicely	*Myrrhis odorata*
Jonquil	*Narcissus Jonquilla*
Pheasant's-eye narcissus	,, *Poeticus*
Daffodil	,, *Pseudo-narcissus*
Wood sorrel	*Oxalis Acetosella*
Solomon's seal	*Polygonatum multiflorum*
Primrose	*Primula vulgaris*
Lungwort	*Pulmonaria officinalis*
Fair-maids-of-France	*Ranunculus aconitifolius*

Common Name.	Botanical Name.
Mossy saxifrage	*Saxifraga hypnoides*
Umbrella-plant	,, *peltata*
Round-leaved saxifrage	,, *rotundifolia*
London pride	,, *umbrosa*
Bluebell or wood hyacinth	*Scilla nutans* (*festalis*)
Meadow-sweet goat's-beard	*Spiraea Aruncus*
Bohemian comfrey	*Symphytum bohemicum*
Foam-flower	*Tiarella cordifolia*
Globe-flower	*Trollius europaeus*
Larger periwinkle	*Vinca major*
Lesser ,,	,, *minor*
Violet	*Viola odorata*

(J) Plants Suitable for Edgings of Flower Borders, etc.

Common Name.	Botanical Name.
Red-leaved bugle	*Ajuga reptans rubra*
Double-flowered Alpine rock-cress	*Arabis alpina flore plena*
Sea pink or thrift	*Armeria maritima*
Dwarf box	*Buxus sempervirens nana*
Dwarf bellflower	*Campanula pumila*
Bieberstein's snow-in-summer	*Cerastium Biebersteinii* (Fig. 66)
Snow-in-summer	,, *tomentosum*
Variegated cocksfoot-grass	*Dactylis glomerata variegata*
Garden pink	*Dianthus plumarius*
Maiden pink	,, *deltoides*
Winter heath	*Erica carnea*
Dwarf or creeping spindle-tree	*Euonymus radicans variegata*
Sea-green fescue	*Festuca glauca*
Evergreen candytuft	*Iberis sempervirens*
Poor-man's orchid	*Iris pumila*, etc.
Golden-leaved dead-nettle	*Lamium maculatum aureum*
Rockfoil	*Saxifraga hirta*
Mossy saxifrage	,, *hypnoides*
London pride	,, *umbrosa*

Common Name.	Botanical Name.
White stonecrop	*Sedum album*
Grey ,,	,, *glaucum*
Rock ,,	,, *rupestre*
Lamb's-ears	*Stachys lanata*
Crimson thyme	*Thymus Serpyllum coccineum*
Golden-leaved valerian	*Valeriana Phu aurea*
Rock speedwell	*Veronica rupestris*
Viola or tufted pansy	*Viola*

Fig. 66.—Snow-in-summer (*Cerastium Biebersteinii*).

(K) Plants for Honey Bees.

In districts where bee-keeping is carried on, the following list of plants will be found useful :—

Asparagus	Broom
Borage	Candytuft
Broad bean	Cerinthe

Clarkia
Clover
Collinsia
Common ivy
Cornflower
Douglas's beeflower
Gilia
Godetia
Ground ivy
Heather
Hyssop
Italian alkanet
Lime-tree
Lupin
Magnolia
Malope
Marjoram
Mignonette
Nasturtium
Rock-cress
Sage
Salvia
Scabious
Snowdrop
Sunflower
Sweet alyssum
Thyme
Vetch
Violet
Wallflower
Winter aconite
Wistaria
Fruit trees and bushes of all kinds

CHAPTER XVI.

BEDDING OUT.

Summer Bedding.—Certain beds and borders in our flower gardens and public parks are planted each year with plants which are capable of keeping up a display of flowers or foliage during the summer and early autumn, until frost comes and destroys them.

Grouping in bold masses of one colour or kind of plant is more effective than dotting single plants here and there or planting a very large number of kinds in a single bed.

It is important that the beds be deeply dug and liberally manured. The plants should be grown on strongly and gradually hardened off before planting out. This latter operation must be carefully performed and a good watering given if the weather is dry. A top-dressing of well-rotted manure, leaf-mould, or spent hops will help the plants to become established and the ground will be kept cool and moist during the summer. All weeds, dead leaves, and flowers must be removed and the plants neatly tied to sticks where necessary.

Spring and Winter Bedding.—It is the practice in many gardens to fill the flower beds with suitable plants for the winter and spring months. The success of this system, however, depends on locality, the kind of soil, and the amount of shelter provided for the garden.

After the summer flowers are over or have been spoiled by frost they may be removed and the beds manured, dug, and levelled for planting.

The following are some of the plants used for spring bedding:—

Bulbous plants, corms, etc.:—

Winter aconite (*Eranthis hyemalis*).
Crocus, snowdrops, Siberian squills (*Scilla*).
Glory-of-the-snow (*Chionodoxa*), tulips, hyacinths.
Daffodils, Spanish Iris.

Biennial flowering plants:—

Wallflowers, snapdragons (*Antirrhinum*), not hardy in all districts.
Drooping catchfly (*Silene pendula*).
Forget-me-not (*Myosotis alpestris, M. dissitiflora*, etc.).
Double daisies (*Bellis*).
Violas and pansies.

Early-flowering perennial plants:—

White rock-cress (*Arabis*), single, double, and variegated kinds.
Aubrietia.
Madwort or gold dust (*Alyssum saxatile*).
Rockfoil (*Saxifraga hirta, S. hypnoides, S. Rhei*, etc.).
Phlox amoena.
Candytuft (*Iberis sempervirens*).
Primroses, polyanthuses.
Snow-in-summer (*Cerastium tomentosum*, and *C. Biebersteinii*, Fig. 66).
Lamb's-ears (*Stachys lanata*).
Golden-leaved valerian (*Valeriana Phu aurea*).
Stone-crop (*Sedum*, several kinds).

Dwarf evergreen shrubs, too, are sometimes used for furnishing the beds during winter, then lifted and replanted in the reserve garden during summer. Certain kinds are kept in large pots, as they resent being lifted twice in a year.

The following are examples of shrubs employed for the above purpose:—

Aucuba, box, cypress, heather (Erica herbacea), junipers, Mahonia, Skimmia, Veronica, golden privet, Cotoneaster, Retinospora, dwarf tree ivies.

LISTS OF BEDDING PLANTS.

(1) *Flowering plants* :—

Ageratum.
Amaranthus caudatus (Love-lies-bleeding).
Begonia semperflorens.
,, *tuberosa.*
China aster (*Callistephus*).
Calceolaria amplexicaulis.
,, Golden Gem.
,, Prince of Orange.

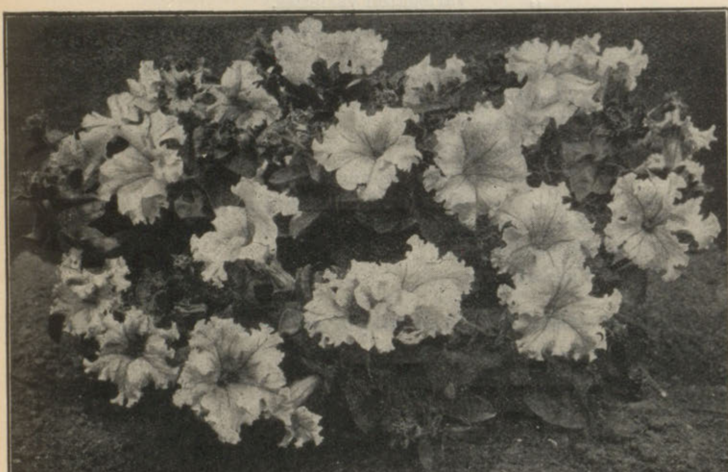


Fig. 67.—Petunia (Sutton's Single Fringed).

Canna indica (Indian shot).
Chrysanthemum Broussonetti (marguerite).
,, *frutescens* (Paris daisy).
Dahlia in variety.
Dianthus chinensis (Indian pink).
Fuchsia in variety.
Heliotrope.
Lobelia cardinalis (scarlet lobelia).
,, *speciosa* (blue lobelia).

African marigold (*Tagetes erecta*).
French marigold (*Tagetes patula*).
Mimulus Harrisonii.
,, *luteus* (musk).
Nemesia strumosa.
Nicotiana affinis (sweet-scented tobacco).
,, *Sanderae* (Sander's hybrid tobacco).
Pansy.
Papaver nudicaule (Iceland poppy).
Pelargonium (geranium) *zonale* of sorts.
,, tricolor varieties.
,, variegated varieties.
,, ivy-leaved varieties.
Pentstemon.
Petunia (Fig. 67).
Phlox Drummondii.
Salvia patens.
,, *splendens.*
Tropaeolum majus (nasturtium).
,, *minus* (dwarf nasturtium).
Stocks (*Matthiola*)
Verbena of sorts.
Viola of sorts.

(2) *Ornamental foliage plants for sub-tropical bedding:—*

Canna indica (Indian shot).
Cannabis sativa (hemp).
Eucalyptus Globulus.
Maize (Indian corn).
Melianthus major.
Musa Ensete.
Palms of sorts.
Solanum atropurpureum.
,, *citrullifolium.*
,, *Dammanianum.*
,, *giganteum.*
,, *laciniatum.*
,, *marginatum.*
,, *pyracanthum.*
,, *robustum.*
Wigandia caracasana.

(3) *Dwarf foliage plants used for bedding* :—

Alternanthera of sorts.
Beet (ornamental-leaved).
Centaurea ragusina.
Cerastium Biebersteinii (Fig. 66).
,, *tomentosum.*
Cineraria maritima.
Dactylis glomerata elegantissima.
Echeveria secunda glauca.
Gazania splendens.
Herniaria glabra.
Iresine Herbstii.
,, *Lindenii.*
Mesembryanthemum cordifolium variegatum.
,, *crystallinum* (ice-plant).
Spergula pilifera aurea.

CHAPTER XVII.

WINDOW GARDENING.

Window Gardens.—Many tender or greenhouse plants may be successfully cultivated in windows. Magnificent specimens are sometimes seen, and a window well filled with healthy plants reflects to a certain extent the character of the inmates.

Window plants for their successful culture require fresh air, light, moisture, suitable soil, clean pots, and some attention to keep the leaves free from dust, etc.

Soil for pot plants.—Different kinds of plants will require different mixtures of soil, and the would-be cultivator will require to have on hand some fibrous, turfy loam, leaf-mould, peat, sand, cocoa-nut fibre, and perhaps a little well-decayed manure or artificial fertiliser. The latter may with advantage be used for pot plants.

Mixture of soil suitable for flowering plants, foliage plants, and palms :—

Turfy loam...	3 parts
Leaf-mould	1 part
Sand	1 part

Mixture for heaths and ferns :—

Turfy loam, free from lime ...	2 parts
Leaf-mould	1 part
Peat	1 part
Sand	1 part

Mixture for cacti and other succulent plants :—

Turfy loam...	2 parts
Old plaster or mortar rubble ...	1 part
Sand	1 part
Dried cow manure...	1 part

NOTE.—The exact proportions of these will depend on the loam, which is the principal ingredient in potting mixtures; the heavier the loam the more sand and leaf mould will it require to lighten it.

Manures for window plants.—Any of the well-known patent or proprietary manures may be used for pot plants, a teaspoonful to each plant or the same quantity dissolved in a gallon of water, or a liquid manure may be made by dissolving 1 lb. guano in 16 gallons of water; or one peck of sheep or horse manure and 1 peck of soot to 30 gallons of water. Manure for pot plants in whatever form used should be given with judgment and care, and only when really required, *e.g.* plants when pot bound, coming into flower, or when in active growth.

Pots and potting.—The pots should be clean, but when new and very dry they should be soaked in a pail of water and allowed to drain again before using. Never use damp or dirty pots, or re-pot a plant that is very wet or very dry. Good drainage may be provided by placing pieces of broken pots (crocks) at the bottom and covering them with moss, half decayed leaves, or rough portions of the potting compost. The soil should be thoroughly mixed and the plants potted firmly. In potting bulbs the pots should be half filled with the compost, the bulbs placed in position and then covered with more soil. The pots may then be covered with ashes or cocoanut fibre for a few weeks. This encourages root action, and then the bulbs, when brought into the house, greenhouse, or frame, will flower more satisfactorily.

Bulbs in cocoanut fibre.—Various kinds of bulbs and corms, *e.g.* hyacinths, daffodils, tulips, crocus, etc., may be grown in ornamental bowls without soil or drainage (Fig. 68). A suitable mixture consists of cocoanut fibre 8 parts, charcoal 1 part, and crushed oyster shells or old mortar rubble 1 part. These should be well mixed and made quite damp, but the fibre must not be at all sticky, nor indeed allow of any water being squeezed out. Fill the bowls with the prepared fibre, placing the bulbs so that their tops show, afterwards pressing the fibre firmly round them. The bowls may then be placed out of doors and

Fig. 68.—Snowdrops grown in Fibre.

covered with cocoa-nut fibre or ashes, or they may be placed in a dark room or cupboard for several weeks to encourage root action, after which they may be assigned to their flowering position. The fibre should be kept uniformly moist, but on no account over water or the roots will rot. Good results may also be obtained by using shingle or sand instead of fibre. Fibre mixed ready for planting may now be obtained from nearly all seedsmen.

Hyacinths in glasses of various designs.—The glasses should be filled with water until it barely touches the base of the bulb. Place them in a dark cupboard or cellar of moderate temperature and add water as it evaporates. In three or four weeks' time, when the roots have grown some inches in length, the glasses may be brought into a subdued light and kept there until the leaves assume a greenish colour. Change the water every fortnight, adding at the same time a little salt and a piece of charcoal to each glass.

Watering.—Rain (soft) water slightly warm is best for indoor plants. Water should only be given when necessary; this may be ascertained by the appearance and touch of the soil, or by giving the pot a tap with the knuckles or a piece of stick. If the pot gives a clear or hollow sound then water is required. In applying water to pot plants it is advisable to give a good soaking, and the pots may, if necessary, be immersed in a pail of tepid water.

Fresh air is beneficial to plants, but cold draughts should be guarded against, as chills are harmful. The plants may be placed out of doors occasionally, especially during a gentle rain, which will refresh and cleanse the leaves.

Light is essential to a sturdy growth and proper development of flower. They should be given as much light as they can bear without injuring the foliage.

Cleanliness is also very important; the plants should be kept as free from dust as possible. The leaves may be lightly sponged with soapy water when dust or insects are in evidence or the plants may be syringed when not in full flower. Greenfly, red spider, and thrips may be got rid of by dipping the plant in, or syringing with, a mixture of 2 oz. soft soap or 2 oz. washing soda to a gallon of water. Scale insects and dust on the leaves may be removed by sponging with soapy water. All dead and decaying leaves and flowers should be removed as they appear.

(A) Suitable Flowering Plants for Windows (Inside).

Common Name.	Botanical Name.
African lily	*Agapanthus umbellatus*
Belladonna lily	*Amaryllis Belladonna*
Jacobaean lily	,, *formosissima*
Spotted-leaved begonia	*Begonia maculata*
Royal begonia	,, *Rex*
Ever-flowering begonia	,, *semperflorens*
Tuberous begonia	,, *tuberosa*
Ligurian harebell or bellflower	*Campanula isophylla*
Sowbread	*Cyclamen persicum*
Bridal wreath	*Francoa ramosa*
Fuchsia	*Fuchsia sp.*
Hyacinth	*Hyacinthus orientalis*
Creeping Jenny or moneywort	*Lysimachia Nummularia*
Musk	*Mimulus moschatus*
Jonquil	*Narcissus Jonquilla*
Lent lily or daffodil	,, *Pseudo-narcissus*
Sacred lily	,, *Tazetta*
Bermuda buttercup	*Oxalis carnosa*
Show or fancy pelargonium	*Pelargonium grandiflorum*
Ivy-leaved pelargonium	,, *peltatum*
Zonal pelargonium (geranium)	,, *zonale*
Arum lily or lily-of-the-Nile	*Richardia africana*
Japanese meadow-sweet	*Spiraea japonica*
Scarborough lily	*Vallota purpurea*

(B) Foliage Plants for Windows (Inside).

Common Name.	Botanical Name.
Acacia	*Acacia lophantha*
Chinese paper-plant	*Aralia Sieboldii*
Norfolk Island pine	*Araucaria excelsa*
Sprenger's asparagus	*Asparagus Sprengeri*
Parlour palm	*Aspidistra lurida*
Variegated parlour palm	,, ,, *variegata*
Variegated sedge	*Carex japonica variegata*

Palms (several kinds)	*Cocos*, *Kentia*, *Latania*, *Areca*, etc.
Dracaena	*Dracaena* (*Cordyline*) *australis*
,,	,, *indivisa*
Eucalyptus-plant	*Eucalyptus Globulus*
Indiarubber-plant	*Ficus elastica*
Club-grass	*Isolepis gracilis*
Variegated ground ivy	*Nepeta Glechoma variegata*
Snake's-beard	*Ophiopogon japonicus variegatus*
Purple wood-sorrel or shamrock	*Oxalis corniculata atropurpurea*
Oak-leaved or scented-leaved pelargoniums	*Pelargonium sp.*
Mother of thousands, wandering Jew, or Aaron's beard	*Saxifraga sarmentosa*
Siebold's stonecrop	*Sedum Sieboldii variegata*
Striped spiderwort	*Tradescantia zebrina*, etc.

(C) Cactaceous and other Succulent Plants for Windows (Inside).*

Agave, several kinds.
Aloe, ,, ,,
Cereus Englemanni.
,, *Fendleri.*
,, *flagelliformis* (rat's-tail cactus).
Cotyledon, several kinds.
Crassula coccinea.
Echinocactus glaucus.
,, *Pentlandi.*
Epiphyllum, several kinds.
Gasteria, ,, ,,
Haworthia, ,, ,,

* These, owing to their succulent nature and smooth leaves, are particularly suitable for schoolroom windows as they withstand dust and long periods of drought better than other groups of plants.

Kalanchoe, several kinds.
Kleinia, ,, ,,
Mamillaria, ,, ,,
Mesembryanthemum (fig marigold), several kinds.
Opuntia (prickly pear), several kinds.
Phyllocactus, several kinds.
Rochea, ,, ,,

(D) Ferns for Windows (Inside).

Common Name.	Botanical Name.
Maidenhair-fern	*Adiantum cuneatum*
Holly-fern	*Aspidium falcatum* (*Cyrtomium falcatum*)
Bulbiferous spleenwort	*Asplenium bulbiferum*
Sea spleenwort	,, *marinum*
Lady-fern	*Athyrium Filix-foemina*
Hare's-foot fern	*Davallia canariensis*
———	*Lomaria gibba*
Welsh polypody	*Polypodium vulgare cambricum*
Hard holly-fern	*Polystichum aculeatum*
———	*Pteris cretica*
———	,, ,, *variegata*
Ribbon-fern	,, *serrulata*
Crested ribbon-fern	,, ,, *cristata*
———	,, *tremula*

Window Boxes.

Window boxes for the cultivation of plants are easily made by a handy man, or a joiner would supply them at a cheap rate. They are made to fit the window-sill, and consist of deal or teak boards 9 inches wide, nailed together, and having holes at the bottom for providing drainage. The boxes may be painted to improve their appearance and to preserve the wood, or pieces of virgin cork, or strips of wood and bark of birch or other rough-barked trees as in Figs. 69 and 70, may be nailed on the front of the boxes to give them a rustic appearance.

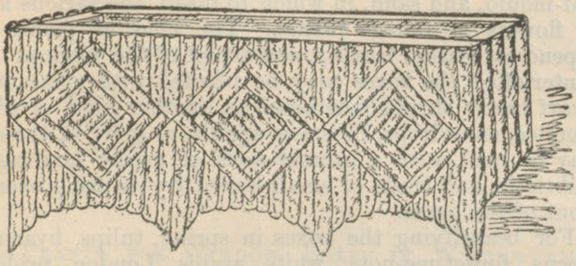


Fig. 69.—A Rustic Window Box ready for planting.

Fig. 70.—Window Box with Summer Flowers.

The boxes should be filled with a good mixture of loam, leaf-mould, and sand, in which to insert the various kinds of flowers or foliage plants. The kind of plants will depend on season, locality, and aspect of the window. For winter effect the boxes may be planted with some of the dwarf hardy shrubs mentioned on another page, or winter aconites, snowdrops, Siberian squills, or glory-of-the-snow may be used, with a ground-work of mossy saxifrage or Aubrietia, and trails of small-leaved ivy to hang over the front of the boxes.

For beautifying the boxes in spring, tulips, hyacinths, crocus, forget-me-nots, white arabis, London pride, or wallflowers may be planted.

The window box in summer should have a fresh supply of soil, and then be planted with some popular bedding plants such as geranium, Petunia, Verbena, marguerite, Begonia, Fuchsia, Lobelia, ground ivy, *Asparagus Sprengeri*, or creeping Jenny. The plants should be carefully hardened off before being placed in the boxes, or they may be planted and established in the boxes before the latter are placed in their permanent position.

It is a good plan to have duplicate window boxes which can be planted in readiness for replacing those that have become shabby.

(E) PLANTS FOR WINDOW BOXES IN SUMMER (OUTSIDE).

Asparagus Sprengeri.
China aster.
Tuberous begonia.
Calceolaria.
Canary creeper.
Creeping Jenny.
Fuchsia.
Variegated ground ivy.
Heliotrope or cherry pie.
Blue lobelia.
Marguerite or Paris daisy.

Mignonette.
Musk.
Nasturtium or Indian cress (*Tropaeolum*).
Pelargonium (geranium).
Petunia (Fig. 67).
Mossy saxifrage.
Stocks.
Verbena.

(F) Plants for Window Boxes in Winter and Spring (Outside).

Common Name.	Botanical Name.
Rock madwort or gold-dust	*Alyssum saxatile*
White rock-cress	*Arabis albida*
Double-flowered rock-cress	,, ,, *flore plena*
Purple rock-cress	*Aubrietia deltoidea*
Red daisies	*Bellis perennis*
Wallflower	*Cheiranthus Cheiri*
Glory-of-the-snow	*Chionodoxa Luciliae*
Crocus	*Crocus aureus*, *C. vernus*, etc.
Winter aconite	*Eranthis hyemalis*
Snowdrop	*Galanthus nivalis*, etc.
Ivy (small-leaved sorts)	*Hedera Helix* vars.
Hyacinth	*Hyacinthus orientalis*
Grape hyacinth	*Muscari racemosum*
Forget-me-not	*Myosotis sp.*
Pheasant's-eye or poet's narcissus	*Narcissus Poeticus*
Lent lily or daffodil	,, *Pseudo-narcissus*
Auricula	*Primula Auricula*
Polyanthus	,, *variabilis*
Primrose	,, *vulgaris*
Mossy saxifrage	*Saxifraga hypnoides*
London pride	,, *umbrosa*
Siberian squill	*Scilla sibirica*
Tulip	*Tulipa sp.*
Small-leaved periwinkle	*Vinca minor*

(G) Dwarf Shrubs for Window Boxes in Winter (Outside).

Common Name.	Botanical Name.
Japanese laurel	*Aucuba japonica*
Dwarf cypresses	*Cupressus* and *Retinospora sp*
Japanese spindle-tree	*Euonymus japonicus* var. *pulchellus*
Dwarf or creeping spindle-tree	*Euonymus radicans variegata*
Dwarf tree ivies of sorts	*Hedera Helix arborea*
Dwarf junipers	*Juniperus sp.*
Skimmia	*Skimmia japonica*
Arbor-vitae	*Thuja occidentalis* vars.
Shrubby speedwell	*Veronica Traversii*

CHAPTER XVIII.

THE PROPAGATION OR MULTIPLICATION OF PLANTS.

Plant propagation is one of the most important and interesting phases of gardening, but, to be successful, patience, skill, method in working, and a genuine love for the work are necessary. Everything required, such as pots, crocks, soil, glass, etc., must be sweet and clean. In large private gardens, public parks, botanic gardens, and nurseries, enormous quantities of plants are required to meet the demand for bedding out, and to supply the needs of the public. A great deal of skill and ingenuity has sometimes to be exercised to propagate novelties and rare plants, or such as are difficult to propagate by seeds or cuttings.

There are several methods by which plants may be propagated, and where, for some reason or other, one method fails another is tried until success is attained. The following are some of the methods practised: Seed sowing, cuttings of stem or root, leaves, buds (eyes), layering, inarching, budding, grafting, division of root stock, suckers, offsets, runners, tubers, bulbs, and corms.

We will now consider these methods separately.

Seeds.—Nearly all cultivated plants produce seed, which, when ripe, may be collected, dried, and sown at the proper season, or when likely to succeed according to the conveniences at our disposal for their successful germination. In a state of nature seeds, when ripe, fall to the ground or are carried to places more or less distant by various agents, such as wind, animals, and streams, or by various explosive arrangements of the fruits which throw the seeds in all directions.

Raising plants from seed is the easiest, most expeditious, and most natural method of plant propagation, and may be resorted to in the case of all seed-bearing plants found in a state of nature. All cereals and other common farm crops—grasses, clovers, turnips, mangels—kitchen garden vegetables of annual or biennial duration, and also many kinds of popular garden flowers—annuals and biennials, such as sweet peas, forget-me-nots, stocks, asters, wallflowers, etc.—may be raised from seed.

The reason why these cultivated and improved varieties come practically true to their respective sorts is that a very rigid process of selection and elimination of inferior individuals, or "rogues" as they are generally termed, has been practised until the variety has become fixed and breeds true.

There are many popular plants of garden origin with variegated leaves, double flowers, etc., which do not come true from seeds; therefore some other method—cuttings, budding, layering, etc.—has to be employed to obtain large supplies true to name. Examples: Apples, pears, strawberries, variegated plants generally, roses, carnations, violas, pansies, pelargoniums, etc. Some of these plants require years from seed before they reach the fruiting stage, consequently it would take many years to fix these varieties by the ordinary selective and re-selective process. The Mendelian system of plant breeding, when applied to fruit and other plants obtained by cross breeding, may result in varieties which will come true to name, so the time may not be far distant when by means of seeds we may be able to increase such plants as apples, pears, plums, etc., and also such florists' flowers as roses, chrysanthemums, etc., which at present do not come true from seeds.

Germination depends on the presence of moisture, air, and warmth. Some seeds, such as those of tropical and subtropical plants, *e.g.* Lobelia, Calceolaria, Begonia, Petunia, balsams, etc., require a great amount of heat. Seeds of plants of cold and temperate regions, however, easily germinate when sown in the open, *e.g.* farm crops, vegetable crops, hardy flowers, trees, and shrubs.

As a rule seeds to be raised under glass should be sown thinly, covered carefully according to the size of the seed, watered, and then kept slightly shaded and moist until germination has taken place. The seedlings may be pricked off in boxes, pans, or pots when large enough to handle, and as soon as established placed near the glass to induce firm, sturdy, short-jointed growth. A compost of light soil—loam, peat or leaf-mould, and sand—may be used for seed sowing. Directions for sowing seed out of doors are given under "soil operations," page 89.

The seeds of some plants will retain their vitality for a number of years, but vitality gradually decreases with age. Cereals, turnips, etc., keep good from 5 to 10 years; the seeds of charlock, runch or wild radish, and a few other plants retain their vitality in the soil for many years, and when old pastures are ploughed or dug over many weeds will appear owing to the seeds having been brought under the influence of the air, thus causing them to germinate. The seeds of bulbous plants, water plants, gentians, Primulas, etc., are best sown as soon as practicable after ripening. On the other hand, the seeds of cucumbers, melons, and vegetable marrows are said to produce better plants if kept two or three years. The seeds of some leguminous plants require to be soaked in hot water, and others slightly filed, before sowing. Some seeds require a period of one to two years to germinate, whilst two or three days will suffice for others.

The germination of seeds may be hastened by watering them with a $\frac{1}{5000}$ solution of formic acid at a temperature of 25° to 30° Centigrade. Moist earth from an anthill also hastens germination. A weak solution of ammonia, potash, or soda will quicken germination.

Cuttings.—In this case portions of the plant are removed and carefully prepared for insertion in sandy soil; this is another easy and common method of plant propagation whereby large quantities of plants may be prepared in a

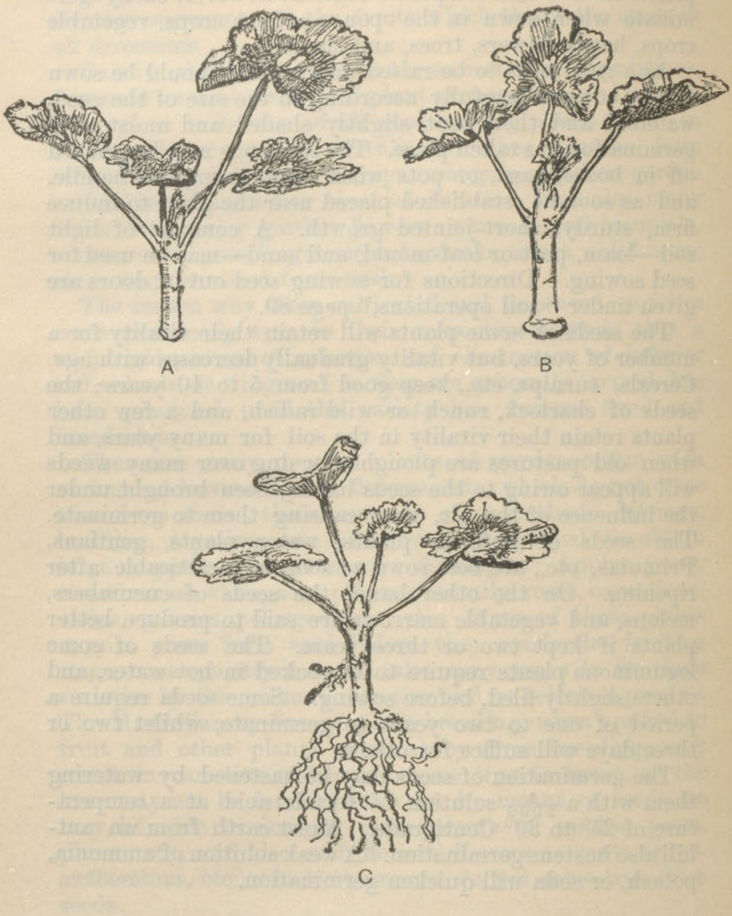


Fig. 71.—Propagation of Geraniums.

(A) A cutting properly prepared. (B) A cutting showing the callused base.
(C) The same well rooted.

short space of time. By this system varieties are kept true to the parent plant, and it is therefore largely used for the propagation of (1) plants that do not, as a rule, come true from seed, (2) plants which do not seed freely, or (3) plants which grow slowly from seed.

There are several methods of making cuttings. Soft wooded or leafy cuttings should be cut below a joint and the lower leaves and all flowers or flower buds removed. Bottom or side growths which have not flowered the first year are the most suitable for this purpose.

Examples of plants which may be treated in this way are Pentstemon, geranium (Pelargonium), Fuchsia, Calceolaria, Viola, etc. Cuttings are generally cut below or through a joint (node), inserted firmly in clean sandy soil, and kept moist and shaded for a time. Most cuttings form a corky layer of tissue at the base called a "callus," from which roots are emitted. Pinks are sometimes propagated by "pipings," *i.e.* the tops of the shoots are pulled away from the base of the stem by a slight jerk. These are inserted at once in pots or boxes, or on a sheltered border, and protected by means of handlights or bell glasses.

Some plants lose moisture from their leaves more rapidly than others. The chief point in striking cuttings is to prevent the leaves losing moisture until the roots are formed to obtain a supply for the leaves. For this purpose small frames are used or bellglasses with a hole through the knob in which cotton-wool can be placed.

Leafless or woody stemmed cuttings are usually taken after the leaves have fallen (October to November). Well ripened shoots of the current year's growth, with or without a "heel," should be selected, inserted deeply outdoors ($\frac{1}{2}$ to $\frac{3}{4}$ of their length) in soil that is well drained and gritty, and the soil firmly trodden to keep the cuttings in position. Gooseberries, currants, mock orange, flowering currant, roses, willows, Spiraeas, etc., may be propagated in this manner.

Buds, i.e. short cuttings of grape vines, Magnolias, hollyhocks, double-flowered Lychnis and double-flowered rocket, consisting of an eye (bud) with a piece of bark and stem attached, require more careful attention and some heat, and should consequently be placed in a warm propagating house.

Root Cuttings.—Many plants are easily propagated by taking a root, cutting it into lengths of 2 to 3 inches, and inserting the pieces in sandy soil in a hothouse or frame during the autumn or spring. In a short time, according to the season, locality, and the kind of plant, young outgrowths (buds) will be formed which will grow into shoots with new roots at the base. Some plants difficult to strike in the usual way are freely propagated in this manner, *e.g.* Japanese Anemone, Acanthus, plume poppy, Oriental poppy, Californian poppy, burning bush (*Dictamnus*), sea lavender, sea holly, globe thistle, Clerodendron, brambles, paeony, Gypsophila, tree of heaven, *Rhus typhina* (*sumach*), false acacia (*Robinia*), poplars, plums, seakale, and horse-radish.

Propagation by leaves.—The leaves of many plants, especially those of a thick or succulent nature, may be inserted or placed on the surface of sandy soil or cocoanut fibre. In due course buds are formed and these in turn give rise to roots and stems. Examples of these are Begonia, Gloxinia, Achimenes, Crassula, Bryophyllum, Saintpaulia, Peperomia, Hoya, Croton, Gesnera, Pelargonium (zonal), india-rubber plant, Stephanotis, *Tolmiea Menziesii*, lady's smock or cuckoo-flower, Ramondia, Echeveria, Streptocarpus, and the scaly leaves of many bulbs. (See Fig. 72.)

Layering, *i.e.* laying or pegging down to the soil a shoot of such plants as are difficult to strike from cuttings. Sometimes the portion of the stem in contact with the soil is half cut through, notched, ringed, tongued, or twisted so as to intercept the downward flow of elaborated sap. A "callus" is formed which gives rise to roots and it is to be noted that the roots are always produced on the upper portion (towards the growing point) of the injured branch. The layered shoot is able to draw its nourishment from the plant whilst roots are forming. When well rooted the shoot may be detached and planted elsewhere. Carnations, Rhododendrons, Magnolias, and many other plants may be propagated in this manner (Fig. 78, p. 243).

Fig. 72.—Propagation of Begonia Rex. (A) Plant in pot. (B) Leaf with ribs marked for cutting on underneath side. (C) Leaf laid on pan with resulting plantlets forming. (D) Young plantlet separated and ready for potting.

Inarching or grafting by approach. Two plants are brought into close contact and a piece of bark cut from each. They are then tied together so that the cut surfaces will form a union. Vines are sometimes propagated in this way.

Budding.—A bud with a portion of the bark attached is taken from a stem and inserted beneath the bark of another plant. The union is effected by the growing together of the cambium layers of the two barks, which readily unite if the operation is performed quickly and carefully, and at the proper season (see Figs. 73 and 74).

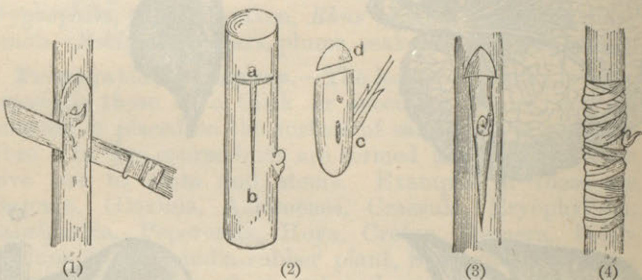


Fig. 73.—Budding Roses.

1) Removing the Bud. (2) Bud and Stock prepared: *a*, *b*, The incision made in the Stock; *c*, The Bud with wood removed; *d*, Upper end of bud not wanted. (3) The Bud inserted on the Stock. (4) The final act of tying in the Bud.

Budding, in many respects, is better than grafting, because, no wood being present in the " shield " or " bud " used for budding, the union becomes more perfect owing to the much larger area, proportionately, of direct contact of the two cut surfaces of bud and stock.

Those plants which do not come true from seeds and are otherwise difficult to increase by " layering " or by " cuttings " are usually " budded " or " grafted."

Roses, apples, pears, plums, peaches, cherries, and many ornamental trees and shrubs are examples of plants propagated by budding. The operation is usually carried out during the months of July and August, and dull or showery weather is favourable for this work. The buds inserted usually remain dormant until the following spring, when, in common with the other buds on the plant, they burst into growth, and in order that the newly inserted bud may have the "lead" the top portion of the plant is removed and the lower buds suppressed.

Fig. 74.—Budding Standard Briars. The buds are shown inserted and tied in.

There are different methods of budding, such as Shield or T budding, square shield budding, flute or tube budding, and ring budding. The first mentioned is the simplest and most common method, and is performed as follows: a shoot of the variety to be propagated is taken when it has made good growth and shows buds in the axils of the leaves. The leaves are first cut off, leaving a small portion of the leaf stalk, then with a sharp knife the bud is sliced off with a portion of the bark and wood attached, the wood being removed with the point of the knife by a sudden jerk, leaving the bud attached to the bark. Should the bud or eye come away with the wood, leaving a small depression, then it is useless for budding, and another must be tried.

A good deal of practice is necessary before one can become expert in budding and grafting. Having prepared the bud it is either placed in water to keep it fresh or quickly inserted underneath the bark of the stock to be used. This is done by making a T-shaped incision in the bark, which is then lifted by the handle of a budding knife and the bud forced down, wedge end first, until the whole of the bark is underneath that of the stock and lying flat against the wood. The bud is kept in position by binding with soft string, worsted, or raffia (matting) above and below the actual bud, which must not be shifted or injured during the operation. The tie may be loosened later, if necessary, when the bud and stock have united.

Grafting to be successful depends on the same principles as in "budding," the chief difference being in the length of the shoot used; in "budding" we take the bud only (a branch in embryo), whereas in "grafting" we take a portion of a shoot 4 in. to 12 in. in length. Grafting in the open is usually performed in the spring—middle of March to middle of May—according to the locality and the nature of the season.

Grafting consists in taking a ripened shoot with several buds on it, of last year's growth (this is called a "scion" or "graft"), of any apple, pear, plum, etc., it is proposed to propagate. The top of the shoot is generally removed and the base cut in a slanting direction or made wedge-shaped according to the kind of grafting to be done. The "stock" is then prepared in such a manner that the cut surfaces, *i.e.* the young wood and bark of both "stock" and "scion," shall come in contact. After the graft has been placed in position it is carefully tied by raffia and waxed or clayed over to keep the cut surface moist and to exclude air and rain until the union or healing up process is complete. Success, however, depends on the manner in which the operation is performed, the skill of the operator in making sharp clean cuts, etc., and also on the season and state of the weather immediately following the insertion of the grafts. The scion and graft must be of near relationship and in proper condition, *i.e.* when the sap is active and growth taking place.

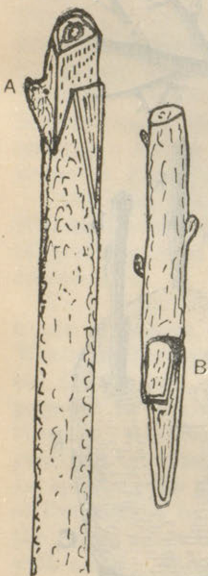


Fig. 75.—Whip Grafting. A, Stock; B, Scion.

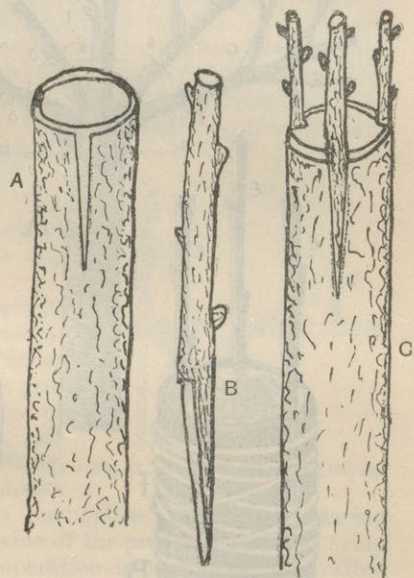


Fig. 76.—Rind or Crown Grafting. A, Stock; B, Scion or graft; C, Scions inserted in readiness for tying.

Kinds of grafting.

Whip or splice grafting (Fig. 75) is a common and simple method. The top of the stock is cut in a slanting direction immediately above a bud if possible. Then a slice is cut upwards from the stock, thus removing a piece of bark and wood and similarly a piece of the bark and wood of the scion is cut so that the two cut surfaces are as equal as

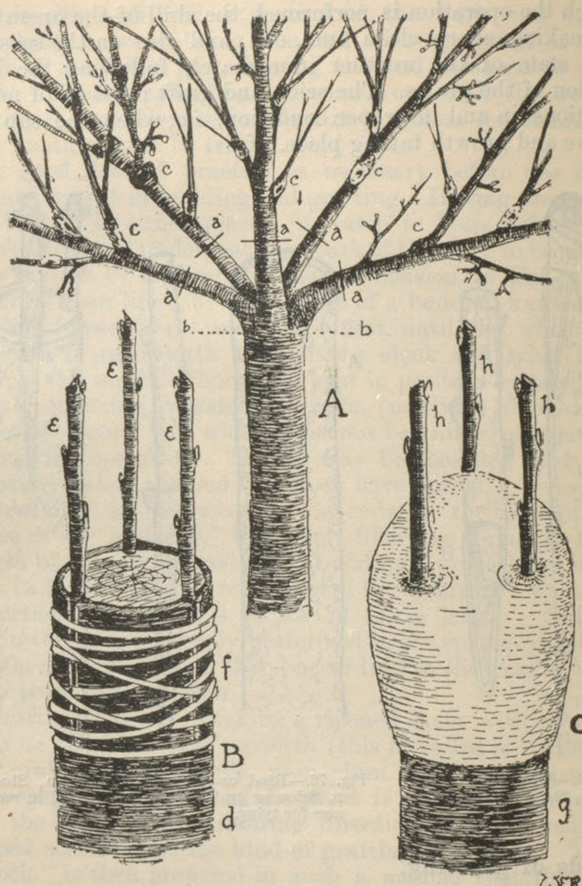


Fig. 77.—Heading Back and Grafting Cankered Fruit Trees.
A. Trunk of Tree. (*a*) Points of cutting back cankered branches. (*c*) Patches of Canker Disease.
B. A Stump with grafts in position, Crown or Rind Grafting. (*d*) The Stock. (*e*) Scions or grafts inserted. (*f*) The ligature used to keep the scions from moving.
C. Scions and ligature clayed in. (*g*) Stock. (*h*) Scions. (*k*) Clay or grafting wax used to exclude air from the junction.

possible. They are then tied together and treated as recommended above. This is the usual method of grafting small variegated plants, young fruit trees, and other plants in which the stock and scion are of about the same diameter.

Crown or rind grafting is the best method of grafting "headed back" old fruit trees with new or better varieties. The trees to be operated upon are headed back, *i.e.* the principal branches are sawn off, the stumps made smooth by means of a sharp knife or chisel, and two or more "grafts" thinned down by means of a sharp knife and inserted under the bark. This is made possible by first making a slit in the bark as shown in Figs. 76 and 77.

Cleft (Fig. 79), notch (Fig. 80), saddle and other methods of grafting need not be discussed here.

Root grafting.—Several kinds of plants, *e.g.* paeony, Wistaria, Euonymus, Clematis, Dahlia, etc., may be propagated by taking pieces of the root, washing them, and grafting by "cleft" grafting, *i.e.* splitting the upper portion of the root, or by "whip" or "splice" grafting, *i.e.* placing the young shoot on one side of the prepared root and tying with raffia. When the operation is completed the grafted roots must be carefully potted and placed in a frame or propagating case.

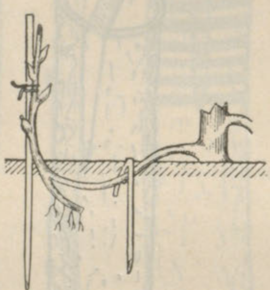


Fig. 78.—Method of Layering Shrubs.

Grafting wax and grafting clay.—Some growers have a preference for home made grafting clay, others for grafting wax or ready made "mastic" obtainable from seedsmen.

Grafting clay may be made as follows :—2 parts clay or clayey loam and 1 part cow dung, to which may be added a little chopped hay to prevent the clay from cracking and falling off.

Grafting wax is made as follows:—2 lb. resin, 1 lb. tallow, and ½ lb. beeswax are melted, well mixed, poured into cold water, and then worked with the hand until the whole is white and of the consistency of putty.

Reasons for grafting and budding:—

(1) To work up a stock of plants that do not seed freely,

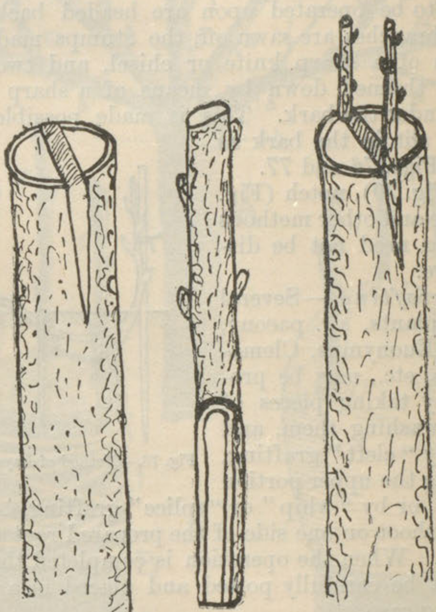


Fig. 79.—Cleft Grafting.

do not come true to name when raised from seed, or are generally difficult to strike by means of cuttings.

(2) To keep sorts true to name.

(3) To save time by accelerating fruitfulness.

(4) To grow certain varieties on soils not suited to them when on their own roots.

(5) Several varieties of apples or pears, etc., may be grown on one tree.

(6) To replace unsuitable kinds (provided they have sound stems) by cutting back and then grafting.

(7) Tall and vigorous growers may be dwarfed by the use of restricting or dwarfing stocks.

(8) To improve the form of trained trees on walls.

(9) To improve the colour and flavour of some kinds of fruits.

Successful grafting and budding are only possible with plants of near botanical relationship: those belonging to the same genus will generally unite with ease.

Some plants, however, will thrive better upon a species of another genus than upon a congener. The pear, for instance, will do better on some species of hawthorn than upon the apple. The leaf-bearing Pereskia makes a capital stock for Epiphyllum. It should be borne in mind that union of tissues is not a proof of affinity, as this can only be measured by the thrift, healthfulness, and longevity of the scion.

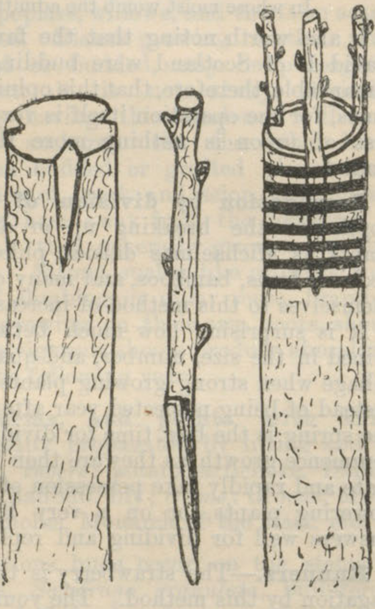


Fig. 80.—Notch Grafting.

To the popular mind there is something mysterious, something akin to magic and entirely opposed to the laws of nature in the practice of grafting and budding.

And yet we learn that budding was practised by the ancients. Vergil, writing about 2,000 years ago, says with reference to this:—

> "Just in that space a narrow slit we make,
> Then other buds from bearing trees we take;
> Inserted thus, the wounded rind we close,
> In whose moist womb the admitted infant grows."

It is also worth noting that the favourite amusements of David I. of Scotland were budding and grafting. It is remarkable, therefore, that this opinion should hold in these times, for the operation itself is very simple and the process of union is nothing more than the healing of a wound.

Propagation by division of the rootstock.—This applies to the breaking up or division of such tufted plants as Michaelmas daisies, phloxes, pyrethrums, Rudbeckias, ferns, bamboos, and many other plants which lend themselves to this method of increasing the stock.

It is surprising how much better results may be obtained in the size, number, and quality of flowers or even foliage when strong growing plants are frequently divided instead of being neglected year after year. On the whole, the spring is the best time for dividing plants, just as they commence growth, as they are then in an active or growing state and rapidly take possession of the soil. With early flowering plants, or on a very light soil, the autumn answers well for dividing and replanting border flowers.

Runners.—The strawberry is the best example of propagation by this method. The young trailing shoots coming from the crown or centre of the plant produce plants at intervals. These produce roots, and may eventually be detached and planted to form a new bed. Silver weed, creeping cinquefoil, Dutch clover, and creeping buttercup are other examples of plants which reproduce their kind in this way.

Offsets.—Such plants as the houseleek (*Sempervivum*), *Echeveria*, *Saxifraga Hostii*, etc., produce little rosettes, or plants between the leaves, which may be detached and planted to form independent plants.

Suckers, or shoots arising from underground stems, *e.g.* raspberries, some briar roses, and sometimes on gooseberries and currants, afford a ready means of increasing these plants, but not a desirable one in the case of the gooseberry. Injury to roots may also cause buds to form, giving rise to shoots, which are then of the nature of suckers; plums, elms, poplars, willows, and the false acacia (*Robinia*) are examples. Plants growing on their own roots, *i.e.* not grafted or budded, may be propagated by these suckers, but it is not always desirable to do so, as plants having this tendency will probably again produce suckers. On the other hand, when suckers arise on budded or grafted plants, from below the point of union of stock and scion, they should be removed by pulling them away from the rootstock or stem, for if cut back they generally grow again, thus giving further trouble. Strong sucker-like growths coming from the base of climbing or pillar roses, brambles or loganberries, when growing on their own roots, should be encouraged, as such vigorous shoots produce abundance of flowers and fruit the following year.

Tubers, bulbs, corms, and plants with thick rhizomes may be readily propagated by lifting and dividing the plants, *e.g. tubers:* potato, artichoke, Dahlia; *bulbs:* tulip, hyacinth, daffodil, lily; *corms:* Crocus, Montbretia (*Tritonia*), Gladiolus, Monarch of the East, etc.

Bulbils or adventitious buds occur on the stems of some lilies, Gladiolus, *Saxifraga granulata*, bulbiferous coral-wort (*Cardamine bulbifera*), and on some fern fronds.

Methods by which various fruits are propagated and the different stocks used for this purpose :—

Apples by grafting or budding on (*a*) wild apple seedlings (crab stock), which encourage strong growth; (*b*) on cultivated apple seedlings (free stock), which induce a moderate amount of growth; and (*c*) specially selected surface rooting apple seedlings (Paradise stock), which cause early maturity and have a dwarfing effect on apples grafted or budded upon them. The "Doucin" is a similarly selected stock used largely by French growers. The "Paradise" and "Doucin" stocks are propagated by layers or cuttings.

Pears by grafting or budding upon (*a*) seedling pear (free stock), (*b*) quince stock, and (*c*) hawthorn; (*b*) and (*c*) exert a dwarfing influence on the trees.

Plums by budding upon seedling damsons, St. Julien plum, and Myrobalan plum.

The *almond*, *peach*, *nectarine*, and *apricot* may be budded on the seedling plum, seedling peach, or seedling almond.

The *cherry* may be budded on the seedling cherry for standard trees and the Mahaleb plum for dwarf trees.

Quinces are grafted on the seedling quince or propagated by cuttings.

Medlars may be grafted on seedling medlars, hawthorns, or upon the quince.

The *grape vine* by means of cuttings, eyes, layers, or by inarching.

Figs by cuttings either of soft or mature wood.

Gooseberries, and red and white currants, by cuttings of strong young wood 12 to 18 inches long, taken in the autumn, with the tips cut away and the buds removed with a knife, except three or four at the top of the cutting. These cuttings should be inserted firmly in well drained soil.

Black currants in the same way as gooseberries, except that the lower buds should not be removed, as these develop later and produce strong vigorous fruiting wood.

Raspberries by suckers.

Strawberries by means of runners.

Blackberries (brambles) and *loganberries* either by layers from tips of the stems, root cuttings, or by division of the rootstock.

CHAPTER XIX.

THE PRINCIPLES OF PRUNING.

The pruning of fruit-bearing plants such as the vine, fig, peach, apricot, etc., is an art that has been practised from time immemorial. Although pruning is a purely artificial process, it is based on one of Nature's laws. Superfluous branches are cast off or starved out of existence by trees and shrubs when wild. The object of the cultivator is to help Nature by forestalling her in this work, thus developing those qualities which he most desires.

In all pruning operations **sharp tools and clean cuts** should be the rule. When a branch is to be wholly removed it must be taken off even with the trunk or stem. Snags, besides being unsightly, are a danger to the tree. One-year-old shoots should be cut immediately above a good bud which points in the direction it is desired the future growth should take.

For small twigs a sharp pruning knife is preferable to secateurs as making a cleaner cut. For large boughs the saw will be required. The jagged surface should be pared over with a pruning knife to make it smooth, and afterwards given a coat of tar to cauterise the wound and prevent decay. Wood cells have no power to multiply, therefore the exposed hard wood can never heal, but the cambium extends and forms a corky layer termed "callus," which gradually grows over and covers the wound, thus sealing the wound against the entrance of the spores of fungi or bacteria, which may cause decay of the wood or be the means of introducing some dreaded disease such as "canker," "silver leaf" disease, etc.

The **reasons for pruning** may be summarised as follows:—

(1) To encourage good growth on newly planted trees and shrubs, especially fruit trees and bushes.

(2) To encourage young growth on old trees and shrubs.

(3) To admit air and light to overcrowded trees, and trained trees on walls, etc.

(4) To encourage the formation of fruit buds by removing or stopping the growing shoots in summer.

(5) To renovate tall and old trees.

(6) To keep trees in any particular form desired.

(7) To prolong the life of trees.

(8) To obtain larger and better fruit.

(9) To promote better and larger flowers on shrubs.

(10) To spur back the young growths of various trees in order to create a larger number of spurs (fruit buds) on the older branches. This may be advisable in the case of trained trees on walls, etc., and for red and white currants, but for a commercial plantation it is more economical to practise thinning and regulating the branches after the trees or bushes are well formed. The young wood thus retained usually fruits when two years old, thus automatically checking rampant growth and doing away with the necessity of pruning the young shoots year after year. The more a tree is cut the more it grows. Therefore hard pruning only aggravates the evil by encouraging rampant growth, and may result in more harm than good. But in the case of old, worn out trees, shrubs, black currant bushes, and some roses, etc., severe pruning is advisable.

Certain varieties of apples, *e.g.* Irish Peach, Maltster, The Queen, Baumann's Red Reinette, Worcester Pearmain, Ecklinville Seedling, Bismarck, etc., have a tendency to fruit at the end of the branches, *i.e.* they form terminal fruit buds on the young shoots. Such varieties will require care and judgment in pruning or many of the fruit buds may be cut away. It is advisable, however, to endeavour to prevent fruit from forming on the tips of the leading shoots by removing all such fruit buds. The lateral shoots in some cases may be allowed to produce fruits on the ends of the shoots.

There are several kinds of pruning :—

(1) *Branch Pruning.*—This method of pruning is practised either for the promotion of growth or for restricting the size of the tree, and also for removing dead, weak, or useless wood, so that more air and light is admitted to all parts of the tree to ripen the wood. Branch pruning is usually done during the autumn or winter, but in any case before growth commences in the spring.

(2) *Summer Pruning, i.e.* stopping or pinching the growing points of the young luxuriant shoots during the growing season, which acts as a check to the growth of the shoots, admitting more air and light to the crop of fruit and promoting the development of fruit buds and spurs for the succeeding year.

(3) *Disbudding* is also a form of pruning, and is practised in order to encourage the production of large flowers on chrysanthemums, roses, carnations, etc., by removing superfluous buds.

(4) *Root Pruning* is practised in order to check very luxuriant growth, and to promote the formation of fruit buds. Plums and other fruit trees growing on some soils have a tendency to produce very strong sapwood, in which case the main or tap roots may be cut. This is done by carefully lifting small sized trees, cutting all the long, deep growing or anchor roots with a sharp knife and then replanting, taking care to spread out the roots and to keep the surface of the soil hoed, after which a top-dressing of manure may be given to encourage surface roots, which are conducive to fruitfulness.

Old established trees may have a trench dug round them, three feet or more from the trunk, and all the large roots cut, care being taken to preserve from injury all those of a fibrous nature. The tree should be undermined, if possible, in order to get at and cut the deep growing anchor roots. These operations completed, the soil must be carefully filled in and the fibrous roots so arranged as to bring them as near to the surface as possible. The future treatment will consist of surface cultivation and mulching with manure. Root pruning is perhaps best done in the autumn before the leaves have all fallen, as the downward flow of the sap which takes place in the autumn promotes the healing of the wounded roots and the formation of new fibrous roots.

Pruning trees and shrubs other than fruit trees and bushes.

Spring flowering shrubs generally produce their flowers on the shoots formed during the previous year, that is to say, on the old wood. The pruning of these, if required, should be attended to immediately after the flowers have fallen, thus encouraging the production of strong shoots for next year's flowering. Thin, weak, or dead shoots may be cut away also at the time of pruning.

The following are a few examples of spring flowering shrubs:—Wistaria, flowering currant (*Ribes*), Guelder rose, New Zealand daisy-bush (*Olearia*), Weigela, almond, yellow jessamine, Forsythia, Deutzia, elder, flowering cherries, Choisya, broom, lilac, *Clematis montana*; rambler, climbing, and hybrid briar roses; *Spiraea Thunbergi, S. opulifolia, S. Van Houttei*, etc.

Summer or early autumn flowering shrubs produce their flowers on the young shoots formed during the current season. Such plants should therefore be pruned during the dormant season—winter or early spring—before growth takes place. If the shrubs are thinned and cut back fairly hard, strong shoots will result, giving fine flowers the same season.

The following plants flower on the young wood:—Tea roses, hybrid tea roses, hybrid perpetual roses, *Spiraea ariaefolia, S. Douglasi, S. Bumalda, S. lindleyana, S. Aitchisoni, Hydrangea paniculata*, mock orange, *Ceanothus*, Fuchsia, *Clematis Jackmani*, honeysuckle.

The following plants require little or no pruning with the exception of the removal of old worn out shoots:—Azalea, barberry, cherrylaurel, Laburnum, Daphne, Magnolia, Mahonia, Rhododendron, etc.

Plants grown for their ornamental stems (coloured bark), which are very effective in winter, such as the red, velvet, and gold barked willows, the dogwood, *Rubus biflorus*, *Berberis virescens*, etc., should be cut back after the winter is over, otherwise the twigs lose much of their ornamental character. Strong young shoots are the most effective.

Large flowering trees such as horse-chestnut, Catalpa, tulip tree, Paulownia, white beam tree, false acacia, etc., are best when left to themselves; Nature does the pruning.

PART III.

GARDEN PESTS AND MISCELLANEOUS INFORMATION.

CHAPTER XX.

INSECT AND OTHER ANIMAL PESTS OF GARDENS.

Preliminary Observations.

Nearly all plants when grown in large quantities, and under conditions of a more or less artificial nature, are liable to be attacked by some kind of pest—animal or vegetable. Generally, however, these pests can be prevented, or held in check, by one or other of the many methods now known to cultivators.

The life-histories of the various garden pests is a subject worthy of more careful study, as the cultivator would then be in a better position to attack them in their most vulnerable stage.

The life-history of a typical insect may be summarised as follows :—

Imago, or the fully-formed insect (moth, fly, or beetle), lays

Eggs, which vary very much in size, shape, or colour, according to the kind of insect. These eggs, when hatched, become

Larvae, which are termed caterpillars in the case of butterflies, moths, and sawflies; maggots in the case of flies; and grubs in the case of beetles. It is during the larval stage that insects do most damage to plants.

Pupa or Chrysalis. The larvae either bury themselves in the ground, or spin a silky cocoon, changing into the pupal stage, from which the imago, or perfect insect, is destined eventually to emerge.

Insects individually, or in small numbers, do very little damage to plants, but when occurring in large numbers much damage to crops may result. Some insects are useful to cultivators, others may be useful at one season of the year and harmful at another, *e.g.* bees, wasps, cochineal insect, silk moth, ladybird, cinnabar moth, etc.

Some insects (*a*) act as Nature's scavengers by destroying dead matter, or (*b*) serve as food for other animals, or (*c*) are useful in conveying pollen from one flower to another.

Insects may prove harmful to plants in the following manner:—

(*a*) By gnawing and destroying plant tissues, *e.g.* caterpillars and grubs.

(*b*) By extracting the sap from plants, *e.g.* red spider, green fly, scale, etc.

(*c*) By stimulating the production of swellings, *e.g.* currant gall mite, cabbage gall weevil, etc.

Some insects will attack almost any kind of plant, *e.g.* surface caterpillars, chafer grubs, wireworm, leather jacket, etc.; others confine their attack to a single genus, or plants of close relationship, as suggested by their names, *e.g.* plum aphis, celery fly, mangel fly, carrot fly, etc.

Certain insects will attack one part only of the plant, e.g.:—

Roots.—Wireworm, chafer grubs, leather jacket, carrot fly, ghost moth larvae.

Stems.—Corn sawfly maggot, stem borers.

Leaves.—Diamond-back moth caterpillars, green fly, celery fly, gooseberry moth.

Flowers.—Apple-sucker moth, raspberry moth.

Fruits.—Codlin moth, raspberry moth.

Seeds.—Pea weevil, bean weevil.

Remedies and Preventives.

Many remedies have been suggested from time to time, but prevention is the best of all remedies. Insects are always lurking about, so a sharp lookout should be kept for their first appearance in order that they may be attacked immediately.

Good cultivation; suitable manuring; keeping down weeds; burning all infested plants, dead leaves, and rubbish in the garden and orchard; keeping plant houses clean, well ventilated, and carefully watered, are some of the preventive measures which should be adopted.

Factors favouring the increase of insects:—

Abundance of their natural food, favourable weather, hot spells, east winds, bad cultivation, poor land, climate, situation, weeds, absence of their enemies, and, finally, neglect to attack the insects when first observed.

Factors limiting their increase:—

Late frosts, early frosts, rapid fluctuations of temperature, cold heavy showers, and strong gales. Certain insects have further drawbacks to contend with in the shape of diseases caused by fungi or bacteria. Many birds are insectivorous, *e.g.* woodpeckers, gold-crested wren, robin, hedge sparrow, cuckoo, wagtails, rook, plover, gull, starling, jackdaw, tits, tree-creeper, fly-catchers, etc., and, in addition, the larvae of ladybirds and of the lace-wing fly feed on aphides, ants, and mites, and some beetles feed on certain insects.

Methods by which insects are destroyed or kept in check:—

(*a*) *Gas process or fumigation* by the aid of hydrocyanic gas, commercial compounds of nicotine, etc., and soil fumigants such as carbon disulphide, "Vaporite," "Apterite," "Killogrub," "Naptho-Nicotyl," etc.

(*b*) *Contact process, i.e.* the spraying of oily or soapy mixtures for the destruction of sucking insects, such as aphis, thrips, red spider, etc.

(*c*) *Toxic process, i.e.* poisoning the food of biting insects by using arsenate of lead, London purple, Paris green, hellebore powder, etc., for fruit-tree pests (caterpillars).

(*d*) *Mechanical process,* such as grease-banding fruit trees, trapping, burning infected leaves, prunings, etc., and certain methods of cultivation which destroy many pests.

Common Insecticides.

Spraying mixtures may be made of either of the following:—

(1) A solution of soapsuds.

(2) 2 oz. carbolic soap dissolved in 1 gallon of water.

(3) Soft soap 2 oz. and washing soda ½ oz. to 2 gallons of water.

(4) 2 lb. tobacco powder or 6 oz. tobacco leaf infused in water for 6 hours, pressed, infused again, and the extract then added to 7 gallons of water. This is an excellent and safe insecticide for dipping or spraying plants infested with green fly, apple sucker, or thrips.

(5) Hot water heated to 130° F is also effective against green fly.

Soot may be applied with advantage in the case of leaf and root pests. It should be dusted over the plants at frequent intervals, being most efficacious when the foliage is damp.

Salt applied at the rate of 4 oz. per square yard or 10 to 12 cwt. per acre, or *gas lime* 1 lb. per square yard, are both useful for such soil pests as wireworm, leather jacket, chafer grubs, etc. They should be applied when the land is free from a crop.

Wood Ashes is beneficial in some cases for soil pests, being in addition of some manurial value to crops.

Lime, when used freshly slaked, destroys certain soil pests, and can also be used as a preventive against attacks of the celery, onion, carrot, and beet flies.

Nitrate of Soda may be used for the cabbage-root maggot at the rate of ½ oz. per plant, applied after planting.

Superphosphate and kainit when worked into the soil at the rate of 4 oz. to the square yard will destroy woolly aphis (American blight) on the roots of apple trees, and the larvae of the pear midge, etc.

Hellebore powder is used for dusting gooseberry and currant bushes attacked by caterpillars, but, being poisonous, it is not safe to gather the fruit until at least four weeks have elapsed from the date of application. The powder may also be sprayed on the bushes, if necessary, by mixing 2 lb. in 10 gallons of water.

Gas tar when prepared as follows will be found valuable for painting dormant vine rods and other fruit trees infested with plant lice, mealy bug, etc. Mix together ½ pint gas tar and 1 gallon of fine dry clay soil, place in an iron pot, add sufficient water to make the mixture of the consistency of paint, and then heat over a steady fire, keeping the mixture well stirred.

Gas tar water is useful for protecting the buds of fruit bushes from the depredations of birds in winter. To make this water obtain any vessel, half fill it with tar, then fill up with water, stir well, and when the tar has quite settled spray the bushes with the clear liquid.

Carbolic acid, tar, paraffin, or napthaline mixed with soil, sand, fine peat, or wood ashes, and applied to the soil before sowing or planting, will ward off attacks of the carrot and onion flies and cabbage gall weevil.

Disulphide of carbon is a dangerous inflammable liquid, requiring to be used with the greatest care, but although so deadly to all animal life it is said to be beneficial to plant growth.

For the destruction of such soil pests as Phylloxera of the vine, Eucharis mite and other bulb mites, eelworm, wireworm, ants, mole crickets, etc., it may be used at the rate of 1 oz. per square yard. It can be injected into the soil either by means of an injector such as the "Vermorel Injector," or by making holes in the soil six inches deep, pouring in the liquid, and covering the holes again with soil.

Paraffin and soft soap emulsion is used for general spraying purposes, and may be prepared as follows:—

Solar distillate paraffin 4 pints, soap $1\frac{1}{2}$ lb., water 10 gallons. Dissolve the soap in boiling water and while still very hot add the paraffin, afterwards churning with a force pump or syringe until the whole is a creamy mass. Then add sufficient water to bring the whole up to 10 gallons. Double the quantity of oil may be used for winter spraying.

Quassia wash is made by boiling 1 lb. of fresh quassia chips in water for two hours, then straining the extract, and mixing with $\frac{1}{2}$ lb. soft soap, afterwards adding 10 gallons of water.

Paraffin, lime, and iron sulphate emulsion is a combined insecticide and fungicide and is made as follows:—Take iron sulphate 10 oz., quicklime 5 oz., paraffin (solar distillate) 24 oz., dissolve the sulphate in water, add the lime which should have been previously dissolved in water, churn in the oil, and make up to 10 gallons by adding the necessary quantity of soft water.

Winter wash for fruit tree pests, *e.g.* moss, lichen, aphis, scale, etc., consists of caustic soda 4 lb., quicklime $\frac{1}{2}$ lb., paraffin $2\frac{1}{2}$ gallons, iron sulphate or copper sulphate 1 lb., and water 20 gallons. The lime should be first slaked in a little water, and then more water added to make it milky. Next dissolve the sulphate in 18 gallons of water, add the milk of lime, and afterwards churn the paraffin into the mixture.

White-washing fruit trees.—If there is much moss or lichen on the trees the bark should be scraped before applying the wash, which might be applied in the form of a spray during winter. It is made from 1 gallon lime, 1 lb. soft soap, 1 lb. size, and 10 gallons of warm water. Or *salt* in the form of brine may be sprayed over the trees in winter, or soot or powdered lime thrown on to the tree trunks or branches when damp, to destroy moss, lichen, and insects.

Paris green, London purple, and arsenate of lead are very poisonous substances used for biting insects such as caterpillars. They are obtainable from horticultural sundriesmen and chemists, directions for using being supplied with them.

A combined insecticide and fungicide can be prepared as follows :—Iron sulphate 2 oz., quicklime 1 oz., paraffin 16 oz., potassium sulphide 4 to 6 oz., and water 10 gallons. Dissolve the sulphate in 6 pints of water, add the lime, and emulsify with the paraffin. Dissolve the potassium sulphide in 9 gallons of water, pour the emulsion into it, and mix well.

This may be used in late winter on fruit trees, bushes, etc., for attacks of red spider, scale, and apple and pear scab.—(*F. V. Theobald.*)

For fungicides see page 278.

Pests of vegetable crops.

Cabbage-root maggot or cabbage fly (Phorbia brassicae).—The maggots attack the roots and stems of the cabbage, cauliflower, and turnip. The flies are found near fresh manure heaps, and the maggots are probably introduced into the soil with the manure.

Preventives and remedies :—

(1) Less animal manure and more artificial manures such as kainit, superphosphate, and nitrate of soda should be used.

(2) Lime may be applied with the dung.

(3) Destroy all badly infested plants.

(4) Practise rotation of cropping and trench deeply to bury the larvae.

(5) Before transplanting, the roots of the plants may be dipped in a mixture of clay, soot, paraffin, and water.

(6) A teaspoonful of nitrate of soda placed round the collar of the plants after transplanting has proved efficacious in some cases.

(7) Soot or gas lime spread round the plants has also proved effective.

Cabbage and turnip gall weevils (Ceuthorhynchus).—The weevils attack the seedlings, causing small round or marble-like swellings on the roots. One or more small maggots will be found inside each swelling, or, if empty, the small hole will be observed through which the fully fed larvae have emerged. The swellings or galls should be cut away before planting and burnt. The old cabbage stalks should also be burnt, and the crop changed the following season, when the ground should be double dug in order to bury the larvae as deeply as possible. I have found that this pest does very little damage to cabbages which have been transplanted. The weevils deposit their eggs on the seedlings in the seed bed, and it is possible that if some soil fumigant, or lime, basic slag, wood ashes, or soot was incorporated with the soil, before sowing the seeds, this would have the effect of keeping away the weevils. Covering the seed-beds with fine muslin or cheese cloth might also prevent egg laying.

Cabbage moth (Mamestra brassicae) *and White cabbage butterfly* (Pieris brassicae).

The caterpillars feed on the leaves of cabbages and allied plants, and may be destroyed by (*a*) hand-picking, (*b*) dusting the plants with lime, soot, or gas lime powder, or (*c*) spraying with brine or lime water. General cleanliness in the garden, rotation of crops, and deep cultivation will all have a tendency to hold these pests in check.

Onion fly (Hylemia antiqua, syn. Phorbia cepetorum).

The maggots are hatched from eggs deposited by the fly at the bases of the leaves of the seedlings.

Plants raised under glass and transplanted are less liable to be attacked than those sown in the open. The planting of small onion sets (small dry bulbs, about the size of marbles) gives good results in many gardens, and should be tried in districts where onion cultivation is generally a failure. Many are the remedies suggested for this troublesome pest, and the following are among the most suitable:—

(1) The onion bed should receive a good dressing of lime, soot, wood ashes, or gas lime, and be deeply dug in order to bury the chrysalids.

(2) Before sowing the seed treat the seed-drills with spirits of tar, 1 gallon to 2 bushels of peat or sand. This is sufficient for a row 60 yards long.

Paraffin or sheep dip mixed with sand or peat may be used in a similar manner.

(3) The seedlings, or newly transplanted plants, should be dusted at frequent intervals with soot or lime; or "Vaporite," "Naptho-Nicotyl," etc., might also be useful for this pest.

(4) All infested plants should be carefully lifted by means of a hand fork, keeping the soil attached, and the whole burnt.

(5) Sowing the seed in August instead of March.

(6) Stir the seed with red lead powder, adding a few drops of paraffin or turpentine to make the powder adhere, before sowing.

Carrot fly (Psila rosae).

The foregoing remarks concerning the onion fly are applicable here, with the exception that carrots are not usually transplanted.

Avoid thinning the plants in very dry weather and give a good watering immediately the operation is completed. Drawing soil over the crowns of the seedlings is an additional preventive measure. Grass clippings from the lawn sprinkled lightly over the seedlings of carrots, turnips, etc., also help to keep away troublesome pests.

Celery and parsnip fly (Acidia heraclei, syn. Tephritis onopordinis).

The larva of this insect is a leaf miner, being found between the upper and lower skins of the leaf, where it feeds on the tissues, producing large, unsightly blotches.

Spraying with quassia extract or paraffin emulsion, or dusting the plants with soot or lime after planting, deters the fly from egg-laying.

All infected portions of the leaves should be picked off and burnt, and this may prevent a severe attack of the pest in the autumn.

As this insect sometimes attacks the leaves of bishop-weed and other plants belonging to the same family, care should be exercised in keeping the land free from such weeds.

Beet and mangel fly (Pegomyia hyoscyami var. betae, syn. Anthomya betae).

The larvae behave much in the same way as the celery fly maggot, and the chief desideratum will consist in encouraging quick growth by the use of suitable manures, *e.g.* kainit, nitrate of soda, and superphosphate.

The infested leaves ought to be picked off and burnt.

Spinach, goosefoot, fat hen, etc., are frequently attacked by this pest and in a like manner, hence the importance of keeping down all weeds in the garden.

Turnip flea beetle (Phyllotreta nemorum).

This insect—the so-called "Turnip Fly"—causes immense damage to the turnip crop (and other closely related plants) in the early stages of its growth, by feeding on the young fleshy seed leaves (cotyledons). The presence of these small beetles is especially noticeable during hot dry, or very cold dry, weather, when growth is slow. It is therefore important to sow on a well-prepared seed bed during weather suitable for rapid growth. Superphosphate or some other artificial manure drilled in with the seed—which should be new—will encourage quick growth.

Soot, lime, or dry road sweepings dusted over the plants will tend to keep the rest in check.

All cruciferous weeds should be destroyed.

Turnip sawfly (Athalia spinarum).

The leaves of turnips are devoured by the caterpillars. The plants may be sprayed with weak liquid manure water, tobacco, quassia, or paraffin emulsion, or dusted with soot or lime.

Turnip snowy fly (Aleyrodes proletilla).

This pest is sometimes troublesome, and may receive the treatment recommended for the turnip sawfly.

Broad bean aphis, nigger, or black dolphin (Aphis fabae).

As the growing points of the bean plants are the parts attacked, it is recommended that these tips be pinched out and burnt as soon as the lower pods are forming. This operation, in addition to strengthening the plant, will also aid in the development of the pods. The plants may be sprayed with any good insecticide as a further precaution.

Pea moth (Grapholitha nebritana, syn. G. pisana).

The larvae or caterpillars of this moth infest the seeds of the garden pea, the eggs having been deposited in the flowers. The larvae bore into the young pods and feed on the seeds, and later on crawl down to the ground where they pass the winter in a cocoon.

The peapods should be picked in a young state, and all caterpillars found in the "wormed" peas should be destroyed.

Pea weevil (Sitones lineatus).

The larvae feed on the roots of peas, beans, clovers, etc., and the weevils feed on the leaves.

Quick growth should be encouraged, and the plants dusted with soot or lime when the foliage is wet, or they may be sprayed with an insecticide.

Pea beetle (Bruchus pisi) *and Bean beetle* (B. rufimanus).

In both cases the eggs are laid in the flowers, and the larvae, when hatched, live on the seeds. When fully fed they change into the beetle stage and remain in the seeds until the following summer, when they eat their way out, leaving a circular hole in the pea or bean seeds, the beetles then flying to the flowers of their respective food plants (peas or beans).

As a remedy disulphide of carbon may be used at the rate of 1 oz. to 100 lb. of seed, by placing the seed in a close box or chamber—over which a cloth is hung—and hanging cloths saturated with the disulphide of carbon over the seeds. This substance is extremely poisonous and highly inflammable. Further remedies consist of soaking the seed in paraffin for 1 hour, or in water at a temperature of 125° F. for 2 hours.

Infested seed may be mixed with a 5 per cent. solution (*i.e.* 1 lb. to 2 gallons of water) of copper sulphate, the quantity stated in brackets being sufficient for 8 bushels of seed. The seed should be thoroughly mixed with the solution. In garden practice, however, it is better to destroy all infected seed.

Insect and other pests of fruit trees and bushes.

American blight or woolly aphis (Schizoneura lanigera).

This insect occurs on the branches, leaves, and sometimes on the roots of apple trees. Two varieties of apple—Northern Spy and Majetin—are said to be immune, and it has therefore been recommended to use these varieties as stocks for grafting.

The following remedies are suggested :—

(1) Scrape the bark and afterwards whitewash.

(2) Brush over the pests with ammoniacal liquor from gas works, spirits of wine (methylated spirits), turpentine, paraffin, or linseed oil, using a stiff brush.

(3) Spray with the "winter wash."

Mussel scale (Mytilaspis pomorum).

This is a sucking insect extracting the juices from the bark, and is very tenacious and difficult to eradicate.

Spraying and brushing as recommended for American blight should be adopted here.

Winter moths (Cheimatobia brumata and Hybernia defoliaria).

The caterpillars in both cases eat the leaves of apple, pear, plum, etc.

The trees may be sprayed with the "winter wash," Paris green, etc., and grease bands (special paper and grease are obtainable for this purpose) placed round the tree trunks in September to trap the wingless female moths as they climb the trees to lay their eggs.

Codlin moth (Carpocapsa pomonella).

The eggs are laid on the young apple fruits at the end of May. The grubs hatch out in eight or nine days and bore their way into the fruits.

Trees attacked should receive the same treatment as recommended for winter moth, and all "wormed" fruit should be gathered and destroyed.

Small ermine moth (Hyponomeuta sp.).

The caterpillars attack the leaves and form web nests, which should be gathered and destroyed.

A vigorous spraying with paraffin or other emulsions may be employed to dislodge the webs and destroy this pest.

Apple blossom weevil (Anthonomus pomorum).

The flowers and flower buds of apples are attacked by the larvae of this insect.

Grease banding in spring, spraying, etc., may be resorted to.

Apple sucker (Psylla mali), Fig. 81.

This pest does great damage to the flowers and flower stalks of apples.

Fig. 81.—Apple Sucker.

Thorough spraying with "winter wash," quassia, or paraffin emulsion, has given good results (*see* Board of Agriculture Leaflet No. 16).

Pear midge (Diplosis pyrivora).

In this case the fruits of the pear are the parts attacked, and all such fruit should be collected and burnt.

Kainit, or gas lime, applied to the soil and dug in has proved an effective remedy.

Oyster scale (Aspidiotus ostreaeformis).

The life-history and treatment here is similar to that of mussel scale, which attacks the apple.

Gooseberry and currant sawfly (Nematus ribesii).

The caterpillars feed on the leaves, and in bad attacks the bushes may be practically defoliated. Any of the following remedies may be adopted:—

(1) Dust lime, soot, sulphur, or hellebore powder (poison) over the bushes when damp.

(2) Spray with either hellebore (2 oz. to 2 gallons of water), paraffin emulsion, or quassia extract.

(3) Apply gas lime or fresh tan to the soil between the bushes.

(4) Scrape off the top soil beneath the bushes, and bury

it deeply in another portion of the garden to destroy the chrysalids. This is only practicable on a small scale.

Magpie or currant moth (Abraxas grossulariata).

The caterpillars, which are beautifully marked, feed on the foliage of currants, and may be destroyed in the manner suggested for the gooseberry sawfly.

Big bud or black currant gall mite (Eriophyes ribis).

This mite occurs on black currant bushes in all parts of Great Britain. It is very minute and cannot be seen without the aid of a strong magnifying glass. The large swollen buds contain great numbers of the pest.

When the bushes are badly attacked they should be grubbed up and burnt, and the ground planted with some other crop for a time, a fresh stock of healthy plants being obtained from a reliable source.

In the case of a very slight attack the buds infected may be removed by hand and burnt, and the bushes sprayed or dusted, at intervals of a fortnight from the end of March to the middle of May, with a mixture of two parts sulphur and one part unslaked lime (ground lime).

Spraying with quassia and soft soap, carbolic acid and soft soap, or sulphur and soft soap, has also given good results.

Birds frequently attack the buds of gooseberries and red and white currants. To prevent this the branches may be tied together during the winter, being loosened again before growth commences in the spring, when they may be pruned.

If the whole plantation be covered with wire netting or fish netting all birds will be kept away from the bushes.

Spraying the bushes in the autumn with some of the following mixtures will usually be found an effective safeguard :—

(1) A mixture of lime, sulphur, and a little size dissolved in water.

(2) Obtain some newly-made gas tar, place in a bucket with an equal quantity of soft water, and allow to stand for forty-eight hours. Then pour off the water without disturbing the tar, and use at the rate of 1 gallon of tar

water to 4 gallons of soft water. It may be necessary to repeat the operation after a time.

(3) Some of the proprietary preparations on the market.

Raspberry moth (Lampronia rubiella).

The larvae of this moth attack the canes and buds of the raspberry.

Infected canes should be burnt and the young fruiting canes sprayed with a thick solution of soft soap or some other insecticide. Gas lime, burnt lime, or soot may be forked into the ground to destroy the larvae.

Raspberry beetle (Byturus tomentosus).

Both the flowers and fruits of raspberries and blackberries are attacked by the larvae of this insect.

Remove the old canes, and all rubbish, and burn them together with any infected fruit.

The young canes may be sprayed with arsenate of lead.

Rose chafer (Cetonia aurata).

The larvae and beetles feed on the roots of the strawberry plant, and search should be made among the plants and roots for them in order that they may be destroyed.

Rose Pests.

Leaf maggots (Tortrix).

These may be destroyed by (*a*) hand-picking, and (*b*) shaking the bushes to dislodge the pest.

Leaf miner (Nopticula, etc.).

All infected leaves should be picked off and burnt and the bushes sprayed with quassia or some other insecticide.

Pith borer (Blastodacna hellerella, etc.).

All shoots attacked should be removed and burnt.

Rose sawfly (Hylotoma rosae).

The caterpillars may be kept down by (*a*) hand-picking, and (*b*) spraying with London purple, lead arsenate, etc.

Pests of plant houses.

Green fly or aphis.

Plants attacked may be sprayed with any of the following remedies :—

(1) Soft soap 2 oz. and washing soda $\frac{1}{2}$ oz. to 2 gallons of water.

(2) Paraffin emulsion.

(3) Tobacco extract.

(4) Fir-tree oil.

Or they may be fumigated by using "XL All" or some other proprietary vaporiser.

Red spider (Tetranychus telarius, etc.).

Constant syringing to maintain a moist atmosphere, together with due care being exercised to prevent the plants becoming dry at the roots, will usually prove effective in keeping this troublesome pest in check.

Spraying with paraffin emulsion will be found an efficacious remedy.

Mealy bug (Dactylopius longispinus).

The same treatment as recommended for green fly may be tried, or the infested plants brushed over with a little methylated spirits, which is fatal to these soft creatures.

Scale insects.

These are troublesome to many plants and may be removed by sponging with soft soap, nicotine soap, fir-tree oil, etc.

Thrips (Thrips minutissima).

The remedies suggested for green fly are applicable here.

Chrysanthemum, marguerite, and cineraria leaf-miner (Phytomyza affinis).

The larvae tunnel the leaves and often do a good deal of damage to the plants if not speedily checked.

All infected leaves should be picked off and burnt, and the plants sprayed with some bitter insecticide, such as quassia, etc., to deter the fly from egg-laying.

In the case of chrysanthemums and marguerites young healthy cuttings should be used for propagation, and the young plants systematically sprayed.

Eelworms (Tylenchus devastatrix, etc.).

There are several kinds of these microscopic pests which infest the roots and stems of nearly all kinds of plants. As they live in the tissues of the plant they are difficult to exterminate ; spraying, for instance, would be ineffectual. The following remedies may be adopted :—

(1) Burn all plants attacked.

(2) Treat the soil with some disinfectant, *e.g.* gas lime, carbolic acid, etc.

(3) Burn the soil, or steam it to a minimum temperature of 180° F.

(4) Freezing the soil may also be found effective, and for this purpose the infected soil should be exposed to the action of frost and the weather generally.

Worms (Lumbricus terrestris, etc.).

Worms in pots may be dislodged by using strong lime water or mustard and water, and killed by the use of Carter's or Sutton's wormkiller.

Woodlice or slaters.

Woodlice will damage choice plants, and the surface roots of tomatoes and cucumbers, as they come through, are also attacked.

Dry conditions favour their increase, and they are encouraged by dry rough staging in greenhouses, the use of turves in market-garden houses for keeping up the soil, and also by the use of littery straw manure as a top-dressing. There is no more effective manner of destroying woodlice than lifting the turves, litter, etc., and giving a good soaking with boiling water, where it can be used without injury to the plants.

Trapping by means of hollowed out pieces of potato, or by placing dry moss in an inverted jar or pot, may be tried.

" Phospho-Nicotyl," prepared by Walter Voss and Co., used according to directions, will be found useful in exterminating woodlice, beetles, and cockchafers.

Ants.

These may be destroyed with the aid of boiling water, paraffin, " Vaporite," " Naptho-Nicotyl," etc.

Wasps (Vespa vulgaris).

Wasps are often responsible for much damage caused to fruit under glass.

They may be kept out of plant houses by covering the ventilators, etc., with fine meshed wire netting, or can be trapped with the aid of bell-glass traps. Their nests should be sought for and destroyed with cyanide of potassium prepared as follows:—Dissolve ½ lb. of the substance in boiling water, bottle and label "Deadly Poison." Saturate a rag or a plug of cottonwool with the liquid, taking care not to inhale the fumes, and by means of a pointed stick force it into the entrance to the nest.

Grubs.

Weevils and their larvae are very destructive to pot plants (Cyclamens, ferns, etc.), and it is difficult to kill them without causing injury to the plants. The latter may be turned out occasionally from the pots and all larvae visible picked out with a pointed stick and killed. If this treatment does not prove effective, the best plan is to shake the roots entirely free from the soil and larvae, re-potting the plants in a fresh uncontaminated compost. Spraying the soil and roots with carbon disulphide, or mixing some soil fumigant with the compost, is another way of killing the grubs. It is necessary to destroy the weevils to prevent more eggs being laid.

Weevils feed at night, and fall to the ground when suddenly disturbed. The plants should be grouped together in the daytime on a large greased or sticky paper, then, when entering at night holding a bright light, the weevils will fall on the sticky paper on tapping the pots or shaking the plants. Ordinary fumigation of the house at night, or trapping with pieces of carrot or potato placed just below the surface of the soil, are further remedies.

Pests common to many crops.

Caterpillars, of which there are many kinds, feed on garden plants. (See remedies suggested for Cabbage Moth Caterpillar, page 261, and Winter Moth Caterpillar, page 265.)

Green fly or aphides (Aphis sp.).

Several kinds are known, each attacking some particular species of plant, but some species pass the winter on another plant. Thus the hop aphis winters on the plum and damson. A study of the life-history will indicate the best time to destroy each kind, so as to prevent their rapid propagation and the development of the *winged* female brood. They may be kept in check by early and persistent spraying with paraffin emulsion, tobacco extract, quassia extract, etc., or one of the many preparations on the market. The latter, being ready for immediate use, will be found convenient for the amateur or small grower.

Red spider (Tetranychus telarius, etc.).

These small creatures are generally found on the underside of the leaves of vines, plums, apples, violets, etc., being especially prevalent when the soil and atmosphere are dry. The leaves attacked turn yellow, their proper functions being thus interfered with.

An application of water to the roots, and syringing the foliage with clear water, or paraffin emulsion, quassia extract, etc., will be beneficial to the plants by destroying the pests.

White or snowy fly (Aleyrodes vaporariorum).

A small four-winged insect which attacks many crops, from cabbages to tomatoes. Spraying with paraffin, quassia, or tobacco washes will destroy this pest.

Leather jacket (Tipula sp.).

The leather jacket is the larva of the crane fly or daddy longlegs.

The larvae do immense damage to the roots of crops, especially on newly broken land. The eggs may be introduced into gardens by means of half decayed leaves, road sweepings, manure, etc., from a badly formed compost heap.

The writer has found hand-picking the grubs effective in many cases, using a pointed stick to remove the soil from around attacked plants. The remedies suggested under wireworms are also applicable to this pest.

Chafer grubs.

One of the commonest is the larva of the May bug (*Melolontha vulgaris*). The beetles are light brown in colour, and are very plentiful on summer evenings, especially in some seasons and districts, when they occur in great numbers.

Hand-picking, good, deep, and constant cultivation, and the use of stimulating manures to encourage quick growth will do much to keep down this pest. Plants not thriving should be carefully examined at the roots to ascertain whether or not the cause is due to the presence of these larvae.

Wireworms (Agriotes sp.).

The wireworm is the larval stage of the click beetle, or skip jack. Unlike most insects it remains in the grub stage for three or four years, causing much damage to all kinds of crops during this period of its existence.

There is no royal road to success in dealing with this pest, but many of the following remedies may prove effectual:—

(1) Good clean cultivation of the soil to destroy suitable places for egg-laying.

(2) Constant working of the soil will kill many of the pests as they change from one stage to another.

(3) Good drainage is desirable.

(4) Liming the soil, together with the use of nitrate of soda or kainit, will stimulate growth, thus giving the crops a good start, and at the same time cause some harm to the pests.

(5) Soot worked into the soil is attended with beneficial results.

(6) Disulphide of carbon may be used (see page 258), or some fumigant such as "Naptho-Nicotyl," "Killogrub," "Vaporite," etc., worked into the soil.

(7) Birds and poultry will eat the larvae on freshly turned soil.

(8) Hand-picking can be resorted to in the case of soil used in greenhouses, or when digging the soil in the garden.

(9) Traps consisting of pieces of carrot, potato, apple, rape cake, etc., may be inserted in the soil, examined at intervals, and all grubs destroyed.

(10) The grubs show a great liking for rape dust and mustard plants, and the former placed between the crops, and the latter sown as an inter-crop, will attract wireworms, leather jackets, and chafer grubs from the main crop under cultivation.

Earwigs (Forficula auricularia).

The flower buds of dahlias and other plants are often greatly damaged by earwigs. These insects are active at night but hide themselves during the day. They may be trapped by means of pots, containing dirty paper or moss, inverted on sticks placed among the plants. The pots should be frequently examined and the pests destroyed. Earwigs are often found in hollow stems, straw, etc., and may be trapped in this manner also.

Slugs (Limax agrestis, Arion hortensis, etc.) *and Snails* (Helix aspersa, Helix rufescens, etc.).

Both slugs and snails are very troublesome in damp or shady gardens, doing a considerable amount of damage to choice plants.

The following are among the many remedies which may be tried :—

(1) Cleanliness in the garden, destroying all rubbish, etc., which might afford shelter.

(2) Deep autumn cultivation of the soil.

(3) Hand-picking at night, especially after rain.

(4) Trapping by means of cabbage or rhubarb leaves, or with boards laid near their haunts. These should be examined daily in order that the pests may be destroyed.

(5) Sharp sand, soot, salt, wood ashes, charcoal dust, or granite chips placed round the plants, or lime put down two or three nights in succession, has proved effectual. One dusting of lime is not sufficient to kill slugs, but two or three applications will destroy them before they have had time to renew their coats.

(6) Strong lime or salt water may be effective under certain conditions.

(7) Collars of zinc placed round valuable plants will afford protection, as snails will not crawl over zinc.

(8) Ducks and birds are fond of these creatures, and will devour large numbers of them. Slow-worms and frogs will also eat slugs readily.

(9) Several preparations on the market, *e.g.* "Slugene," "Slug-death," "Slugicide," "Naptho-Nicotyl," "Vaporite," "Apterite," etc., are useful in killing slugs and snails.

Worms on lawns may be dislodged by using lime water, or Sutton's or Carter's wormkiller.

Rabbits and Hares.

These animals should, if possible, be kept out of garden and fruit plantations with the aid of wire netting. Where this is not possible the trunks of the trees may be treated with a wash in which equal parts of lime, cow manure, and clay have been mixed, and a little assafoetida (a strong-smelling substance obtainable from chemists) added. The wash should be applied with a tar brush. The use of some substance such as bitter aloes or bitter apple (*Colocynth*) in powder mixed with clay is worthy of a trial.

The following preparation, which lasts about twelve months, is also effective:—

Take half a bucketful of clay and mix with linseed oil until the clay has dissolved into a paintlike consistency. Then add 1 lb. of soda and 1 lb. of lime, thoroughly mix the whole, and apply the preparation by means of an ordinary paint brush.

Ordinary lime wash or a special preparation known as "Smearoleum" may be used, or old sacking, bands of paper, wire netting, or straw placed round the trunks to prevent rabbits and hares eating the bark.

These pests are very troublesome to fruit trees when the ground is covered with snow.

CHAPTER XXI.

PLANT DISEASES CAUSED BY FUNGI.

Preliminary Observations.

Plants, like animals, are often attacked by some fungoid disease, and in this respect cultivated plants are more susceptible than wild plants. There are many kinds of diseases known, but only a few of the more common will be noted here.

Diseases proper are due to the attack of fungi which belong to a low type of plant life and are mostly microscopic in structure.

Some fungi—termed saprophytic fungi—live on dead or decaying matter, and are quite harmless to living plants. Examples of this class are found in mushrooms, toadstools, etc.

On the other hand, those fungi which attack and live upon living plants, *e.g.* rusts, smuts, mildews, moulds, etc., are known as parasitic fungi, as they are harmful to the higher types of plants.

Parasitic fungi are very minute and only visible when they occur in masses. They are usually present long before we suspect them, by which time great damage to the plants attacked may have resulted.

Fungi produce spores which are analogous to seeds of the higher plants, in so far as the capability of reproducing their species is concerned. The spores are very minute and may be carried by wind or by insects to other plants, thus setting up fresh areas of infection. Under favourable conditions the spores germinate and the disease spreads rapidly unless checked by some preventive measure. When the fungus has permeated the tissues and is well fed, it produces fruit, and usually kills the host plant.

Reproduction of fungi.

Fungi reproduce themselves by two, three, or even four methods.

In the case of rose mildew (*Sphærotheca pannosa*) the disease is carried over the winter on the stems and fruits (hips) of the rose trees, and in this connection many small black patches may be observed on the rose stems. Hence the necessity of hard pruning—the prunings being carefully burnt—where rose mildew has been troublesome. The spores of rose mildew are produced from these dark patches in the spring, and carried on to the young delicate leaves and shoots by cold draughts. The fungus rapidly covers the surface of the leaves and shoots and soon produces fruit (spores), which are in turn blown on to all the plants in close proximity.

The sclerotia disease of lilies, snowdrops, crocus, cucumbers, melons, tomatoes, potatoes, beans, onions, etc., behaves as follows :—

1*st stage* or summer condition as seen on the leaves or flower buds.

2*nd stage*. The mycelium of the disease, *i.e.* the fungus plant, permeates the stems, bulbs, or tubers, forming small lumps which at first are white, and then black. These lumps are the sclerotia or resting stage of the disease.

3*rd stage*. After a season of rest, and under favourable conditions, the sclerotia start into growth with the growing bulb or stem, or form wine-glass-like structures containing spores.

Diseases may be encouraged or brought about by faulty methods of cultivation, such as overcrowding, insufficient light, improper watering, improper ventilation, too much or too little heat, unsuitable climate, unsuitable soil, over-manuring, etc.

Diseased plants should not be utilised for purposes of propagation, nor should the seeds of diseased hollyhocks or tomatoes be sown, in case the disease be perpetuated in this manner. All diseased bulbs and plants should be burnt, as it is useless throwing them on the manure or rubbish heap, or even feeding them to animals, as this is not sufficient to kill the spores.

With regard to fungi which live in the soil, *e.g.* sclerotia diseases, club-root or finger-and-toe disease, warty disease of potatoes, etc., (*a*) all diseased plants should be burnt, (*b*) a change of crop should be practised, and (*c*) the infected soil treated with lime or some other substance.

Those diseases which attack the leaves of plants, *e.g.* potato disease or blight, leaf mildews, and rusts on carnations, hollyhocks, chrysanthemums, etc., may be kept in check by burning the most badly attacked leaves, and spraying or dusting the plants with a good fungicide in order to kill all spores that may alight on the plants—a preventive measure rather than a cure.

Fungicides, *i.e.* fungus killers or remedies against attacks of plant diseases.

Bordeaux mixture.

Copper sulphate 2 lb., quicklime (fresh burnt) 2 lb., water 20 gallons.

Method of mixing:—Dissolve the copper sulphate in a tub (metal vessels must *not* be used) in a small quantity of water. Mix the lime also with a small quantity of water—in a separate vessel—until a milky liquid is formed. Then add the two solutions together, and afterwards make up with water to 20 gallons. When using keep the lime in suspension by stirring occasionally.

Note. The copper sulphate should be pure (98 per cent. purity). It is also known as blue vitriol, blue copperas, and bluestone, and is sold at about 3d. per lb. or 28s. per cwt.

Bordeaux mixture is now obtainable in powder form from various dealers.

Bordeaux mixture made with lime water.

A method of manufacturing Bordeaux mixture which much reduces the cost of spraying is recommended in the "Eighth Annual Report on the Woburn Fruit Farm."

Dissolve 6 lb. 6½ oz. copper sulphate in two or three gallons of water by suspending in a piece of sacking. Take two or three pounds of good quicklime, place in 120 gallons of soft water, stir up at intervals, then allow the fluid to become quite clear. Run off 86 gallons of the clear fluid into the copper sulphate solution, mix, and make up to 100 gallons with soft water. The lime water method of manufacturing Bordeaux mixture has been in use in Italy since 1886, but in France and America the use of milk of lime is preferred.

In manufacturing Bordeaux mixture by the lime water method, the potassium ferrocyanide test is not needed if the proper quantities of copper sulphate and lime water are used. Further, the method is less dependent on the quality of the lime available, and where an abundance of soft water can be procured potato growers should find it satisfactory.

Burgundy mixture.

Copper sulphate 2 lb., washing soda (pure) 2½ lb., water 10 gallons.

This is prepared in a similar manner to Bordeaux mixture, and is generally used for the same purposes.

Copper sulphate solution.

Copper sulphate 2 lb., water 20 gallons. For apple and pear scab this may be applied as a winter spray.

Iron sulphate solution.

Iron sulphate 25 lb., sulphuric acid 1 pint, water 50 gallons.

Mix the iron sulphate and sulphuric acid together and then add to the stated quantity of water in a wooden vessel.

This solution is also for use as a winter spray for the destruction of the resting spores of apple scab, etc., and must not be used on leaves, flowers, or fruits.

Iron sulphate is also known as ferrous sulphate and green vitriol, and costs about 4d. per lb.

Iron sulphate in a fine powder is used for destroying soil fungi such as sleeping disease of tomatoes, diseases of sweet peas, etc.

Potassium sulphide (*liver of sulphur or sulphuret of potassium*).

Potassium sulphide 2 oz., water 5 gallons. Dissolve the potassium sulphide in half a gallon of hot water, and then make up to 5 gallons by adding cold water. It should be kept in well-stoppered bottles until required for use, and it should be noted that it discolours white paint.

Potassium sulphide is a popular remedy for all rusts and mildews.

Flowers of sulphur.

For mildews and other superficial fungi flowers of sulphur may be dusted on the foliage, applied by means of bellows, or mixed with water and sprayed on the plants.

Mixed with milk it may be painted on the hot water pipes to create sulphurous fumes.

Lime.

Lime (burnt lime in a fine powder) is sometimes applied as a fungicide, but is more suitable for use as an insecticide.

Diseases of vegetable crops.

Club root or finger-and-toe (Plasmodiophora brassicae).

This fungus, which attacks turnips, cabbages, etc., is capable of existing in the soil for several years without the presence of a host plant. The writer has found that practically all members of the cabbage family (*Cruciferae*) may be attacked by this disease if grown on infected soil. Turnip, cabbage, kale, cauliflower, radish, mustard, cress, wallflower, honesty, candytuft, etc., and such weeds as shepherd's purse, charlock, and wild radish (runch) are all attacked, hence the importance of keeping infected land clear of such crops and weeds whilst attempting to destroy the fungus by liming (gas lime or burnt lime) or some other method of soil sterilisation (see page 78).

The use of pig manure encourages this disease in the soil.

Remedies and preventives:—

(*a*) Quicklime applied in autumn at the rate of 1 to 2 tons per acre, after the crop affected has been removed.

(*b*) A complete change of crop when planting the infected piece of land again.

(*c*) Avoid the use of pig manure and acid manures such as superphosphate.

(*d*) Basic slag and potash give good results.

(*e*) When planting, dip the roots of cabbage or cauliflower plants in a puddle made by mixing clay or soil with soot and sulphur.

Potato disease (Phytophthora infestans).

The well-known potato blight may be kept in check by spraying with Bordeaux mixture. (See Leaflet No. 23 issued by the Board of Agriculture.)

Potato wart disease or black scab (Synchytrium endobioticum).

No cure has yet been discovered for this terrible disease which threatens to overrun the whole country. It is noteworthy that this disease is most prevalent in cottage and allotment gardens, due probably to continuous cropping of potatoes on the same piece of land, neglecting to destroy any diseased tubers, and receiving "seed" in exchange which may have been grown on infected land.

Preventive measures which may be adopted:—

(*a*) Good clean cultivation.

(*b*) Burn diseased crop or boil before feeding to pigs.

(*c*) Liming the soil.

(*d*) Change the potato crop for some other as recommended under club root.

(*e*) Grow those varieties of potatoes least liable to attack, *e.g.* Aberlady Early, Abundance, Conquest, Crofter, Golden Wonder, Langworthy, Peacemaker, Provost, Sutton's Discovery, and What's Wanted.

(*f*) The use of night soil and ashes favours the disease.

This disease is still under investigation by the Board of Agriculture and various agricultural colleges.

Potato leaf-curl (Macrosporium solani).

This disease, which is due to a soil fungus, causes the haulm to be stunted, and the leaves turn yellow and curl. In such cases the crop is very light and scarcely worth lifting.

Where the disease has occurred a fresh supply of seed tubers should be obtained, and the infected land given a dressing of lime.

Potatoes should not be planted again on infected land until three or four years have elapsed.

Potato scab is caused by *Spongospora scabies* or by *Oospora scabies*, both of which attack the skin of the tuber during its growth in the soil. Scab is only a skin blemish and does not impair the cooking quality of the potato, but depreciates its market value.

These scab diseases must not be confused with the potato wart disease, which for a number of years after its appearance in Britain was known as black scab, a name which has since been discarded.

Ashes, sharp sand or lime in the soil, or very dry soil, appear to favour the production of scab by causing injury to the young growing tubers. Scab may also be caused by false wireworms or millipedes (*Julus pulchellus*) introduced to the land in leaf-mould or decaying vegetable matter. In the cases just mentioned the scab is due to mechanical injury, but should the soil be infected with the scab diseases referred to above there would be further danger of these gaining an entry.

Scabbed potatoes for planting may be immersed for two hours in a solution made by mixing one pint of commercial formalin with 36 gallons of water. The tubers should then be spread out to dry, when they may be cut and planted in the usual manner.

Powdered sulphur sprinkled in the drills before planting has given good results.

Acid manures, such as superphosphate, may be used in the case of this disease, and the application of 2 cwt. nitrate of potash per acre has also proved beneficial.

A change of crop is desirable on infected land. (See Board of Agriculture Leaflets Nos. 94, 137, and 232.)

Tomato black-rot.

This disease is said to be due to the same fungus (*Macrosporium solani*) which causes black-stripe of tomatoes and potato leaf-curl.

Too much heat and moisture in conjunction with insufficient ventilation may be the cause, or in any case will favour the disease.

All diseased parts should be removed and burnt, and more air given, after which the remaining plants may be sprayed with potassium sulphide.

Sleepy disease (droop or wilt disease) of tomatoes (Fusarium lycopersici).

The roots are the first to be attacked, and then the leaves suddenly droop and the tomato plant dies.

All infected plants should be lifted and burnt as soon as the disease is noticed.

Fresh soil, or a change of crop, is desirable, and the infected soil should be treated with lime or some other substance in order to sterilise it.

Seeds from plants which have been attacked by this disease are supposed to transmit the disease to the seedlings.

As a preventive measure sturdy short-jointed plants only should be planted, and plenty of air and space afforded them. The house and plants should be sprayed with a fungicide, such as potassium sulphide or weak Bordeaux mixture.

Tomato leaf mould or yellow spot (Cladosporium fulvum).

This fungus attacks the leaves of the tomato much in the same manner as the potato blight attacks the potato in some seasons. Too much warmth and moisture coupled with insufficient ventilation favours this disease.

All leaves showing signs of the disease should be burnt, more air and space given each plant, and less moisture afforded. The plants should, if possible, be watered in the mornings, in order that the atmosphere of the house may become dry before night.

The plants may be sprayed in the early stages of their growth with dilute Bordeaux mixture or potassium sulphide.

Tomato rot or bacterial disease (Bacillus solanacearum). The fungus enters the young fruit by means of the style, causing at a later stage the decay of the fruit.

Insects are likely to carry the disease, so should be excluded from tomato houses so far as it is practicable.

Firm growth should be encouraged by a proper amount of heat, light, and air.

All infected fruits should be burnt.

Pea mildew (Erysiphe Martii).—Pea mildew is a white powdery fungus occurring at times on the haulms and leaves of green peas, especially during hot, dry weather, and when they are grown on poor soil. The plants should receive a good soaking of water, and be syringed in addition. Spraying, or dusting, witlr sulphur might be tried in extreme cases.

Onion mildew (Peronospora Schleideni).—This disease is sometimes common on spring sown onions. In case of an attack the plants may be dusted with a mixture of 2 parts lime and 1 part sulphur when the leaves are damp, or they may be sprayed with potassium sulphide.

Onion smut (Urocystis cepulae).—This smut occurs in some districts, but may be controlled by sprinkling the seed with formalin solution (1 pint to 30 gallons of water) after it is sown in the drills.

Parsley, parsnip, and celery brand or leaf rust (Puccinia bullata, syn. P. apii).—Pale, wart-like, swollen spots on the leaves indicate the presence of this fungus.

All leaves showing signs of the disease should be picked off and burnt, and the plants sprayed with dilute Bordeaux mixture.

Broad bean rust (Uromyces fabae).—The rust occurs on the leaves of the bean plant, having passed the winter on vetches or other leguminous plants.

The plants may be sprayed with potassium sulphide, and the haulm burnt immediately after the pods have been gathered.

Mint rust (Puccinia menthae).—This disease is prevalent when the soil becomes very dry, and on soils deficient in lime.

Mint should be grown in a good open situation, and plants or cuttings obtained from a healthy stock.

Diseases of fruit trees and bushes.

Apple scab (Fusicladium dendriticum), Fig. 82.

Apple scab is a disease which attacks the fruit of the apple, forming small scab-like patches which harden the skin, sometimes causing the apple to crack and develop unevenly. During the winter the disease may exist on fallen apples and on the twigs of the apple tree. In the spring the spores are produced and carried to the young leaves, and finally to the fruit.

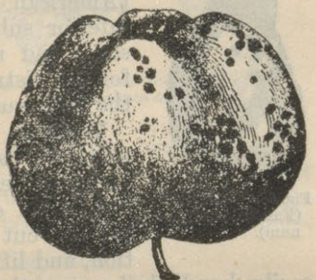


Fig. 82.—Apple Scab (Fusicladium dendriticum).

All fallen or badly scabbed fruit should be burnt, and close or hard pruning adopted in the case of diseased trees; after this burn carefully all prunings and rubbish generally. After pruning, and whilst the trees are still dormant, they may be sprayed with a strong fungicide, such as copper sulphate solution or iron sulphate solution, to kill the winter or resting spores of the fungus. As an additional precaution three sprayings with dilute Bordeaux mixture should be given at the following periods:—

(1) When the buds begin to expand.

(2) When the petals are falling.

(3) When the fruit has attained the size of a pea.

In bad cases it may be desirable to root up the trees and burn them.

Pear scab (Fusicladium pirinum), Fig. 83.

Pear scab is very similar to apple scab in its mode of attack, and may be treated in the same manner as recommended above.

Canker disease (Nectria ditissima).

Canker is a wound parasite attacking apple branches, ultimately eating through and causing the death of the shoots or branches. This disease can only effect an entrance to the tree through some injury caused either by severe pruning, gun shots, frosts, or an attack of woolly aphis (American blight). Cold poor soil, an inferior subsoil, deep planting, bad seasons, and unsuitable varieties of apples for the district are other factors rendering the trees susceptible to attack.

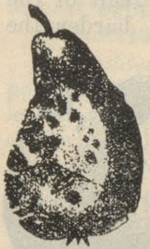


Fig. 83.—Pear Scab (Fusicladium pirinum).

There is no absolute cure known; the most we can do is to destroy all very badly cankered trees, hard prune cankered boughs in others, and carefully paint or tar the cut surfaces to prevent re-infection, and lift and replant such trees as are easily handled, keeping the roots near the surface. If the trees cannot be lifted the application of suitable manures such as a mixture of superphosphate, sulphate of potash, and sulphate of ammonia as a top-dressing, or liberal treatment with farmyard or liquid manure, will encourage surface roots. Care in pruning, good surface cultivation, drainage, burning all diseased branches, and attention to suitable varieties are matters to be considered when canker makes its appearance (see Fig. 77, p. 242).

Gooseberry mildew (Microsphaera grossulariae).

Sometimes described as the European gooseberry mildew to distinguish it from the more virulent disease known as American gooseberry mildew. The former attacks the upper surface of the leaves, causing them to assume a whitish appearance, but does very little damage and may be checked by spraying with potassium sulphide or dusting the plants with sulphur and lime.

American gooseberry mildew (Sphaerotheca mors-uvae), Fig. 84. Since its appearance in Ireland a few years ago this disease has been found in several of the southern and eastern counties of England. This, in common with many other diseases, is not easily eradicated from a plantation. The fungus not only attacks the young twigs and leaves, but also the fruit, rendering it quite unfit for market. The disease is supposed to have been spread from district to district by means of returned empties. A careful watch should be kept for the disease, destroying any bush or fruit attacked and spraying the bushes with potassium sulphide. Close pruning of the young shoots and burning the prunings has been strongly recommended.

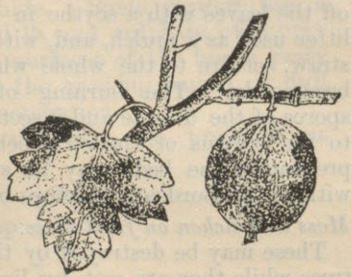


Fig. 84.—American Gooseberry Mildew (Sphaerotheca mors-uvæ).

Raspberry spot (Gloeosporium venetum).

On the canes and leaves of raspberries this fungus forms little red spots, which, becoming confluent, produce irregular blotches having a red margin. The canes so attacked die in the second season.

Remedial measures will consist of burning all diseased leaves and canes, and then spraying the remaining canes in the winter with sulphate of iron solution, before growth commences. The foliage may afterwards be sprayed with dilute Bordeaux mixture.

Strawberry mildew (Sphaerotheca humuli).

This fungus is similar to the mildew which atttacks the hop. The mildew spreads to the fruits as well as the leaves, spoiling their colour, and giving them a sickly appearance.

Spraying the plants with potassium sulphide will check the disease.

Damp shady positions favour the spread of this fungus.

Strawberry leaf spot (Sphaerella fragariae).

Circular reddish-brown spots on the leaves of strawberries are an indication of the presence of this disease.

In the case of a severe attack it will be advisable to cut off the leaves with a scythe in the autumn, shake up the litter used as a mulch, and, with the addition of more dry straw, set fire to the whole when the mown leaves have become dry. The burning of the leaves destroys the spores of the disease and insects, whilst causing no injury to the crowns of the strawberry plants. As a further precaution the beds may be sprayed two or three times with dilute Bordeaux mixture before the flowers open.

Moss and lichen on fruit trees.

These may be destroyed by throwing dry lime over the trees while they are wet, by lime washing, or by spraying with lime.

The "winter wash" or caustic soda wash will be found useful for this purpose, and will destroy in addition many insects on the trunks of the trees. These remedies are all applied during the dormant season.

Crown gall.

This gall occurs on various kinds of fruit trees, fruit bushes, roses, etc., and is caused by a bacterium (*Bacillus tumefaciens*), which probably gains an entry to the root or stem as the result of some injury to the bark by frost, etc. Badly attacked plants should be dug up and burnt, and an application of lime given to the soil before planting again. Where the attack is slight the galls may be cut away and the wounds covered with a paste composed of sulphate of iron 1 part, sulphate of copper 2 parts, and quicklime 3 parts.

Diseases of flowers.

Hollyhock rust (Puccinia malvacearum).

Rose rust (Uredo rosae).

Chrysanthemum rust (Puccinia chrysanthemi).

Carnation rust or mould (Helminthosporium echinatum).

The above rusts occasionally appear in gardens, and in this connection it must be remembered that these diseases may also occur on other plants closely related to the ones in question. All leaves showing signs of attack should be picked off and burnt, and the plants then sprayed with Condy's fluid or potassium permanganate, dilute Bordeaux mixture, or potassium sulphide. Some growers use a mixture of tobacco powder 1 lb. and sulphate of copper $\frac{1}{4}$ oz. for dusting the under surfaces of the leaves every two or three weeks during the growing season, a dull still day being chosen for the operation.

An effective spray mixture may be prepared as follows:—

Sulphur	$\frac{1}{2}$ lb.
Soft soap	$\frac{1}{2}$ lb.
Soot	$\frac{1}{2}$ lb.
Lime	$\frac{1}{2}$ lb.
Paraffin	$\frac{1}{2}$ pint.

Boil the sulphur, soap, soot, and lime together in a gallon of water for half an hour, then add the paraffin, and allow the whole to simmer for about two minutes. The mixture should then be allowed to stand until it becomes clear, when it may be placed in bottles and used as required at the rate of $\frac{1}{4}$ pint to 1 gallon of water, or stronger in the case of a bad attack.

Chrysanthemum mildew (Oidium chrysanthemi) *and Rose mildew* (Sphaerotheca pannosa).

Various causes, such as dryness at the root, cold draughts, or a damp close atmosphere, favour the above and other fungi of a similar nature.

Good cultivation, careful watering and ventilation, and allowing sufficient space for the plants may do much to keep these diseases in check.

All infected leaves should be removed and burnt, attention to this matter being especially desirable in the autumn.

Plants attacked may receive a dusting of sulphur over the leaves, or by painting the hot-water pipes with sulphur and milk the same result will be attained.

Spraying with potassium sulphide, or carbolic soap

(Lifebuoy), ½ lb. to 3 gallons of water, are both effective remedies.

Damping-off fungus (Pythium).

Seedlings of asters, stocks, cress, tomatoes, cucumbers, etc., when grown in a close moist hotbed or propagating-house, are sometimes attacked by this fungus.

Under the conditions referred to the disease creeps along, or makes its appearance on the surface of the soil, and attacks the young sappy seedlings, causing them to topple over, after which they never recover. The conditions must be altered immediately to check the disease and save the other seedlings. This may be effected by admitting more air and light, withholding water, and placing the pot or pan of seedlings near the glass.

Diseases of lilies, snowdrops, hyacinths, gladioli, etc., caused by species of Botrytis, are not easily destroyed, the mycelium of the fungus having penetrated the bulbs. By isolating healthy plants and spraying or dusting them with sulphur, and burning all badly diseased stock, the diseases may be overcome.

Streak disease (Thielavia basicola) of sweet peas and many other plants. The above-named fungus is perhaps not a true parasite, but only attacks plants weakened by unhealthy conditions such as over watering, insufficient drainage, and careless application of manure to the soil. The manure should be well decomposed and thoroughly incorporated with the soil some time before planting or sowing.

CHAPTER XXII.

COMMON WEEDS OF CULTIVATION.

A weed may be described as "any useless or troublesome plant," the term being also applicable to a plant growing in the wrong place.

Many persons regard all wild plants as weeds, but this is scarcely a correct view to take of all our native flowering plants, of which there are between 2,000 and 3,000 kinds known, including varieties. Those scarce in one district may be common in another, and may occur among crops on cultivated land, causing no little trouble to farmers and gardeners. No sharp line of demarcation can be drawn between wild plants on the one hand and weeds on the other.

It is important that teachers of school gardening should know some of the common weeds of cultivation, and accordingly a list of these is given on pages 293-298.

Weeds show a distinct preference for certain classes of soils, and, to a lesser extent, seem to be associated with certain crops. The latter is probably due to the different methods of cultivation required by various crops, and also to the source of the seed sown. There are a certain number that are commoner in gardens, and others found more frequently in cornfields than elsewhere. It must be understood, however, that weeds are by no means confined or restricted, in all cases, to particular formations or localities. Competition with other plants has also to be taken into account, as plants do not always occur where they might grow best, but where they are able to compete successfully with others.

For methods of destroying weeds see tillage operations, hoeing, weeding, etc., page 87.

Spraying with solutions of the sulphates of iron and copper is now adopted in the case of many troublesome cornfield weeds, some of which may be destroyed and others crippled.

* Charlock, runch, persicaria, and spurrey may be killed by spraying with a four to five per cent. solution of copper sulphate, while the following weeds are more or less crippled and seeding largely prevented by spraying with a five per cent. solution of copper sulphate, or a fifteen per cent. solution of sulphate of iron:—Poppy, corn cockle, black bindweed, dock, groundsel, dandelion, perennial sow-thistle, thistles, and coltsfoot.

* For the botanical names of weeds mentioned see special list.

(A) Weeds Characteristic of Common or Ordinary Soils (Loams) Under Cultivation.

(a = annual, b = biennial, p = perennial.)

Common Name.	Botanical Name.	Natural Order.	Colour of Flower.	Duration.
Fool's parsley	*Aethusa Cynapium*	*Umbelliferae*	white	a
Scarlet pimpernel	*Anagallis arvensis*	*Primulaceae*	scarlet	a
Red bartsia	*Bartsia Odontites*	*Scrophulariaceae*	purplish	a
Shepherd's-purse	*Capsella Bursa-pastoris*	*Cruciferae*	white	a
Creeping field thistle	*Carduus arvensis*	*Compositae*	purple	p
Mouse-ear chickweed	*Cerastium vulgatum*	*Caryophyllaceae*	white	a
Flax dodder	*Cuscuta Epilinum*	*Convolvulaceae*	yellow pink	a
Heath ,,	,, *Epithymum*	,,	,,	a
Great ,,	,, *europaea*	,,	,,	a
Clover ,,	,, *Trifolii*	,,	,,	a
Sun spurge	*Euphorbia Helioscopia*	*Euphorbiaceae*	yellow	a
Petty ,,	,, *Peplus*	,,	,,	a
Hemp-nettle	*Galeopsis Tetrahit*	*Labiatae*	pink	a
Goose-grass or cleavers	*Galium Aparine*	*Rubiaceae*	white	a
Herb-Robert	*Geranium Robertianum*	*Geraniaceae*	red	a
Henbit	*Lamium amplexicaule*	*Labiatae*	,,	a
Red dead-nettle	,, *purpureum*	,,	,,	a
Toadflax	*Linaria vulgaris*	*Scrophulariaceae*	yellow	p
Wild chamomile	*Matricaria Chamomilla*	*Compositae*	white	a
Field mint	*Mentha arvensis*	*Labiatae*	lilac	p

(A) Weeds Characteristic of Common or Ordinary Soils (Loams) Under Cultivation—*continued.*

(a = annual, b = biennial, p = perennial.)

Common Name.	Botanical Name.	Natural Order.	Colour of Flower.	Duration.
Field forget-me-not	*Myosotis arvensis* ...	*Boraginaceae* ...	blue	a
Ribwort plantain	*Plantago lanceolata* ...	*Plantagineae* ...	greenish	p
Greater ,, ...	,, *major* ...	,, ...	,,	p
Annual meadow-grass	*Poa annua*	*Gramineae* ...	—	a
Knotgrass	*Polygonum aviculare*	*Polygonaceae* ...	white or pink	a
Black bindweed or climbing buckwheat	,, *Convolvulus*	,, ...	greenish	a
Persicaria or red shank	,, *Persicaria*	,, ...	red	a
Creeping crowfoot or buttercup ...	*Ranunculus repens* ...	*Ranunculaceae*	yellow	p
Runch or wild radish	*Raphanus Raphanistrum*	*Cruciferae* ...	,,	a
Groundsel	*Senecio vulgaris* ...	*Compositae* ...	,,	a
Black nightshade	*Solanum nigrum* ...	*Solanaceae* ...	white	a
Sow-thistle	*Sonchus oleraceus* ...	*Compositae* ...	yellow	a
Perennial sow-thistle	,, *arvensis* ...	,, ...	,,	p
Chickweed	*Stellaria media* ...	*Caryophyllaceae*	white	a
Couch-grass	*Triticum repens* ...	*Gramineae* ...	—	p
Coltsfoot	*Tussilago Farfara* ...	*Compositae* ...	yellow	p
Annual stinging-nettle	*Urtica urens*	*Urticaceae* ...	green	a
Ivy-leaved speedwell	*Veronica hederaefolia*	*Scrophulariaceae*	blue	a

(B) Weeds Characteristic of Light or Sandy Soils Under Cultivation.

(a = annual, b = biennial, p = perennial.)

Common Name.	Botanical Name.	Natural Order.	Colour of Flower.	Duration.
Common mayweed	*Anthemis Cotula* ...	*Compositae* ...	white	a
Fat hen or goosefoot	*Chenopodium album* ...	*Chenopodiaceae* ...	green	a
Corn marigold	*Chrysanthemum segetum*	*Compositae* ...	yellow	a
Horsetail or pipeweed	*Equisetum arvense* ...	*Equisetaceae* ...	—	p
Scentless mayweed or corn feverfew	*Matricaria inodora* ...	*Compositae* ...	white	a
Long-headed poppy	*Papaver dubium* ...	*Papaveraceae* ...	red	a
Field poppy	,, *Rhoeas* ...	,, ...	,,	a
Sheep's sorrel	*Rumex Acetosella* ...	*Polygonaceae* ...	reddish	p
Knawel	*Scleranthus annuus* ...	*Illecebraceae* ...	greenish	a
Spurrey or yarr	*Spergula arvensis* ...	*Caryophyllaceae* ...	white	a
Sand spurrey	*Spergularia rubra* ...	,, ...	pink	a or b
Field speedwell	*Veronica agrestis* ...	*Scrophulariaceae* ...	blue	a
Wild pansy or heartsease ...	*Viola arvensis*	*Violaceae*	yellowish	a

(C) Weeds Characteristic of Calcareous (Chalky) Soils Under Cultivation.

(a = annual, b = biennial, p = perennial.)

Common Name.	Botanical Name.	Natural Order.	Colour of Flower.	Duration.
White mustard	*Brassica alba*	*Cruciferae*	yellow	a
Charlock	,, *arvensis* ...	,, ...	,,	a
Fumitory	*Fumaria officinalis* ...	*Fumariaceae* ...	pink	a
Dove's-foot cranesbill	*Geranium dissectum* ...	*Geraniaceae* ...	red	a
Soft cranesbill	,, *molle* ...	,, ...	pink	a
Ploughman's spikenard	*Inula Conyza*	*Compositae* ...	yellow and purple	p
Corn gromwell	*Lithospermum arvense*...	*Boraginaceae* ...	white	a
White or evening campion ...	*Lychnis vespertina* ...	*Caryophyllaceae* ...	,,	p
Corn buttercup	*Ranunculus arvensis* ...	*Ranunculaceae* ...	yellow	a
Field scabious	*Scabiosa arvensis* ...	*Dipsaceae* ...	lilac	p
Shepherd's needle or Venus's comb	*Scandix Pecten-veneris*	*Umbelliferae* ...	white	a
Field madder	*Sherardia arvensis* ...	*Rubiaceae*	pink	a
Bladder campion	*Silene Cucubalus* (*S. inflata*)	*Caryophyllaceae* ...	white	p

(D) Common Weeds found in Hedgerows, Roadsides, etc., and which sometimes give trouble in the Garden or Field—chiefly of a Biennial or Perennial Character.

(a = annual, b = biennial, p = perennial.)

Common Name.	Botanical Name.	Natural Order.	Colour of Flower.	Duration.
Gout or bishop-weed	*Aegopodium Podagraria*	*Umbelliferae*	white	p
Yarrow or milfoil	*Achillea Millefolium*	*Compositae*	,,	p
Bent-grass	*Agrostis vulgaris*	*Gramineae*	—	p
Beaked parsley	*Anthriscus vulgaris*	*Umbelliferae*	white	b
Daisy	*Bellis perennis*	*Compositae*	,,	p
Soft brome-grass	*Bromus mollis*	*Gramineae*	—	a
Barren brome-grass	,, *sterilis*	,,	—	a
Hardhead	*Centaurea nigra*	*Compositae*	pink	p
Rough chervil	*Chaerophyllum temulum*	*Umbelliferae*	white	b
Ox-eye daisy or gowan	*Chrysanthemum Leucanthemum*	*Compositae*	,,	p
Lesser bindweed	*Convolvulus arvensis*	*Convolvulaceae*	white or pink	p
Greater ,,	,, *sepium*	,,	,,	p
Yorkshire fog	*Holcus lanatus*	*Gramineae*	—	p
White dead-nettle	*Lamium album*	*Labiatae*	white	p
Nipplewort	*Lapsana communis*	*Compositae*	yellow	a

(D) Common Weeds found in Hedgerows, Roadsides, etc., and which sometimes give trouble in the Garden or Field—chiefly of a Biennial or Perennial Character—*continued.*

(a = annual, b = biennial, p = perennial.)

Common Name.	Botanical Name.	Natural Order.	Colour of Flower.	Duration.
Corn cockle	*Lychnis Githago* ...	*Caryophyllaceae* ...	red	a
Dog's mercury	*Mercurialis perennis* ...	*Euphorbiaceae* ...	green	p
Ground ivy	*Nepeta Glechoma* ...	*Labiatae*	blue	p
Silverweed...	*Potentilla Anserina* ...	*Rosaceae*	yellow	p
Acrid or biting-buttercup ...	*Ranunculus acris* ...	*Ranunculaceae* ...	,,	p
Bulbous buttercup	,, *bulbosus* ...	,, ...	,,	p
Yellow rattle	*Rhinanthus Crista-galli*	*Scrophulariaceae* ...	,,	a
Sorrel	*Rumex Acetosa* ...	*Polygonaceae* ...	green	p
Curly dock	,, *crispus* ...	,, ...	,,	p
Common dock	,, *obtusifolius* ...	,, ...	,,	p
Ragwort	*Senecio Jacobaea* ...	*Compositae* ...	yellow	p
Dandelion	*Taraxacum officinale* ...	,, ...	,,	p
Stinging-nettle	*Urtica dioica*	*Urticaceae*	green	p
Wall speedwell	*Veronica arvensis* ...	*Scrophulariaceae* ...	pale blue	a
Germander speedwell	,, *Chamaedrys* ...	,, ...	bright blue	p
Common ,, ...	,, *officinalis* ...	,, ...	pale blue	p

CHAPTER XXIII.

TABLES OF COMMON AND BOTANICAL NAMES.

VEGETABLES, SALADS, AND HERBS (CULINARY AND MEDICINAL) ARRANGED ACCORDING TO THEIR FAMILIES (NATURAL ORDERS).

Cruciferae—*Cabbage Family.*

Vegetables :—	
Wild or seaside cabbage	*Brassica oleracea*
Cultivated cabbage	,, ,, *capitata*
Red or pickling cabbage	,, ,, ,, *rubra*
Savoy	,, ,, ,, *bullata*
Brussels sprouts	,, ,, ,, *gemmifera*
Kale, curly green, or borecole	*Brassica* ,, *acephala*
Kohl rabi or turnip-rooted cabbage	,, ,, *caulo-rapa*
Cauliflower	,, ,, *botrytis*
Broccoli	,, ,, ,,
Rape or colewort	,, *Napus*
Garden turnip	,, *Rapa*
Swede ,,	,, *Rutabaga*
Seakale	*Crambe maritima*
Salads :—	
American or land cress	*Barbarea praecox*
White mustard	*Brassica alba* (*Sinapis alba*)
Black or brown mustard	,, *nigra* (*Sinapis nigra* or *Brassica sinapioides*)
Cress	*Lepidium sativum*
Watercress	*Nasturtium officinale*
Radish	*Raphanus sativus*

Herbs :—

Horseradish	*Cochlearia Armoracia*

Portulaceae—*Purslane Family.*

Salads :—

Purslane	*Portulaca oleracea*

Rutaceae—*Rue Family.*

Herbs :—

Rue	*Ruta graveolens*

Leguminosae—*Pea and Bean Family.*

Vegetables :—

Scarlet runner bean	*Phaseolus multiflorus*
French, dwarf, or kidney bean	,, *vulgaris*
Garden or green pea	*Pisum sativum*
Broad bean	*Vicia Faba*
Horse or field bean	,, ,, *equina* (*syn. arvensis*)

Cucurbitaceae—*Melon and Cucumber Family.*

Vegetables and Salads :—

Cucumber	*Cucumis sativus*
Vegetable marrow	*Cucurbita Pepo*

Ficoideae—*Fig Marigold Family.*

Vegetables :—

New Zealand spinach	*Tetragona expansa*

Umbelliferae—*Parsley Family.*

Vegetables :—

Celery	*Apium graveolens*
Celeriac	,, ,, *rapacea*
Bulbous-rooted chervil	*Chaerophyllum bulbosum*
Carrot	*Daucus Carota*
Parsnip	*Peucedanum sativum* (*Pastinaca sativa*)

Herbs :—

Angelica	*Angelica Archangelica*
Chervil	*Anthriscus cerefolium* (*Chaerophyllum aromaticum*)

Caraway	*Carum Carvi*
Parsley	,, *Petroselinum* (*Petroselinum sativum*)
Coriander	*Coriandrum sativum*
Samphire	*Crithmum maritimum*
Fennel	*Foeniculum vulgare*
Sweet Cicely	*Myrrhis odorata*
Dill	*Peucedanum graveolens*
Aniseed	*Pimpinella Anisum*

Valerianaceae—*Valerian Family.*

Salads :—	
Italian corn salad	*Valerianella eriocarpa*
Corn salad or lamb's lettuce	,, *olitoria*

Compositae—*Daisy Family.*

Vegetables :—	
Cardoon	*Cynara Cardunculus*
Globe artichoke	,, *Scolymus*
Jerusalem artichoke	*Helianthus tuberosus*
Scorzonera	*Scorzonera hispanica*
Salsify or vegetable oyster	*Tragopogon porrifolius*
Salads :—	
Endive	*Cichorium Endivia*
Chicory	,, *Intybus*
Lettuce	*Lactuca sativa*
Dandelion	*Taraxacum officinale* (*T. Dens-leonis*)
Herbs :—	
Southernwood	*Artemisia Abrotanum*
Wormwood	,, *Absinthium*
Tarragon	,, *Dracunculus*
Mugwort	,, *vulgaris*
Marigold	*Calendula officinalis*
Costmary or sweetmary	*Chrysanthemum Balsamita* (*Balsamita vulgaris*)
Tansy	*Tanacetum vulgare*

Campanulaceae—*Bellflower Family.*

Salads :—	
Rampion	*Campanula Ranunculus*

Boraginaceae—*Borage Family.*

Herbs:—	
Borage	*Borago officinalis*

Solanaceae—*Potato Family.*

Vegetables and Salads:—	
Tomato	*Lycopersicum esculentum*
Potato	*Solanum tuberosum*

Labiatae—*Dead-nettle Family.*

Vegetables:—	
Chinese artichoke	*Stachys tuberifera*
Herbs:—	
Hyssop	*Hyssopus officinalis*
Lavender	*Lavandula vera*
Horehound	*Marrubium vulgare*
Balm	*Melissa officinalis*
Peppermint	*Mentha piperita*
Pennyroyal	,, *Pulegium*
Green or spear-mint	,, *viridis*
Bush basil	*Ocimum Basilicum*
Sweet basil	,, *minimum*
Sweet or knotted marjoram	*Origanum Majorana*
Pot marjoram	,, *Onites*
Common marjoram	,, *vulgare*
Rosemary	*Rosmarinus officinalis*
Sage	*Salvia officinalis*
Clary	,, *Sclarea*
Annual or summer savory	*Satureia hortensis*
Winter savory	,, *montana*
Common thyme	*Thymus Chamaedrys*
Lemon ,,	,, *citriodorus*
Garden ,,	,, *vulgaris*

Chenopodiaceae—*Goosefoot and Beet Family.*

Vegetables and Salads:—	
Spinach beet	*Beta Cicla*
Seakale beet or chard beet	,, ,, var.
Beetroot	,, *maritima vulgaris*

Wild spinach, Good King Henry, allgood, or Lincolnshire asparagus	*Chenopodium Bonus-Henricus*
Round or summer spinach	*Spinacia oleracea*
Prickly or winter spinach	,, ,, *spinosa*

Polygonaceae—*Knotweed and Rhubarb Family.*

Vegetables :—	
Rhubarb	*Rheum Rhaponticum*
Salads :—	
Common sorrel	*Rumex Acetosa*
Mountain ,,	,, *montanus*
French ,,	,, *scutatus*

Liliaceae—*Lily Family.*

Vegetables :—	
Shallot	*Allium ascalonicum*
Onion	,, *Cepa*
Potato onion	,, ,, var.
Welsh onion	,, *fistulosum*
Leek	,, *Porrum*
Garlic	,, *sativum*
Rocambole or sand leek	,, *Scorodoprasum*
Asparagus	*Asparagus officinalis*
Herbs :—	
Chives	*Allium Schoenoprasum*

Agaracineae (Fungi)—*Mushroom or Toadstool Family.*

Vegetables :—	
Meadow or horse mushroom	*Agaricus arvensis*
Field mushroom	,, *campestris*
Cultivated mushroom	,, ,, *hortensis*

THE PRINCIPAL FARM CROPS AND GRASSES, ARRANGED ACCORDING TO THEIR FAMILIES (NATURAL ORDERS).

Cruciferae—*Cabbage Family.*

White mustard	*Brassica alba* (*Sinapis alba*)
Rape	,, *Napus*
Turnip	,, *Rapa*

Swede	*Brassica Rutabaga*
Black mustard	,, *nigra* (*Sinapis nigra*)
Thousand-headed kale	,, *oleracea* var. *acephala*
Drumhead or cattle cabbage	,, ,, ,, *capitata*
Kohl rabi	,, ,, ,, *caulo-rapa*

Linaceae—*Flax Family.*

Flax or linseed	*Linum usitatissimum*

Leguminosae—*Bean and Clover Family.*

Soya bean	*Glycine Soja* (*Soja hispida*)
Lucerne or alfalfa	*Medicago sativa*
Sainfoin	*Onobrychis sativa* (*O. viciaefolia*)
Field pea	*Pisum sativum arvense*
Alsike clover	*Trifolium hybridum*
Crimson or Italian clover	,, *incarnatum*
Red clover	,, *pratense*
White or Dutch clover	,, *repens*
Fenugreek	*Trigonella Foenum-groecum*
Horse bean	*Vicia Faba equina*
Common vetch or tare	,, *sativa*

Umbelliferae—*Parsley Family.*

Sheep's parsley	*Carum Petroselinum*
Carrot	*Daucus Carota*

Solanaceae—*Potato Family.*

Tobacco	*Nicotiana Tabacum*
Potato	*Solanum tuberosum*

Chenopodiaceae—*Goosefoot Family.*

Sugar beet	*Beta Cicla*
Mangel	,, *maritima vulgaris*

Polygonaceae—*Knotgrass Family.*

Buckwheat	*Fagopyrum esculentum*

Urticaceae—*Nettle Family.*

Hemp	*Cannabis sativa*
Hop	*Humulus Lupulus*

Gramineae—*Grass Family.*

Cereal or Grain crops—grown for their seeds (fruits):—

Wild oat (a weed)	*Avena fatua*
Tartarian oat	,, *orientalis*
Common oat	,, *sativa*
Shetland or bristle-pointed oat (not much grown now)	,, *strigosa*
Two-rowed barley	*Hordeum sativum distichon*
Four-rowed barley or bere	,, ,, *vulgare*
Six-rowed barley	,, ,, *hexastichon*
Rice (in hot countries)	*Oryza sativa*
Rye (grown largely as a green crop)	*Secale cereale*
Wheat	*Triticum sativum vulgare*
Maize or Indian corn (in hot countries)	*Zea Mays*

Grasses for grazing or for hay:—

Marsh bent-grass	*Agrostis alba*
Fiorin-grass	,, ,, *stolonifera*
Common bent-grass	,, *vulgaris*
Meadow foxtail	*Alopecurus pratensis*
Tall oat-grass	*Avena elatior* (*Arrhenatherum avenaceum*)
Narrow-leaved oat-grass	*Avena pratensis*
Downy oat-grass	,, *pubescens*
Hungarian forage-grass or awnless brome-grass	*Bromus inermis*
Schrader's brome-grass	,, *Schraderi*
Crested dogstail	*Cynosurus cristatus*
Cocksfoot	*Dactylis glomerata*
New Zealand tall fescue	*Festuca arundinacea*
Hard fescue	,, *duriuscula*
Tall fescue	,, *elatior*
Various-leaved fescue	,, *heterophylla*
Sheep's fescue	,, *ovina*
Fine-leaved sheep's fescue	,, ,, *tenuifolia*
Meadow fescue	,, *pratensis*
Red fescue	,, *rubra*
Italian rye-grass	*Lolium italicum* (*multiflorum*)
Perennial rye-grass	,, *perenne*

Reed canary-grass	*Phalaris arundinacea*
Canary-grass	,, *canariensis*
Timothy or catstail	*Phleum pratense*
Annual meadow-grass	*Poa annua*
Wood meadow-grass	,, *nemoralis*
Smooth-stalked meadow-grass	,, *pratensis*
Rough ,, ,, ,,	,, *trivialis*
Yellow oat-grass	*Trisetum flavescens* (*Avena flavescens*)

Grasses of a weedy or less important nature:—

Tufted hair-grass	*Aira caespitosa*
Wavy hair-grass	,, *flexuosa*
Sweet vernal-grass	*Anthoxanthum odoratum*
Pearl-grass or bulbous oat-grass	*Arrhenatherum avenaceum* var. *bulbosum*
Heath false brome-grass	*Brachypodium pinnatum*
Wood ,, ,, ,,	,, *sylvaticum*
Rough brome-grass	*Bromus asper*
Soft ,, ,,	,, *mollis*
Rye ,, ,,	,, *secalinus*
Barren ,, ,,	,, *sterilis*
Yorkshire fog or soft-grass	*Holcus lanatus*
Creeping soft-grass	,, *mollis*
Wall barley	*Hordeum murinum*
Meadow barley	,, *pratense* (*nodosum*)
Crested koeleria	*Koeleria cristata*
Darnel rye-grass (poisonous)	*Lolium temulentum*
Purple molinia	*Molinia caerulea*
Mat-grass	*Nardus stricta*
Decumbent heath-grass	*Triodia* (*Sieglingia*) *decumbens*
Couch-grass or twitch	*Triticum repens* (*Agropyron repens*)

There are many other kinds of grasses found, more or less commonly in a wild state, for further particulars of which some good "British Flora" should be consulted.

Cultivated Fruits, arranged according to their Families (Natural Orders).

Ampelidaceae—*Vine Family.*

		Native Country.
Grape vine	*Vitis vinifera*	South Europe, West Asia, North Africa

Rosaceae—*Rose Family.*

Apple	*Pyrus Malus*	(Britain) Temperate Europe and Asia
Pear	,, *communis*	,,
Medlar	,, *germanica* (*Mespilus germanica*)	,,
Quince	*Cydonia vulgaris* (*Pyrus Cydonia*)	North Persia ?
*Sloe or black-thorn	*Prunus spinosa*	(Britain) Europe and North Asia
Wild plum and damson	,, *communis* (*P. domestica*)	Europe
Greengage	*P. communis* variety	
Bullace	*Prunus insititia*	(Britain) Europe, Orient
Myrobalan or cherry plum	,, *cerasifera*	Caucasus ?
Peach	,, *Persica* (*Persica vulgaris*)	China, etc.
Nectarine	*P. P.* var. *nectarina*	
Apricot	*Prunus Armeniaca*	North China, etc.
Almond	,, *Amygdalus*	South Europe, Levant, etc.
Wild cherry, mazzard, or gean	,, *Avium* (Gean, Heart, and Bigarreau vars.)	Europe, etc.
Morello cherry	*Prunus Cerasus* (Morello, Duke, and Kentish vars.)	Europe, etc.
Strawberry	*Fragaria vesca* (vars. and hybrids)	(Britain) Europe
Common blackberry or bramble	*Rubus fruticosus*	Europe

* Not cultivated.

		Native Country.
Cut-leaved or parsley-leaved bramble	*Rubus laciniatus*	Garden origin
Raspberry	,, *Idaeus*	Europe and West Asia
* Cloudberry, Roebuck berry, Mountain raspberry or bramble	,, *Chamaemorus*	(Britain) Europe (on mountains)
Japanese wine-berry	,, *phoenicolasius*	China and Japan
Loganberry	,, (hybrid between American raspberry and bramble)	

Saxifragaceae—*Rockfoil and Currant Family.*

Gooseberry	*Ribes Grossularia*	Northern Hemisphere
Black currant	,, *nigrum*	North Europe and North Asia
Red ,,	,, *rubrum*	Northern Hemisphere
White ,,	,, ,, var. *album*	

Cucurbitaceae—*Cucumber Family.*

Melon	*Cucumis Melo*	Tropics

Vacciniaceae—*Cranberry Family.*

American or large cranberry	*Oxycoccus macrocarpus*	North America
*Marsh whortle-berry or marsh cranberry	*Oxycoccus palustris* (*O. quadripetala*)	(Britain) Europe
*Bilberry, black whortleberry, or blaeberry	*Vaccinium Myrtillus*	,, ,,
*Great bilberry or bog whortle-berry	,, *uliginosum*	,, ,,
*Red whortle-berry or cow-berry	,, *Vitis-idaea*	,, ,,

* Not cultivated.

Ericaceae—*Heath Family.*

		Native Country.
*Alpine or black bearberry	*Arctostaphylos alpina*	(Britain) Europe
*Common or red bearberry	*Arctostaphylos Uva-ursi*	” ”

Urticaceae—*Nettle and Elm Family.*

Fig-tree	*Ficus Carica* var. *domestica*	Afghanistan, Eastern Persia
Mulberry	*Morus nigra*	Temperate Europe and Asia

Poisonous Plants.

A list of the principal kinds of plants which are poisonous will not be out of place here, as it is important for all connected with country life to be able to recognise most of these plants. When found growing in public places steps should be taken to destroy them.

The evidence that a particular plant is poisonous to stock is frequently of a very slight and often conflicting character. Some animals are more susceptible than others, the young being generally more easily affected than those of adult age. On the other hand some animals, especially in a wild state, appear to possess the power of discriminating between dangerous and innocuous plants.

Clippings of yew trees, box edging, Rhododendrons, and Azaleas, roots of scarlet runner beans, and other plants of a poisonous nature should not be thrown into ditches or any place accessible to animals, but should be burnt.

Aconite or monkshood	*Aconitum Napellus*
Wood anemone	*Anemone nemorosa*
Wild celery	*Apium graveolens*
Lords-and-Ladies	*Arum maculatum*
Deadly nightshade or Belladonna	*Atropa Belladonna*
Azalea	*Azalea mollis*, etc.
Box-tree	*Buxus sempervirens*
Cowbane or water hemlock	*Cicuta virosa*

* Not cultivated.

Meadow saffron	*Colchicum autumnale*
Hemlock	*Conium maculatum*
Monterey cypress	*Cupressus macrocarpa*
Yellow cypress	,, *nootkatensis*
Laburnum	*Cytisus Laburnum* (*Laburnum vulgare*)
Spurge laurel	*Daphne Laureola*
Mezereon	,, *Mezereum*
Thorn-apple	*Datura Stramonium*
Larkspur	*Delphinium Ajacis*
Foxglove	*Digitalis purpurea*
Sun spurge	*Euphorbia Helioscopia*
Caper ,,	,, *Lathyrus*
Petty ,,	,, *Peplus*
Henbane	*Hyoscyamus niger*
Savin	*Juniperus Sabina*
Acrid or wild lettuce	*Lactuca virosa*
Yellow vetchling	*Lathyrus Aphaca*
Indian peas or tares	,, *sativus*
Darnel rye-grass	*Lolium temulentum*
Lupin	*Lupinus luteus*, *L. albus*, etc.
Corn cockle	*Lychnis Githago*
Dog's mercury	*Mercurialis perennis*
Hemlock water dropwort	*Oenanthe crocata*
Horsebane	,, *Phellandrium*
Field poppy	*Papaver Rhoeas*
Opium poppy	,, *somniferum*
Herb-Paris	*Paris quadrifolia*
Cherry laurel	*Prunus Laurocerasus*
Buttercups	*Ranunculus*, several species
Lesser spearwort	,, *Flammula*
Celery-leaved crowfoot	,, *sceleratus*
Rhododendron	*Rhododendron ponticum*, etc.
Poison ivy or poison oak	*Rhus Toxicodendron*
Poison sumach	,, *venenata*
Bittersweet or woody nightshade	*Solanum Dulcamara*
Black nightshade	,, *nigrum*
Black bryony	*Tamus communis*
Yew	*Taxus baccata*
White hellebore	*Veratrum album*

Medicinal Plants.

Many medicinal plants are very poisonous, others being quite harmless. Care should, therefore, be exercised in using any plant whose properties are unknown to the user. Those of a poisonous nature—indicated by the letter **p**—are also included in the list of poisonous plants.

p.	Aconite or monkshood	*Aconitum Napellus*
	Parsley piert	*Alchemilla arvensis*
	Marsh mallow	*Althaea officinalis*
	Pasque-flower	*Anemone Pulsatilla*
	Chamomile	*Anthemis nobilis*
p.	Deadly nightshade or Belladonna	*Atropa Belladonna*
	Barberry	*Berberis vulgaris*
	Bryony	*Bryonia dioica*
	Celandine	*Chelidonium majus*
	Saffron	*Crocus sativus*
	Broom	*Cytisus scoparius*
p.	Thorn-apple	*Datura Stramonium*
p.	Foxglove	*Digitalis purpurea*
	Squirting cucumber	*Ecballium Elaterium*
	Gum-tree or Eucalyptus	*Eucalyptus Globulus*
	Eyebright	*Euphrasia officinalis*
	Fennel	*Foeniculum vulgare*
	Liquorice	*Glycyrrhiza glabra*
	Jalap	*Ipomoea Purga*
p.	Savin	*Juniperus Sabina*
	Common mallow	*Malva sylvestris*
	Pennyroyal	*Mentha Pulegium*
p.	Opium poppy	*Papaver somniferum*
	Solomon's seal	*Polygonatum multiflorum*
	Cascara sagrada	*Rhamnus purshiana*
	Turkey rhubarb	*Rheum officinale*
	Castor oil plant	*Ricinus communis*
	Damask rose	*Rosa damascena*
	Rue	*Ruta graveolens*
	Elder	*Sambucus nigra*

p = poisonous as well as medicinal.

	Dwarf elder	*Sambucus Ebulus*
	Blood-root	*Sanguinaria canadensis*
	Figwort	*Scrophularia nodosa*
p.	Bittersweet or woody nightshade	*Solanum Dulcamara*
	Comfrey	*Symphytum officinale*
p.	Black bryony	*Tamus communis*
	Dandelion	*Taraxacum officinale*
	Coltsfoot	*Tussilago Farfara*
p.	White hellebore	*Veratrum album*

p = poisonous as well as medicinal.

CHAPTER XXIV.

USEFUL TABLES.

Longevity of Garden Seeds (M. de Vilmorin).

	Mean.	Utmost Years.		Mean.	Utmost Years.
Angelica ...	1 or 2	3	Parsley ...	3	9
Bean	3	8	Pea, Garden ...	3	8
Beet	6	10	,, Field ...	3	8
Borecole ...	5	10	Pepper ...	4	7
Broccoli ...	5	10	Pumpkin ...	4 or 5	9
Cabbage ...	5	10	Radish ...	5	10
Carrot ...	4 or 5	10	Rhubarb ...	3	8
Cauliflower ...	5	10	Rosemary ...	4	?
Celery ...	8	10	Rue	2	5
Cress, Common	5	9	Sage	3	7
Cucumber ...	10	10	Salsify ...	2	8
Endive ...	10	10	Scorzonera ...	2	7
Gourds ...	6	10	Seakale ...	1	7
Kohl rabi ...	5	10	Spinach ...	5	7
Leek	3	9	Strawberry ...	3	6
Lettuce ...	5	9	Thyme ...	3	7
Maize... ...	2	4	Tomato ...	4	9
Mustard ...	4	9	Turnip ...	5	10
Onion... ...	2	7	Water-melon	6	10
Parsnip ...	2	4	Wormwood ...	4	6

Seed Tables.

(A) GARDEN CROPS.

	Required to Sow.		Seed required to Sow 1 Acre.
	Size of Plot.	Quantity of Seed.	
Asparagus ...	1 sq. yd.	½ oz.	4-5 lb.
Beans, Broad ...	Row 50 ft.	1 pt.	2-4 bush.
Beans, Kidney	Row 100 ft.	½ ,,	2-2½ ,,
Beans, Runner	Row 50 ft.	1 ,,	2-3 ,,
Beet	Row 50 ft.	1 oz.	5-7 lb.
Broccoli ...	Bed 4 sq. yd.	½ ,,	1 lb. transplanted
Brussels sprouts	Bed 4 sq. yd.	½ ,,	1 lb. ,,
Cabbage ...	6 sq. yd.	½ ,,	1 lb. ,,
Carrot	Drill 100 ft.	1 ,,	8-10 lb.
Cauliflower ...	Bed 4 sq. yd.	½ ,,	1 lb. transplanted
Celery	5 sq. yd.	½ ,,	5 oz. ,,
Cress	3 sq. yd.	1 ,,	2-3 lb. (water)
Endive	4 sq. yd.	½ ,,	1 lb. transplanted
Kale	4 sq. yd.	½ ,,	1 lb. ,,
Leek	5 sq. yd.	1 ,,	1 oz. for 1000 plants
Lettuce... ...	5 sq. yd.	¼ ,,	1 oz. for 1000 plants
Mushroom ...	7 sq. yd.	1 bush.	—
Mustard ...	3 sq. yd.	1 oz.	1 pk.
Onion	9 sq. yd.	1 ,,	10-15 lb.
Peas, Early ...	Row 50 ft.	1 pt.	3-4 bush.
Peas, Late ...	Row 80 ft.	1 ,,	2-3 ,,
Parsley... ...	Row 50 ft.	½ oz.	—
Parsnip... ...	Row 80 ft.	1 ,,	8-10 lb.
Potatoes ...	Row 50 ft.	½ pk.	12-18 cwt.
Radish	3 sq. yd.	1 oz.	8-12 lb. in drills
Savoy	5 sq. yd.	½ ,,	1 lb. transplanted
Spinach... ...	Drill 100 ft.	1 ,,	10-15 lb. drills
Turnip	4 sq. yd.	½ ,,	2-3 lb. drills

(B) FARM CROPS.

Quantities of Agricultural Seeds Required to Sow a Statute Acre.

Barley	3 bushels
Beans...	3 ,,
Beet	12 lb.
Broom	20 to 25 lb.
Buckwheat	2 bushels
Burnet	40 lb.
Cabbage, in beds for transplanting	1 lb.
,, drilled	4 to 6 lb.
Carrot	8 lb.
Chicory	8 lb.
Clovers, alone	16 lb.
,, with rye grass	12 to 14 lb.
,, and grasses mixed for permanent pastures, about	35 to 40 lb.
Clovers, crimson	25 lb.
Furze or gorse, for cover	20 to 25 lb.
,, ,, for feeding or mowing	35 to 40 lb.
,, ,, for single line for fencing, to sow one mile	3 to 4 lb.
Grasses and clovers for one year's ley	20 lb.
,, ,, ,, ,, two years' ,, ...	24 lb.
,, ,, ,, ,, three ,, ,, ...	32 lb.
Grass seeds for permanent pasture	40 lb.
,, ,, ,, temporary ,, ...	25 to 40 lb.
,, ,, ,, renovating ,, ...	10 to 20 lb.
Hungarian forage-grass	28 to 40 lb.
Kale, thousand-headed, in drills...	4 lb.
,, ,, ,, broadcast	12 lb.
Kidney vetch	25 to 30 lb.
Kohl rabi, in drills...	4 lb.
Linseed, for flax	$2\frac{1}{2}$ bushels
,, for seed	$1\frac{1}{2}$,,
Lucerne	20 to 25 lb.
Lupins	2 bushels

Maize...	1 to $1\frac{1}{2}$ bushels
Mangel wurzel	6 to 8 lb.
Mustard	20 to 25 lb.
Oats ...	3 to 4 bushels
Onion, for bulbing ...	10 lb.
,, for drawing green ...	15 lb.
Parsley, along with other seeds ...	1 lb.
Parsnip	8 lb.
Peas in drills 2 to 3 feet apart	2 to $2\frac{1}{2}$ bushels
Potatoes, rows 27 inches apart, sets $18\frac{1}{2}$ inches, averaging not less than $2\frac{1}{2}$ oz....	18 cwt.
Rape ...	16 lb.
Rye (if for straw plait, double) ...	$2\frac{1}{2}$ to 3 bushels
Rye-grass	3 bushels
Sainfoin, in husk	4 to 5 bushels
,, milled	56 lb.
Sorghum, drilled	15 lb.
,, broadcast	26 lb.
Sunflower	10 lb.
Sugar beet ...	12 lb.
Swede, in drills	3 to 4 lb.
Tares, winter	$2\frac{1}{2}$ bushels
,, spring	2 to $2\frac{1}{2}$ bushels
Turnip, in drills	3 to 4 lb.
Vetches, when sown alone	4 bushels
,, when sown with rye or oats ...	3 ,,
Wheat	$2\frac{1}{4}$ to $2\frac{1}{2}$ bushels

Some of the Principal Weights and Measures used for Fruit in Leading Markets.

	London.	Birmingham.	Liverpool.	Sheffield.	Manchester.	Glasgow.
Apples	Bushel of 56 lb.	By net weight 63 lb. (packages vary).	Pot. 64-72 lb. net.	In all kinds of packages at per cwt. of 112 lb.	Pot. 64-72 lb., or half sieve 28 lb. net.	Sleek 40 lb.
Currants ...	Per sieve of 5 gal.	By net weight 63 lb.	Pot. 63 lb., half pot. 32 lb., or half bush. 24 lb. net.	,, ,,	Half sieve 24 lb., half pot. 32 lb. net.	
Cherries	Half sieve 3½ imp. gal.	By net weight 63 lb.	Half bush. 24 lb.	,, ,,	,, ,,	
Gooseberries ...	Peck or sieve.	By net weight 63 lb.	Half bush. 24 lb., pot., and half pot.	,, ,,	Half sieves of 28 lb.	
Grapes	2 lb. and 4 lb. punnets.	Baskets 7-12 lb.	Baskets and per lb.	Per lb. or cwt.	Handle baskets of 7-12 lb.	
Pears	Bushel sieve.	Baskets 72 lb.	Pot. of 64-72 lb. net.	Per cwt.	Pots. and half pots. ; choice fruit half sieves of 28 lb.	,, 50 ,,
Plums	Sieve and half sieve.	Pecks or sieves, 12 lb. (if ripe).	Half bush. 28 lb., pots. and half pots. 72, 36 lb.	,,	Half pot. 36 lb., and half sieve 28 lb.	,, 60 ,,
Raspberries ...	Gallon basket, half sieve, and lb.	Pecks or sieves.	Baskets 12 and 6 lb. net, sieves 12-15 lb. net.	Per quart or cwt.	Half sieve 24 lb., and pecks 12 lb.	
Strawberries ...	Pottle, about 1 quart ; gallon baskets, etc.	Baskets, 1 gallon ; sieves.	Same as Raspberries.	Per lb. or per peck.	Peck 12 lb. net, and per lb.	

All kinds of fruits are sold by weight. The sleek or West of Scotland bushel now represents a fixed weight as tabulated.

Principal Covent Garden Weights and Measures.

Bundle.—Asparagus, from 100 to 150 heads. Celery and broccoli, 6 to 20, according to size. Seakale, 13 to 18, according to size. Rhubarb, 20 to 30 stems, according to size and season.

Bunch.—Carrots, 36 to 40. Turnips, 20 to 25. Greens, as many as can be tied together by the roots.

Bushel sieve = $10\frac{1}{2}$ imperial gallons, diameter $17\frac{3}{4}$ inches at top and $11\frac{1}{4}$ inches deep. Apples and pears are put in bushels, sieves, or half sieves, according to quality and nature of fruits.

Sieve.—A sieve of peas is equal to 1 bushel. A sieve of currants is equal to about 20 quarts. A sieve of cherries is equal to about 48 lb.

Half sieve.—Contains $3\frac{1}{2}$ imperial gallons, diameter averages $12\frac{1}{2}$ inches, and is 6 inches in depth.

Bushel basket.—Diameter at top $14\frac{1}{2}$ inches, at bottom 10 inches, depth 17 inches. Apples, pears, walnuts, and old potatoes are often measured by the bushel.

Bushel, flat.—Length 21 inches, width 16 inches, depth inside 10 inches.

Hand.—A hand of radishes varies from 12 to 30 according to the season.

Punnet.—Seakale punnets are 8 inches in diameter at the top, $7\frac{1}{2}$ inches at the bottom, and are 2 inches deep. Radish punnets are 8 inches in diameter and 1 inch deep. Mushroom punnets are 7 inches in diameter and 1 inch deep. Grapes are put up in 2 lb. and 4 lb. punnets ; new home-grown potatoes in 2 lb. punnets.

Pottle.—A long tapering basket holding rather more than $1\frac{1}{2}$ pint. A pottle of strawberries is supposed to contain a half gallon, but seldom holds more than $1\frac{1}{2}$ pint. A pottle of mushrooms should weigh 1 lb.

Tally.—A tally of cabbage is 5 dozen.

Score.—A score of lettuce is 22 heads.

BOOKS OF REFERENCE.

Many books have been published on horticulture, botany, chemistry, and nature study.

The following selection of books the author believes will be found useful to those desiring fuller information on the cultivation of crops, soils, manures, plant diseases, insect pests, identification of plants, general botany, and nature study.

In addition, the Board of Agriculture and Fisheries issues leaflets dealing with a variety of subjects. Single copies may be obtained gratis and post free, or bound volumes, each containing 100 leaflets, price sixpence each, post free. The various subjects are also obtainable in classified sections, at a cost of one penny per section, about twelve being now available. Application for the leaflets should be made to the Secretary, Board of Agriculture and Fisheries, 4 Whitehall Place, London, S.W. Leaflets are also issued by the Irish Board of Agriculture, Dublin, and the new Board of Agriculture for Scotland will also issue leaflets as occasion demands :—

Thompson's Gardener's Assistant. Gresham Publishing Co. 6 vols. £2 8s. (Very comprehensive.)

The Horticultural Note Book. J. C. Newsham. 2nd edition. Crosby, Lockwood & Son. 4s. 6d. net. (Contains valuable information.)

The Soil. A. D. Hall. John Murray. 5s. net.

Manures. A. D. Hall. John Murray. 5s. net.

The Chemistry of the Garden. Cousins. Macmillan & Co. 1s.

Insect Pests of Fruit. F. V. Theobald, Wye College. 30s.

Common Weeds of Farm and Garden. H. C. Long. Smith, Elder & Co.

The Marketing of Garden Produce. R. L. Castle. John Lane. 2s. 6d. net.

Plant Biology. Cavers. University Tutorial Press. 3s. 6d.

School Lessons in Plant and Animal Life. Rennie. University Tutorial Press. 3s. 6d.

Nature Study. Rennie. University Tutorial Press. 3s. 6d.

Suggestions on Rural Education. T. S. Dymond. Board of Education (England and Wales). 3d.

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Nature Study (Plant Life). G. F. Scott-Elliott. Blackie & Son. 3s. 6d.

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Elementary Botany. Percy Groom. 3s. 6d.

Agricultural Botany. J. Percival. Duckworth & Co. 7s. 6d. (A very useful work.)

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